ANNALS

OF THE

SOUTH AFRICAN MUSEUM

VOLUME XIII

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PRINTED FOR THE

TRUSTEES OF THE SOUTH AFRICAN MUSEUM

BY NEILL AND CO., LTD., EDINBURGH.

1913 – 1923.

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INDEX OF NEW GENERIC NAMES INTRODUCED IN THIS VOLUME.

DATE OF ISSUE OF THE PARTS.

Part 1, July 24th, 1913.
Part 2, October 16th, 1913.
Part 3, May 7th, 1914.
Part 4, April 8th, 1915.
Part 5, October 6th, 1916.
Part 6, May 30th, 1917.
Part 7, May 1923.
Part 8, September 1923.

LIST OF PLATES.

INDEX OF GENERA.

ANNALS

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SOUTH AFRICAN MUSEUM.

(Vol. XIII.)

1.—*Inscriptions left by Early European Navigators on their Way to the East.*—By L. Péringuey, Director.

In a country as recently occupied permanently as 1652, relics of very ancient history cannot be plentiful.

Yet, earlier European pioneers landed on its shores as far back as 1485; others even annexed Table Valley to the Crown of their King, before the Dutch founded their settlement; and these forerunners of the present Colonists have left a few relics which are the more precious because of their rarity.

These are exhibited in part of the Entrance Hall.

Portuguese Commemorative Pillars and Inscriptions.

Earliest in date is the pillar termed by the Portuguese "padrão," erected by Diogo Cão in 1485 at Cape Cross, the second being that erected by Bartholomew Diaz at Angra Pequena in the year 1487. Both these localities are now part of German South-West Africa.

Within a short period, dating from the end of the fifteenth and the beginning of the sixteenth centuries, three geographical events of unique magnitude took place. Christopher Columbus discovered America on the 12th of October, 1492, some four years after Dias, whom he met in Lisbon on the latter's return, had doubled the Cape. Also, five years later, 1497–1499, da Gama succeeded in reaching India, and Magellan in the first voyage round the world

connected the western and eastern extremities of the Old World. All these discoveries were the results of attempts to discover a sea-road to India. Even at his death, Columbus was persuaded that he had reached Asia.

Bent upon discovering this sea-way, the Portuguese navigators, mostly hugging closely the coast of Africa, had persistently proceeded southwards, thus gradually going beyond Liberia, the extreme limit reached by the Carthaginian Hanno in his celebrated voyage of discovery or settlement along the north-west coast of Africa, about five hundred years before the Christian era. His fleet is said to have consisted of sixty large vessels, on which were embarked thirty thousand persons of both sexes.

But nearly a century before the Portuguese entered upon their grand career of discovery a chartered company of Dieppe and Rouen merchants did, between 1364 and 1413, in the reign of Charles the Fifth of France, send expeditions to the Gold Coast.

When John the Second, King of Portugal, ascended the throne the efforts to reach this goal, India, were not relaxed. Diogo Cão and Affonso d'Aveiro were commissioned to go farther south; Cão reached the River Congo, or Zaire, and ultimately Cape Negro (Cape Cross) in 21° 41′ S. There he erected a padrão, which, however, unlike those put up later on by Bartholomeu Diaz, seems to have had no special name. The scanty records of the period left it doubtful where this last pillar of Cão had been set; but in 1893 the captain of the German man-of-war *Falke* discovered this relic on Cape Cross. It bore two inscriptions in a sufficiently good state of preservation not to offer any difficulty in deciphering; and according to L. Cordeiro the two inscriptions are as follows:—

"(A)mundi creatione fluxerunt anni 6684 et (a)Christi nativitate 148; ? 9(uum) (e)xcelenti(ss)imus (s)erenissi(mus)que Rex d. Johannes secundus portugal (iae) per ia(co) bum canum ejus militem colu(m) nam hic situari jus (s)it."

(Six thousand six hundred and eighty-four years had elapsed since the world was created, and 148? since the birth of Christ, when the most excellent and most serene King, D. João the Second of Portugal, ordered this column to be set up by Jacobus Canus, his knight.)

The second inscription, which follows the turn of the upper cylindrical part of the column, is in Portuguese—

"Era da creacao do mundo de bjMbjclxxxb e de X (to) de llllclxxxb o. eycelent(e) esclarecido Rei dom J s°. de portugal mandou descobrir esta terra e poer este padram por d(°c.) ao cav°. de sua casa."

The translation into English would be—

"In the year of the creation of the world, 6684, by the excellent and enlightened King Dom John the Second of Portugal, was

Fig. 1.

ordered the discovery of this land, and the erection of this pillar by Diogo Cão, a knight of his house(hold)."

[For Diogo Cão had been made a knight in 1484 as a result of his first voyage, which led to the discovery of the River Zaire, now usually termed Congo.]

By order of the Emperor of Germany this pillar was removed to Germany, and a replica of the same erected where the original stood. Through the courtesy of the German authorities the

Trustees of the South African Museum have the promise of a facsimile of the original padrão.

In 1487 King John the Second of Portugal fitted out another expedition, consisting of three vessels, two of some fifty tons' burthen, the other being smaller and used as a store-ship, and this new venture of discovery he placed under the command of Bartholomeu Diaz.

It is during this reign that the discoverers were, for the first time, provided with commemorative pillars, or "padrões," to be erected at the farthest point reached, or to mark the progress of their journey. Cão is the first navigator who left Portugal with these regulation pillars.

But the old chroniclers are certainly not clear about the number of padrões erected by that other bold navigator, Bartholomeu Diaz, who was to round the extreme part of Africa. Recent research has, however, brought forth conclusive evidence that he erected five pillars during his memorable journey, each having its respective name.

The exact dates of the erection, corresponding mostly with his landings, are only approximate, but they are as follows, according to Codine:—

Departure from Lisbon, August 1–14, 1487.

Landing at Angra Pequeña and erection of the pillar called Padrão Santiago, November 13–14, 1487.

Landing at Angra das Voltas, November 19–24, 1487. Erection there of a third but nameless padrão.

This bay, the translation of the name of which is "bay of tackings," owing to Dias's ships taking five days to reach the shore, was taken to be in 28° 44′ lat. south, and corresponds nearly to that of the present mouth of the Orange River (28° 58′ S.). At this place Dias left his store-ship with nine men. But as he called there on his return it is not certain if the pillar was erected at the above-mentioned date, or on his return (August 24, 1488).

Arrival at the Bahia of Vaqueiros, or Bay of Cowherds, and at the Bahia of San Braz (Mossel Bay), apparently towards the end of January, 1488. He was certainly there on the 3rd of February of that year.

It has been suggested that Cowherds Bay and San Braz Bay are identical, the date of his arrival corresponding to that dedicated to St. Blaise led to it being renamed as such.

Reaches Algoa Bay, sets up a third pillar (Padrão da Cruz), on a small island of that bay, middle of February, 1488.

Reaches the River Rio Infante; thence retraces his way to Algoa Bay and erects a fourth pillar, Padrão San Gregorio, on Cape Padron, to the east of the bay, February, 1488.

Discovery of the Cape of Good Hope (Cabo tormentoso),* and

Fig. 2.

22 cm. × 58 cm.

erection there of a fifth pillar, Padrão San Felipe, August 16–17, 1488.

Exploration of St. Helena Bay, August 18, 1488.

Return to Angra das Voltas, where the only survivor of the men he left there nine months previously expires at the sight of his comrades.

Departure for Prince Island, and arrival in Lisbon, December, 1488.

* Dias, in spite of the legend, never named this part otherwise than Cape of Good Hope.

Of the five padrões here mentioned as erected by Dias, only one of them has hitherto been found, namely, Padrão Santiago. The fragment exhibited is part of it.

It was originally erected on the summit of a small granite eminence, and was discovered by Captain Owen in 1833, but "cast down evidently by design as the part of the shaft that had originally been buried in the rock had remained unbroken." This pillar, including the part originally placed in the ground, would have been altogether 7 feet 9 inches in length, corresponding in height with that erected at Cape Cross by Diogo Cão, and "was composed of marble rounded on one side, but left square on the other." The cross surmounting the pedestal was found at some distance. "It was sixteen inches square, of the same breath and thickness as the shaft, and had on the centre an inscription almost obliterated."

Three pieces of the original Padrão Santiago were received at the Museum in 1856, two of which, part of the rounded side, were sent to Lisbon; but a replica of the same has been made for us, presented by the Museum of the Geographical Society of Lisbon; a fourth fragment is to be found in Auckland, New Zealand, left there as a gift by a former Cape Governor, the late Sir George Grey. The cross itself has not been recovered.

Portuguese Inscriptions.

Vasco da Gama was the next navigator who was to complete, ten years later, the exploration of Dias, and to reach India (1497–1499). It seems, however, that the erection of padrões had then fallen into disuse, for there is, I believe, no record of any put up by this explorer, who, it is now almost certain, retraced the itinerary of his predecessor, Dias. Other expeditions were to follow on the way to the East Indies.

Pedro Alvarez, better known under his nickname of "Cabral," in trying to double the Cape, discovered Brazil. One of his captains, Pedro de Atayde, separated from the fleet by a storm, reached the Bay of San Braz (Mossel Bay), and left there a letter in a shoe, placed, it is said, on the island in a conspicuous situation, and which was found by Joas da Nova, who had sailed from Portugal on the 5th of March, 1501, in charge of four vessels.

Stone I.—The Mossel Bay Stone.

The fragmentary inscription on a stone found in Mossel Bay, appears to be a record of the visit of one of these two expeditions.

"At the demolition of the old Government House, there were found two stones on which were engraved, on the one a cannon, and on the other Portuguese words, of which some were broken off, others were indistinct, yet without doubt are the names of a certain ship and its captain, also the time of the arrival here, being the year 1500 or 1501." The stone with "the cannon" seems to have disappeared, or it is no longer to be found.

The inscription on the Museum specimen is, however, very baffling, owing to its present incompleteness.

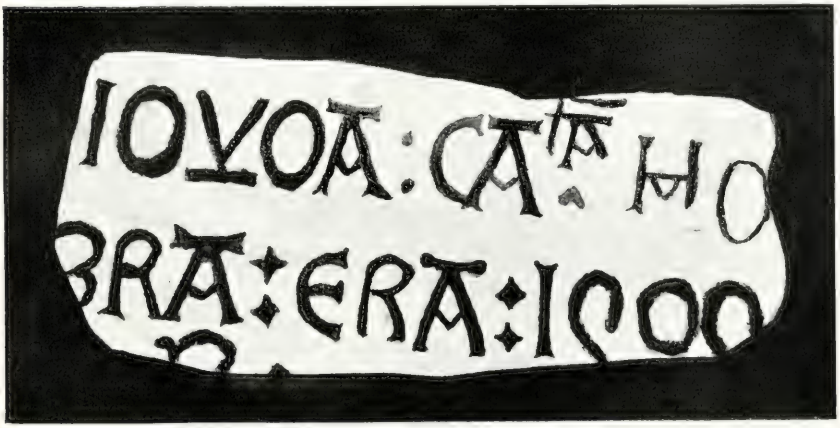


Fig. 3.

11 cm. × 21 cm.

It is skilfully graved, however; and if we assume, as is highly probable, that "DA NOVA" or "NUEVA" was spelt, by mistake or otherwise, Novoa, and that BRA stands for Braz (the Portuguese name São Braz), the inscription refers to the call at Mossel Bay of da Nova's squadron in 1501; in spite of the graved date, which appears to be 1500. This, however, has no importance, because 1500 in the old style may partly correspond to 1501 new style, the year running then from end of March.

If da Gama has left in Africa other inscriptions, and if they are found eventually, they would not be much more ancient than that of the Mossel Bay Stone. The latter can, therefore, be looked upon as the third most ancient European relic hitherto found in Southern Africa.

Stone II.—The Plettenberg Bay Stone.

The second Portuguese inscription, known as the Plettenberg Bay Stone, was removed to Cape Town about the year 1860. It is stated that the stone originally stood on a sandhill about three miles south of the present village of Plettenberg, on the littoral of the Cape Province.

Fig. 4.

52 cm. × 47 cm.

This inscription reads, "Here was lost the ship *São Gonzales*. Year 1630. They made two boats."

The *São Goncalo*, or *Gonzales*, reached India on the 24th of September, 1629, and left for the kingdom, *i.e.* Portugal, on the 4th of March of the year following.

Fernao Lobo de Menezes was then captain of the vessel, and the latter having sprung a leak, he made for the land, and "came to the bay called Fermosa, on the confines of the Cape of Good Hope." But while they were endeavouring to pump the vessel dry and trying to right her, a storm came upon her while at anchor and she foundered.

All the people left on her (one hundred and fifty) perished, but one hundred of them were ashore at the time of the gale. They eventually built two boats with the debris of the vessel, one of which set sail for Mozambique, where it arrived safely; the other reached the Cape (Table Bay), and sighting there the *São Ignacio de Loyola*, of the fleet of 1630, were taken on board, but this vessel perished upon the bar of Lisbon.

Such is the abbreviated history of the three Portuguese relics in the Museum.

French, English, Dutch, and Danish Inscriptions.

After de Gama's discovery, Cabral, da Cunha, Albuquerque, Almeida, Sequeira, and other explorers, all Portuguese, visited the eastern seas and the Islands of Spices via the Cape. The Spaniards, by now a powerful maritime nation, did not follow on their track, because the Pope had arbitrated on the respective sphere of both Portugal and Spain. The ventures were very lucrative, as proved by the number of ships sent from Portugal: 507 from the year 1500 to 1550, and 264, of much larger tonnage, from 1550 to 1560.

But a few years only after da Gama had opened the road to India other nations are found to have entered this newly discovered field.

Privateers or merchantmen, or both together, began to operate in the Mozambique Channel and other regions, and these were French.

In 1508 Queimado, commander of one of the ships of Tristan da Cunha's fleet, was captured by Frenchmen in the Mozambique Channel. In 1560 Captain Bondard, from La Rochelle, was hanged at Mozambique for plundering Portuguese caravells in the Indian Ocean.*

Of three French privateers that sailed from Dieppe in 1526, one is known to have stopped at Madagascar, and to have done some trading there.

So that it is inexact to say that during the period 1500 to 1560 no European flag, other than the Portuguese, was seen in the Eastern seas. But their expeditions did, after a time, sail from the island of St. Helena without touching at Table Bay, and therefore left no inscriptions there.

French Inscription.

Stone III.

On one stone is a French inscription with the date unfortunately mutilated. This piece of rock has been badly used;

* The Portuguese claiming a monopoly of their discoveries under a Papal Bull, the operations of any competitor were considered by them to be piratical.

the date is missing, also the continuation of the four lines of letters.

On the reverse of the thick slab is a Dutch record dated 1634. On examination it becomes apparent that the block on which the French inscription stood was pared or reduced so as to allow of the new one, which is entire, being graved on the reverse. But how long the first preceded the second, and whose record it is, remains, so far, a mystery.

Paulmier de Gonville is believed, with good reason, yet without much documentary evidence, to have rounded the Cape in 1503, and to have reached Madagascar in that year. But he sailed from

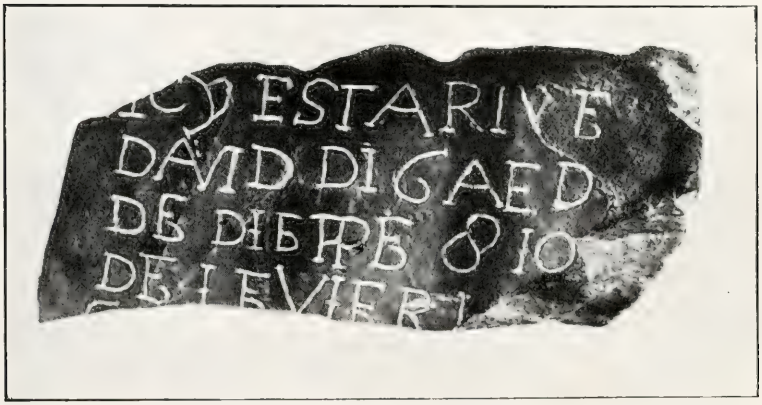


Fig. 5.

57 cm. × 24 cm.

ICY EST ARRIVE DAVID DIGAED DE DIEPPE 8 10 DE FEVRER 1 . . .

(Here arrived David Digaed from Dieppe, 8–10 February, 1 . . .)

Honfleur, not Dieppe, in June. The inscription cannot be, therefore, ascribed to him.

There is no information about the vessels who were flying the French flag in 1508 in the Mozambique Channel, and even captured there, as stated before, one of the ships of Tristan da Cunha's fleet.

In 1527 a French vessel, one of a company of three, all from Dieppe, stopped at Madagascar, traded there, and left behind a sailor, whom Diogo de Fonseca picked up in 1531.

The brothers Parmentier, also of Dieppe, following the Cape route, left with two ships, *La Pensée* (400 tons) and *Le Sacre* (120 tons), on

March 28, 1529, and reached Sumatra the same year, where one of the brothers, Jean, died in December. But apart from the name of the home port, there seems to be no connection with that of the ships or the dates.

The only instance of French vessels being recorded near Table Bay, but not *in* Table Bay as is generally believed, in these early times, is by the Dutch Commander Spilbergen, a record corroborated by the narrative of Francois Pyrard, from Laval, who was on board an expedition from St. Malo, consisting of two vessels, *Le Croissant* and *Le Corbin*, under the command of La Bardelière. The accounts of both leave no doubt that the French vessels met the Dutch Commander sailing out of the Bay, and did not land.

It does not, therefore, seem improbable that this French graved record is that of one of the vessels that left Dieppe in 1526; in which case this is the oldest inscription other than the Mossel Bay.

Post Office Stones.

From the end of the sixteenth and the beginning of the seventeenth century many vessels, other than Portuguese, touched at Table Bay in order to obtain fresh provisions from the natives. Anthony Marlow, on board the English ship *Hector* in 1602, says, speaking of Table Bay, "the best and cheapest place to refresh men in these voyages that ever ship can come to"; and it is recorded that on the first voyage of an English squadron to the East Indies begun under command of the Admiral G. Raymond, who perished with the Flag-ship, and finished by Captain James Lancaster, they put into Table Bay where ultimately thirty natives brought forty bullocks and about as many sheep, of which the English got a good supply, giving two knives for an ox. These vessels left graved on flat stones inscriptions recording the name of the ship and of her captain and the dates of arrival and departure. Letters were often also placed beneath these stones, as borne out by the inscriptions.

In these early days a stream descending from Table Mountain ran to the sea, discharging its water into Table Bay near what is now Adderley Street, and there it was that the mariners landed, to fill their water-casks at or near the bottom of Strand Street, where was a large sand-dune continued as far as the present Green Point Common.

Most of the inscribed stones recovered have been found near what is now Adderley Street, with the exception of two English which were used, intentionally or not, in building the walls of the "Castle"

with the inscription outwards. But as from 1602 the vessels of the English and Dutch East India Companies called nearly every year at the Cape, and as moreover the captains of the English vessels were instructed to leave such records, it is possible that graved stones other than those now recorded will be found at some future time.

While digging foundations for an extension of the present railway station in Cape Town in 1906, the old landing-place at the foot of Adderley Street was uncovered, and a number of graved stones that had evidently been collected and brought to the spot in former days were exposed to view. These stones, and others recovered before, form the series bearing the name of "Post Office Stones."

An extract of a letter addressed by Edward Blitheman to Sir Thomas Smith (East India Company's Records) leaves no doubt as to the object for which these stones were inscribed, and seems to explain also the presence of the two inscriptions in the Castle at some distance from the customary place:

"And in the time of our being there (Table Bay, October, 1613) the Dutchman (also in the Bay) made known unto us a packet of letters which their company had found on the top of a hill. So our General sent myself and Mr. Millward for the fetching of them, being a place at least distant two miles from our tents. So finding them we perceived them to be the letters of the factors of Captain Downston's fleet . . . and afterwards our General sealed them up again in a letter of his directed to your worship and buried them by the stone where he placed his name."

The French Commander Beaulieu, who sailed on the 2nd of October, 1619, from Harfleur, in Normandy, on a voyage to Bantam, *viâ* Senegal and the Gold Coast where he traded, landed in Table Bay on the 16th of March, 1620, and he writes thus:—

"Some of our men going ashore happened to light upon a great stone, with two little packets of pitched canvass underneath, which we afterwards found to be Dutch letters. When we opened them we found first a strong piece of pitched canvass, then a piece of lead wrapped round the packet; under that two pieces of red cloth, then a piece of red frieze, all wrapped round a bag of coarse linen in which were the letters very safe and dry. They contained an account of several ships that had passed that way; particularly of an English advice boat that was gone to England to acquaint the Company with the injury the Dutch had done them in the East Indies. They likewise gave notice to ships that passed that way to take care of the natives who had murdered several of their crew, and stolen some of their water-casks."

This narrative of the French Commander throws, in addition, a singular light on the dangers attending at that time landing in Table Bay, for he adds: "The next day I sent fifty men on shore with sails to make tents of; when the boat returned they told me they had found several corpses of dead men and clothes scattered up and down, and a small fortification of earth which we guessed to be built by the Danes, for one of the natives that spoke a sort of jargon of broken English gave us to understand more by signs than by his language that five ships had sailed from thence to the eastward about three months before."

English Inscriptions.

Stone IV.

If the French followed very early in the wake of the Portuguese, such cannot be said of the English, for it is only in 1577 that the famous sea Captain Drake, and, nine years later, Thomas Candish, sighted the Cape; but they did not land.

In July, 1591, however, the fleet of Admiral Raymond put into Table Bay, and on the 22nd of April, 1601, the first fleet fitted out by the "Governor and Company of Merchants of London trading to the East Indies," and commanded by Sir James Lancaster, sailed from Torbay. It consisted of the *Dragon* (600 tons); the *Hector* (300 tons); the *Ascension* (260 tons); and the *Susan* (240 tons). It is not known if Admiral Raymond, or Lancaster, left any inscribed stones to denote their landing in Table Bay, but the ship *Hector* of Lancaster's fleet was again at the Cape homeward bound in 1605, *i.e.* 1606 present style, as proved by the graved stone No. 6.

Antony Hippon, who was mate or master of the *Hector*, and had put into Table Bay in 1605, did again call at the Cape as mate or master of the *Dragon* in 1607. He looked for and found his first inscription, and added to it the date of his second arrival or departure. He was in charge of the *Globe* in the seventh voyage, and reached the Cape on May 21, 1611, sailing hence on June 6th. Possibly the name *Anthony H.* in smaller letters on the lower part of the slab is a record of this occasion. It is this Captain Hippon who planted the first English factory on the mainland of India (Masulipatan). He died on board the *Globe* one month after leaving Table Bay.

The stone bearing this inscription was discovered lately, embedded in one of the walls in the Castle, and it is the oldest in date of the English records of call in Table Bay.

These two vessels, the *Dragon* and the *Hector*, were often navigating in company, and numerous indeed have been their calls. They were in Table Bay from September 9, 1600, to October 29th on their outward voyage.

Lancaster commanded the former, J. Middleton the latter. Both vessels were again in Table Bay in July, 1604, and also on their return voyage from December 27th to January 16th of the same year.

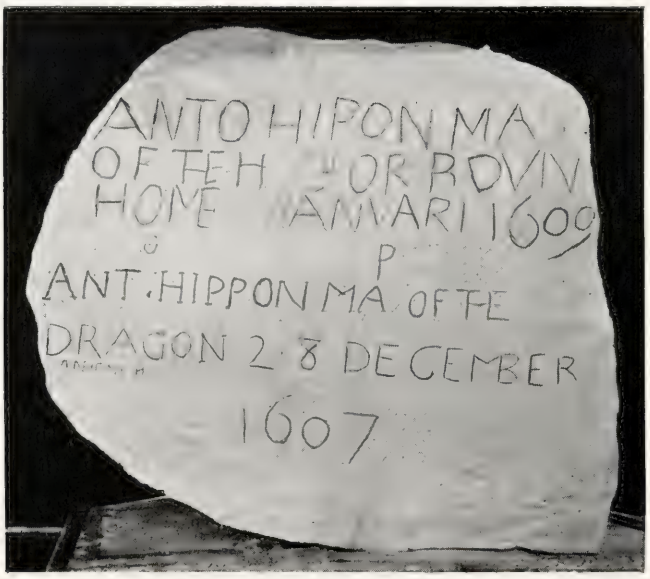


Fig. 6.

82 cm. × 80 cm.

ANTO HIPON MA(STER) OF THE HECTOR BOUND HOME JANUARY 1605.

ANTO HIPPON MA(STER) OF THE DRAGON 28 DECEMBER 1607, and in smaller letters, Anthony H.

The *Hector* was in Table Bay in 1602, as shown by a letter of Anthony Marlowe already quotod. We find again the *Hector* in the Bay from December 18, 1607, to January 1, 1608; and the *Dragon*, possibly on some date prior, homeward bound. Captain John Saris, commanding the *Clove*, *Hector*, and *Thomas*, outward bound, sailed from Table Bay on his outward voyage on August 9, 1611. The *Gift*, *Hector*, and *Hope* were in Table Bay in 1614.

William Edwards, writing to the East India Company on June 28, 1614, says: "Found, as the custom is, advice of divers of our ships that had lately touched there (Table Bay) both outward and homeward (viz.) the *Dragon* arriving there the 20th February, 1613, departing thence the 6th March next, homeward."

The *Dragon* was one of the vessels of Keeling's fleet of 1615, and had on board the factor, Thomas Arthington, who in a letter to the Company dated from Saldania, June 18, 1615, and sent by the homeward-bound vessel the *Hope*, mentions that "Ten of the condemned men set willingly ashore at Saldania."

From 1601 to 1612 the shareholders or subscribers to the concern that became eventually the East India Company, founded on December 31, 1600, bore individually the cost of the voyage of each venture; and the profit or loss resulting therefrom was theirs.

It is only in, or about, the year 1612 that these ventures were conducted on the joint-stock system, and it is on record that the *Concord* from London, the first ship of the Company sent on this new system, was met in Table Bay by Captain John Saris, homeward bound, on May 16, 1614.

For this reason the records of "calls" anterior to 1612 are not very complete, and the dates are possibly somewhat inaccurate, owing to the then partly acceptance of the Gregorian computation, 25th of March to 24th of March, instead of 1st January to 31st December.

It seems, however, established that the *Red Dragon*, *Hector*, *Ascension*, and the *Susan*, under Sir Henry Middleton, anchored July 17, 1604. "Cole, master of the *Hector*, was drowned. Sailed August 20th." This was the second voyage of the English Company. The upper inscription of Stone 6 records the return voyage of the *Hector*.

In 1605 the English Captain Sir Edward Michelburne came to Saldania Bay (read Table Bay) with the *Tigre* and *Tigre's Whelp*, and stayed there from April 9th to May 3rd. The natives brought him so much cattle that he took some to sea; for a piece of an old iron hoop he bought a large bullock.

In 1607 William Keeling came to "Salania," and bought much cattle. He found the natives very bold and daring. On a rock he saw engraved the words: "Captain Middleton, in the *Consent*, 24th July, 1907."

In the same year Captain D. Middleton, a brother of Sir Henry of that name, called here also, and obtained much cattle.

Captain Robert Cavertree also came in the same year to Saldanha, where he bartered many sheep and oxen for old iron.

Alexander Sharply was in Table Bay on July 4, 1608. He took in about 400 (?) head of cattle. In 1608, July 13th, the *Ascension* and *Union* anchored in Table Bay, and left on September 25th. "Viewing over the stones where the ships that are bound outward and homeward do use to set their names, when we found Captain Keeling, Captain Hawkins, Captain Middleton and divers others, being passed towards the Indies, vizt., Capt. Middleton in July 1607, and Captain Keeling the month of December ditto anno."

In the year 1609 Captain Keeling on his home voyage took some sheep, "the fattest he had ever seen," from Robben Island, and left lean ones, obtained on the mainland, in their place.

In 1610 Captain Nicholas Downton, with the *Peppercorn* and the *Darling*, and Sir Henry Middleton in the *Trades Increase*, arrived in Table Bay.

Sir Henry Middleton found a letter buried underground, according to agreement made in England with his brother, but so soiled by damp that he could "not read any part thereof." Downton touched again, outward bound, on June the 15th, 1614; but he was not so successful this time in revictualling his ship "Refreshing of flesh we had in a manner none; we had some little fish by our continual endeavours in the river. Set sail and put to sea, the 2nd of July."

Keeling's fleet of 1615 was also in Table Bay outward bound in that year. From it were landed at Robben Island ten convicts from the Old Bailey, to make a settlement. These are the men alluded to by Thomas Arthington.

But no inscription left by the commanders of the ships above mentioned has been as yet recovered, with the exception of one of Sir Henry Middleton's ships, the *Hector*, and of Saris' vessel, the *Thomas*.

Stone V.

In preparing the foundations for one of Mr. Garlick's stores, at the foot of Adderley Street, the workmen found a fragment of stone bearing an inscription on each side. The original stone is in the possession of the Cape Town Corporation.

The date of the arrival and departure coincide with that of the outward-bound fleet commanded by John Saris, of which the *Thomas* was one, together with the *Hector* and *Clove*, and it is therefore to be assumed that the inscription is that of the *Thomas*.

It will be noted that in one corner of the stone there is what

FIG. 7.
32 cm. × 21 cm.

On the obverse the words read as follows :—

THOMA MR. M. . . . TH. BARN.
MR. MAT. JULY YE AUGUST 1. (?) D. C. H.

FIG. 8.
33 cm. × 21 cm.
WILLIAM PAGE, OUTWARD BOUND, 1618.

appears a fairly successful attempt to reproduce the "square and compasses" in a position in which these implements are usually associated with Freemasonry; certainly the first figures of their kind revealed in South Africa.

On the reverse of the stone the impression is very plain.

This is the first record of call of this vessel.

Another will be found further on bearing the date 1628.

Stone VI.

The next inscription in point of date is that of the arrival and departure of the fleet commanded by Charles Clevenger (the C.L.E. of the legend), who flew his flag on the *Palsgrave*. The latter, 1,083 tons, and *Elizabeth*, 978 tons, were new ships built by the East India Company in the previous year.

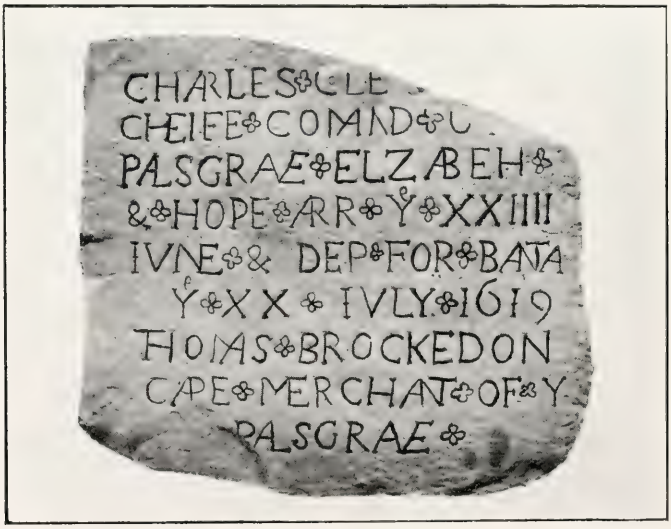


Fig. 9.
68 cm. × 51 cm.

CHARLES CLE CHEIFE COMAD O(F) PALSGRAVE ELIZABETH AND HOPE ARR(IVED) Y^{E} XXIIII JUNE AND DEP FOR BANTA Y^{E} XX JULY 1619. THOMAS BROCKEDOM CAPE MERCHANT OF Y^{E} PALSGRAVE.

This inscription records for the first time the presence on board the Commodore's ship of a "factor" styled there "Cape Merchant." The status of these supercargoes had at last been established, by

order doubtless of the East India Company. That the relations between the commanding officers of the vessels and the factors who had really charge of the commercial side of the ventures were not always of the most amicable kind would seem to be proved by the following extracts: the complaints to the Company emanating from the factors (East India Records, 1613–15):—

"It is good to distinguish or limit the officers and charges of captain and cape merchant, for the captains do arrogate all authority to themselves from your merchants."

Again. Robert Gipps, Cape Merchant, in the *Peppercorn*, 19th June, 1615, in Saldania, to the East India Company.—Discord between Captain Harris and Robert Gipps. The Captain reviled the Merchant and threatened him. "The Captain arrogates much over the Merchants. He brings £100 to sea for private purposes."

This falling out between Captain Harris and the Cape merchant was, however, smoothed over, and the two men reconciled by the Council of the fleet.

Thomas Brockedon, the Cape merchant on board the *Palsgrave*, subsequently became the chief agent of the British East India Company at Batavia.

Although the inscriptions give the date of departure of vessels, this does not necessarily imply the absolute date when the ships sailed. Thus, a factor named Mills, writing from Tiku, in Sumatra, which was reached on August 23rd, says:—

"The 3rd of August before day we sett sayle from the Cape where we were 16 dayes wynde bound." The vessel had evidently been retained in the roadstead by adverse winds for fourteen days.

At the Cape they had met the *Lesser James*, homeward bound.

This No. 9 inscription, cut into solid rock, was found a few feet below the surface, when Messrs. Wilson, Miller, & Gilmore, of Adderley Street, were rebuilding their premises in Adderley Street, opposite the Post Office.

Stone VII.

Four months after the departure of Clevenger outward bound, and of the *Lesser James*, returning to England, another English vessel recorded its arrival and departure from Table Bay.

This stone bears an inscription on each face. The oldest in date is that of the *Bull* of 400 tons, which touched at Table Bay in 1619, but not for the first time, because one reads in the "English Factories in India" that the ship was sent home in 1618.

On the reverse of this stone are graved letters which, judging

from their shape or style of cutting, are parts of four different inscriptions. All four, however, are very obscure.

Of the first inscription on the upper side of the stone, the figures 161 alone are distinct, and these seem to be completed by the figure 8, which would thus give the year as 1618.

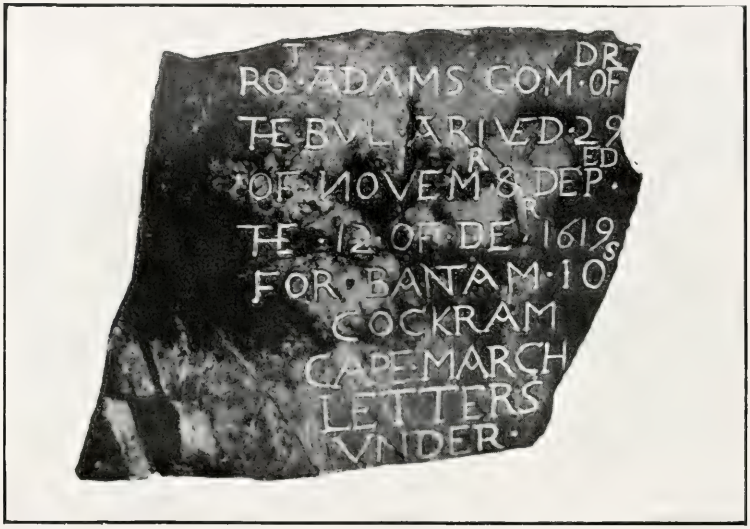


Fig. 10.
40 cm. × 38 cm.

RO^{T} ADAMS COM$^{DR.}$ OF
THE BUL ARIVED 29 OF
NOVEM^{R} & DEP^{ED} THE 12 OF DEC^{R} 1619
FOR BANTAM 10$^{S.}$ COCKRAM. CAPE MARCH.
LETTERS UNDER.

Below this the second inscription, which is very distinct in parts, reads as above.

Below this are two lines graved in a different style and undecipherable, and lastly, on the lower end of the block, and executed again by another hand, a very rough graving—

WILL VOR LETTERS 1629.

The ship *William* had returned to England in December, 1628; but she might have touched again here in 1629.

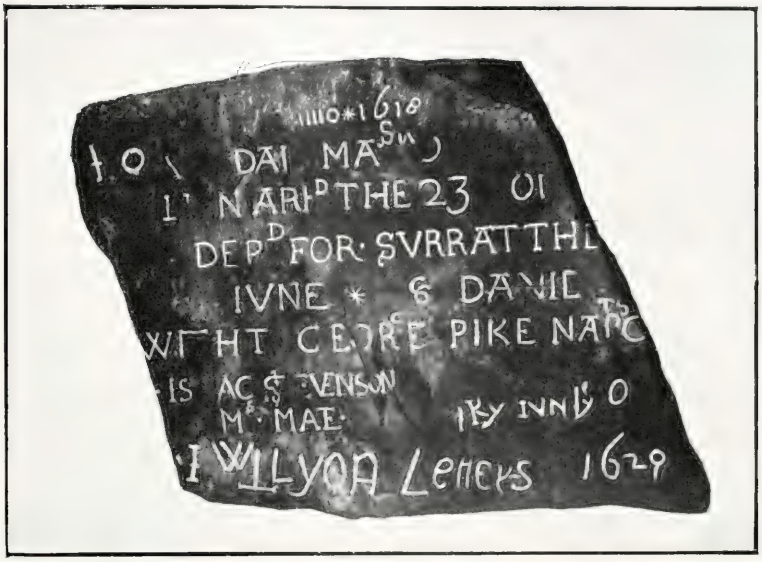


FIG. 11.
42 cm. × 37 cm.

DAY MAY.....? D. THE 23.....
DEP FOR SURRAT THE.....JUN & D.....
XII III GEORGE PIKE MARC

As to the better-preserved inscription, in which the name of George Pike figures plainly, a person of this name was a Factor of the Company.

Stone VIII.

The stone bears two inscriptions. (See next page.)

The slab is deposited in the vestibule of the General Post Office, Cape Town. The specimen on exhibition in the Museum is a cast of the same.

The *London*, a vessel of 800 tons, Captain Richard Blyth, with the *Jonas* and the *Lion*, sailed from Surat, December 18, 1622, anchored in "Saldania Bay, March 10, 1622–3; left again March 23rd, not 20 as inscribed, reaching the Downs, July 18, 1623."

The second inscription would appear to be a Dutch one.

This stone was found in 1897, when an excavation was being

made in the ground immediately in front of the then recently completed offices of the Union Castle Company in Adderley Street. It had, however, been discovered before, but was evidently left *in situ* until it became again hidden from sight, for we read in the *Cape Town Gazette* of Friday, August 17, 1827: "On removing the earth to make some repairs to a drain in the Heeregracht (now Adderley Street) a large stone was uncovered, upon which the following inscription was traced," and a correct transcription is there given.

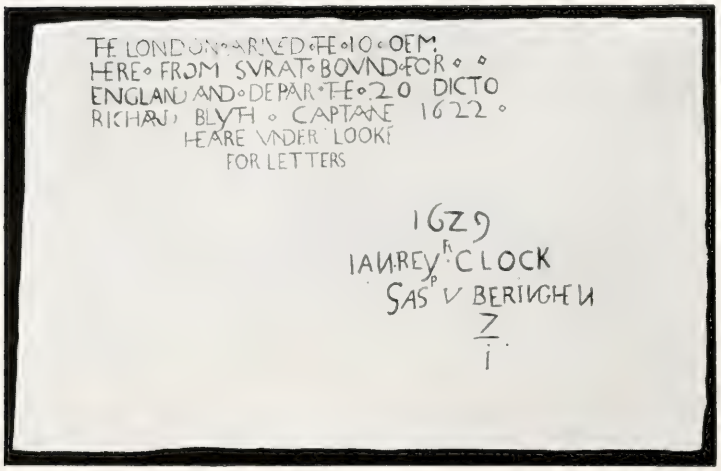


Fig. 12.
105 cm. × 60 cm.

The upper inscription reads :—

THE *LONDON* . ARIVED THE . 10 . OF M(ARCH) HERE . FROM SURAT . BOUND . FOR . ENGLAND AND . DEPAR(TED) THE . 20 DITTO . 1622. RICHARD BLYTH CAPTAIN. HERE UNDER LOOK FOR LETTERS.

Below this—

1629. JAN. REY$^{R.}$ CLOCK (OR CLOOK) GASP V BERING^{HEN} H. $\frac{7}{1}$.

Stone IX.

The *London* a few years later met the *Blessing* and the *William* at the Cape both inward bound, and a record of this call exists in an

inscription on a very uneven rock, and graved by a hand but little acquainted with cutting letters on stone :—

THOMAS WALIS
WILLIAM HARVEY
MYSMATES OF THE
ONDON 8 OF MAY
1627
JOHN SHORT
A M.

The same ship was in Table Bay in 1631; as shown by the inscription graved on the obverse of a flat stone bearing on the other side a Dutch inscription dated 1632 (*Stone XVII.*)

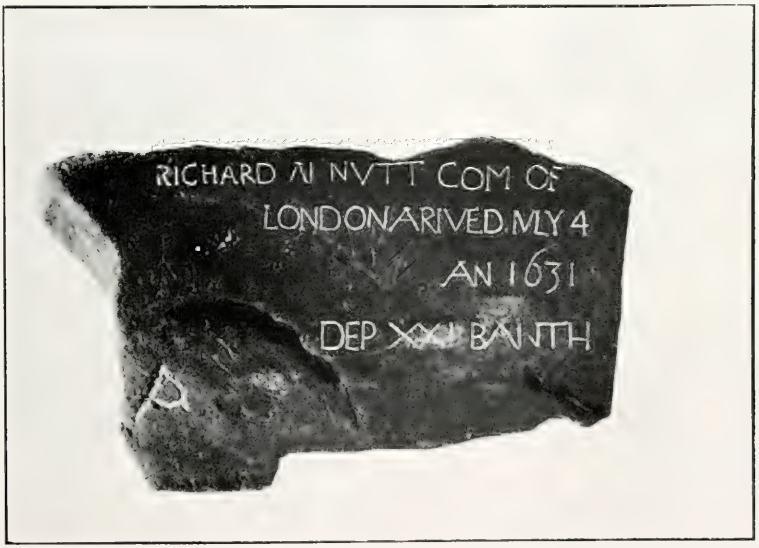


Fig. 13.
56 cm. × 33 cm.

RICHARD ARNOTT COM. OF
LONDON ARRIVED JULY 4.
AN 1631.
DEP. XXII. ? M I I H

Stone X. has three English inscriptions cut on a large slab found built, topsy-turvy, in one of the outer walls of the Castle in Cape Town, about ten feet above the glacis, and not far from the main gateway. There seems to be little doubt that this stone was lying close by, and was utilised for the original building of the

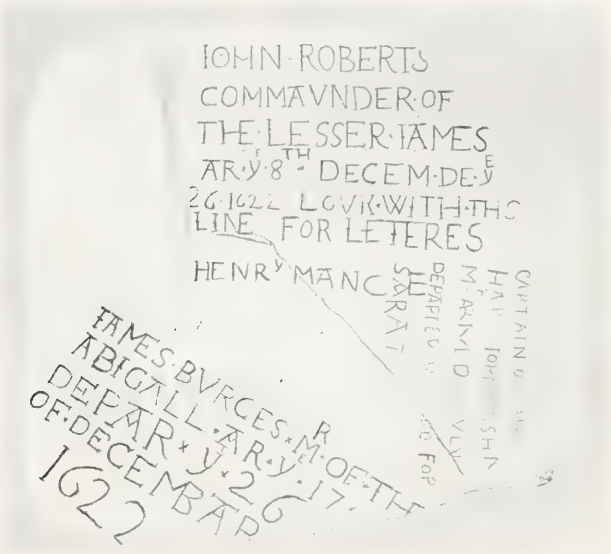


Fig. 14.
100 cm. × 86 cm.

The first inscription reads :—

JOHN ROBERTS, COMMANDER OF THE LESSER JAMES ARRIVED THE 8TH OF DECEMBER, DEPARTED THE 26TH, 1622. LOOK WITH THIS LINE FOR LETERES.

The second is as follows :—

JAMES BURGES MASTER OF THE ABIGAIL ARRIVED THE 17TH ; DEPARTED THE 26TH OF DECEMBER.

Castle, which was begun in 1666 and completed in 1679. Doubtless the stone bearing Hippon's inscriptions of 1605 and 1607, also built in the walls, was likewise found close by and utilised for the same purpose.

The *Lesser James* was a vessel of 450 tons, commanded by John Roberts. She left Batavia, homeward bound, in the last day of August, 1622. The ship reached England in the middle of June, 1623.

The *Abigail* was a new ship which sailed from England for Batavia in 1622. In his journal, the Master, James Burgess, makes the following entry: "1622. 17th December. Arrived at Saldania. Ther I mete the *Littell James* and to Hollandars bounde home."

The third inscription, set at right angles to the upper one, is much weathered and was badly graved. It is as follows: "Bartholomew Goodall (almost indistinct on the stone), Captain of the *Hart*, John Pashley, Master, arrived 10th of July, departed 20th ditto, 1627, for Surat."

The *Hart* was one of the six vessels forming Captain Hall's fleet bound for Surat; the others were *Star*, *Scout*, *Refuge*, *Mary*, and *Hopewell*. They left Dover Roads on March 23, 1627. "Anchored at Coney (Dassen) Island, and got some refreshments, July 7th. Sailed again, and at night got into Table Bay, where they found General Coen with five Dutch ships bound for Batavia. Pitched a tent ashore and landed the sick men." The fleet sailed on the 20th.

Pashley, after the death of Goodall in October of the same year, was transferred as Master to the *Hopewell*. He was again in one of the three vessels of the return fleet, *Star*, *Exchange*, and *Blessing*, that left for England on December 27, 1628, and "anchored on the bay of Salldayny" on March 12th, sailing again on March 20th.

Judging from the inscriptions of the *Lesser James* and the *Abigail*, it would seem that each vessel of the fleet left its own record. For, the instructions of the East India Company to their Captains were very explicit. "When you arrive in the Bay of Saldania (for such was still the name of Table Bay, although changed into its present one by the Dutch Admiral Joris Spilbergen at the time of his visit in 1601) you shall make search for letters, and in like manner at your departure thence, leave behind you in writing fitt remembrances of all matters useful."

The "remembrances" did not, however, always reach those for whom they were intended, or, when they did, without having been occasionally pryed into by people for whom they were not intended. Those taken cognisance of by Beaulieu are a case in point; but we have other instances.

Thus: Thomas Kerridge, aboard the *Jonas*, at Swally, writes to the East India Company, November 15, 1624. They endeavoured

to avoid touching at the Cape, but were forced by contrary winds to do so. Anchored there on July 19th. . . . "Wee perceaued by inscriptions on stones that the *Dolphin* was departed thence homeward bound from Surat, in April last; but could not finde anie letters through the inscription mentioned some to be left which appeared plainely to be disinterred and taken thence by the Dutch or Danes, ships of each having touched there since her departure."

In William Minors's account of the homeward voyage of the *Scout*, we find the following:—

"Anchored in Table Bay (January 20, 1626), where we found two Dutch ships." Minors (who was then master's mate) was sent ashore to look for letters, but "they were taken away before."

Again: Letter from President Kerridge and others, at Surat, to the East India Company, January 4, 1628.

"Have opened the Company's letter addressed to the President and Council at Batavia. . . . This they had already learnt from a letter left by the *London* at the Cape, which was dug up by the Dutch General Coen, and *after perusal* handed to Captain Hall (December, 1627)."

Are we, then, to suppose that the letters or communications were duly deposited without any precaution under the slate blocks, some small, some large, but selected because of their smooth surface? Yet the words are significant.

"Letters under;" "Soeckt brieven"; "Hieronder leggen brieven"; "Heare under looke for letters." . . .

The *Lesser James* inscription does, however, throw light on certain dispositions taken to prevent, as far as possible, not only the natives, but people other than the initiated to obtain readily cognisance of the documents, some of them of considerable interest to the parties concerned.

A carefully executed cast of the slab has revealed at the end of the words *line*, in the sentence "look with this line for letteres," a narrow groove reaching nearly to the side of the slab.

From which it becomes apparent, if not certain, that there obtained among the Captains of the East India Company a certain secret code as to the localities chosen for the "Post Office" boxes. This assumption will also explain the presence or occurrence of several English inscriptions on the same rock, and often on either side of the stone. Moreover, so far as the recovered inscriptions go, only one stone is known which bears on one side an English, on the other a Dutch legend; we know, however, of another with a French on the obverse, and a Dutch on the reverse.

Stone XI.

This stone was for a long time in the possession of what is now known as the Dutch Orphanage, at the top of Long Street, but which was in the early part of 1800 the High School, or Academy "Tot nut van't Algemeen."

It is not certain whether it was found close to the spot or was brought there to serve as an object-lesson.

It bears on either face several inscriptions. The oldest in date is that of the *Royal James*.

The Fleet of 1624 consisted of the *Royal James*, *Jonas*, *Eagle*, *Star*, *Spy*, and *Scout*; the first-named vessel being commanded by John Weddel; Richard Swanley was Master; Henry Wheatley Purser; and Richard Langford a Purser's Mate. Their names figure in the inscription, and the additional one, Edward Smith, is that of the Purser's Mate of the *Jonas*.

Thomas Kerridge, going out to resume his post of President at Surat, and who was on board the *Jonas*, gives the following account of his stay at the Cape.

After imputing to the action of the Dutch or Danes the disappearance of letters which, from the graved inscriptions left by the *Dolphin*, he expected to find under the stones, he proceeds: "In this place wee found reasonable store of refreshing, as well flesh from the countrie people as fish taken plentifully in the River, whereby, together with the wholesomeness of the Ayre and hearbes et. ct. for bathes, our sick men for the most part (their sickness being the scurbeck) thanks be to god, recovered within 10 dayes in some reasonable measure to help themselves. The 29 July the whole fleete set sayle togeather from the Cape." (I.O. Records.)

Monck's account of the same journey (he was on board the *Royal James*) bears out part of Kerridge's narrative: "July 14. Saw the Sugarloaf Mountain. July 15. Decided to put into Table Bay, owing to want of water, much sickness on board, and a doubt of whether they could reach Madagascar this monsoon. July 29. Set sail again."

Below the *Royal James* inscription is another, if not two:—

THOMAS MILLS MAR R S E
. . . EY. A 12 1635 CAP JOHN W
COMM OF JONAS ARR FROM DEP 26

Thomas Mills, a Factor of the Company, was at Masulipatam in March, 1624, and he died there towards the end of 1627. The

inscription recording his passage in Table Bay is therefore anterior to any of those figuring on the stone.

The date 1635 may or may not be that of the record of the *Jonas*; the letters are very indistinct or obliterated, but the date of departure, 26th, does not tally with that of the fleet of 1624, which sailed on the

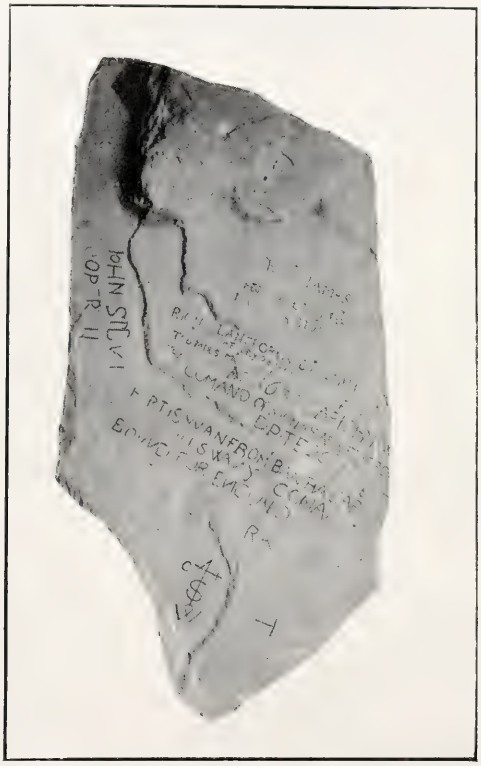


FIG. 15.

125 cm. × 72 cm.

ROYAL JAMES HENRY WHEATLEY PURS.
RICH LANGFORD EDWARD SMITH JULY 28 1624.

29th, as shown by the quotations from Kerridge and Monck; and if the inscription is that of the *Jonas*, it is eleven years older.

Another inscription appears to be:—

SWAN . . FROM . . BANT . . CAP . . SWAN Y . . CO . . OF ENGLAND

This may perhaps refer to the ship *Swan*, a record of which dated 1632 is treated of further on. But if SWAN Y stands for Swanley the inscription must be anterior to 1626, at which date Richard Swanley, Master of the *Lion*, was slain in an encounter with the Portuguese; but his ship valiantly freed herself. The *Palsgrave* and *Dolphin* abandoned her and fled, while the ships at Swally "most basely lay

FIG. 16.

127 cm. × 72 cm.

THE WILL ARRIVED THE FIRST OF SEPTEMBER FROM SURAT
DEPART THE 18 DITTO 1628 CHRIS BROWNE COMM.

Under this on the right-hand side:—

ARTHUR HATCH PREACHER OF THE . . .

still." The *Lion* was again attacked, whereupon she was blown up by her crew. The Portuguese saved the men, but presently hanged them except one whom they sent to Kerridge, the President at Surat, with letters.

Lastly, at the lower end of the face of the stone are a few letters which seem to be JOHN STEV (R) O C E R T; and in the right-hand corner is a monogram, which may prove to be that of Alexander Sharpley, in which case it would date from 1608; but the "W" remains

unexplained. If it is that of Richard Swanley, the same difficulty reappears, as the upper letter is certainly not an "R."

Before closing with the inscriptions of one face of the Orphanage stone, it is not out of place to mention that while the *Royal James* was in Table Bay in 1622, Mr. Patrick Copland, the preacher of the ship, collected from the gentlemen and mariners a sum of £70 8s. 6d. towards the building of a free school in Virginia.

On the other side of the large heavy slab figures a well-graved inscription and one or two others which are very indistinct.

The word Will is the abbreviation for *William*. The ship reached England in the following December. She was a 700 tons vessel, and the approximate value of her cargo was £60,000. Arthur Hatch, who was the preacher on board, went out first in 1619, returning in 1623; then in the present voyage, 1626–8, and a third time in the *Charles* in 1632.

In his account of the voyage, Andrew Warden, who was second mate says: "September 1 (1628). Got into Table Bay. Caught some seals on Penguin (Robben) Island and made a hogshead of lamp oil. Took in more ballast and a supply of water."

Stone XII.

The inscription recording the call of the *Star* is not graved but written with paint, or tar, and is therefore very faint, although it becomes very legible if wetted. The *Star* was a bad sailor, and on one occasion, as she proved a great hindrance to the fleet, it was resolved to "leave her behind to make her way to Surat as best she can." She was one of the fleet of 1625, under Weddell and Clevinger, and was sent back to England to convey thither a Persian Ambassador. By her was sent the news of the fight with the Portuguese off Gombroon, in which Becker, the Dutch Commander, was slain. The Portuguese were "putt to the worst," whereupon the English sailed for Surat.

In William Minors's account of the homeward voyage of the *Scout*, which vessel anchored in Table Bay on January 20, 1626, and found there two Dutch ships from Batavia bound for Holland, he states that he, Minors, was sent ashore to look for letters, "but they were taken away befor; onely wee founde written uppon a stone of the *Starr*, and the two Dutch shippes; the *Maidvandorph* and *Weezopp*, the 14th of October, and there departure thence the 25th of dicto."

John Rowe was Commander of the *Star*. His instructions on leaving Swally were to make the best of his way to England, keep-

ing company with the Dutch ships mentioned but misspelled by Minors, the *Maagd van Dort* and *Wesp*, and assisting them as far as possible. "He is to be on his guard against pirates or enemies."

Fig. 17.
41 cm. × 25 cm.

Who the Wilson was who recorded his name with that of the ship is not known. But from the above account it is plain that this *written* inscription is the record of the call of the vessel homeward bound; and it is a wonder that it has been preserved so long.

Stone XIII.

Except for the record of, possibly, the *Jonas*, *i.e.* 1635, the *Swan* inscription is the latest.

It is very distinct, but it gives no indication as to the vessel being inward or outward bound.

The *Swan* closes the list of the hitherto discovered early records of the English ships in Table Bay. A lucky accident may lead to the discovery of some of the numerous missing ones. On Penguin (now Robben) Island it was expected that some would have been found, but in spite of a search they have not. Yet, the Dutch Admiral, Cornelis Maatlief, in 1608, found the names of many Englishmen cut in stones who had been there; on the other hand

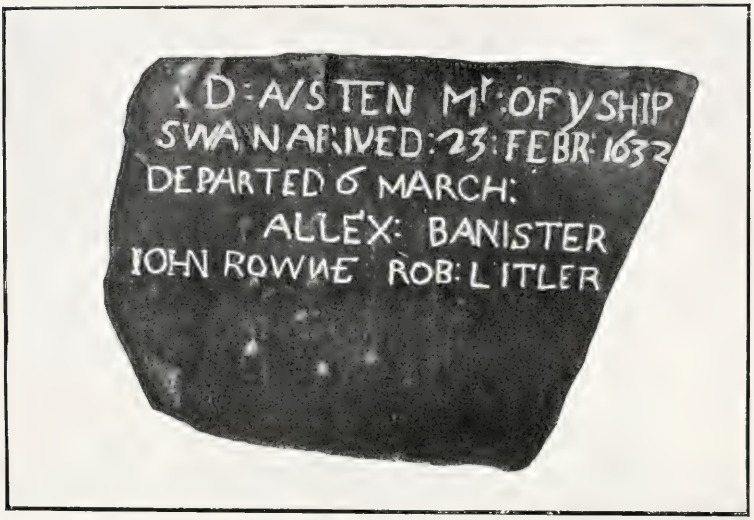


FIG. 18.

27 cm. × 20 cm.

D: AUSTEN M^R. OF Y^E SHIP SWAN ARRIVED 23 FEBR(UARY) 1632 DEPARTED 6 MARCH: ALEX: BANISTER JOHN ROW. E: ROB: LITLER.

the instructions to the English Commanders to look for or deposit letters, etc., applied to Saldania, but the island may have been considered to have been part of the Bay.

Dutch Inscriptions.

It is only at the end of the sixteenth century that the Dutch, who were still pressing on strenuously in their search for the North-West Passage to reach India, began to turn their attention to the Cape route, and the "Compagnie van Verre" (Association of Distant Lands) of Amsterdam and Middelburg sent Cornelis Houtman from the Texel with four vessels to find the way to the east. Houtman sailed from Texel on April 2, 1595, reached Sumatra in July, 1596, and returned to Amsterdam in August, 1597. The new venture was so readily taken up that within six years no less than forty-nine ships were dispatched to India. They included the fleets of C. Houtman in 1595; of the same C. Houtman, Jan van Neck, W. van Warwyk, S. de Weert, and O. van Noort in 1598; of

S. van der Hagen and P. van Caerden in 1599; of J. van Neck in 1600.

The Dutch East India Company, the full title of which was "De Vereenigde Nederlandtsche Geoctroyeërde Oost-Indische Compagnie," was founded in 1602, but that the ventures were proving remunerative is shown by the increasing number of vessels sent from April, 1601, to 1606 (old reckoning). The expeditions which left Holland from that date are as follows: April, 1601, W. Harmansen, 5 ships; J. van Heemskerk, 9 ships; May, 1601, J. van Spielbergen, 3 ships; June, 1602, W. van Warwyk, 14 ships; Matalief, 11 ships; April, 1606, P. van Caerden, 8 ships; December, 1607, P. W. Verhoever, 13 ships, etc., etc.

It is not known if all these fleets touched at Table Bay. Sailing at first with Portuguese maps they would make for St. Helena Bay and Mossel Bay; but after the visit of Spielbergen to Table Bay, they made that place for some time a port of call.

Cornelis Houtman is the first Dutch navigator who landed in South Africa. He came to St. Helena Bay, where he bartered cattle for iron, and had some dispute with the Hottentots. The quarrel was, however, made up, and the fleet departed after nine days' stay. It may be the same fleet, sailed by "Portingalles sea cards" which came to Mossel Bay, where the inhabitants (Hottentots) spoke very strangely—clocking like turkey cocks. The Commander says "the natives seem savage, yet with us they used all kinds of friendship."

This friendship was not to be of long duration, for in his second voyage Houtman, in November, 1598, anchored in Table Bay with two ships, the *Leeuw* and the *Leeuwin*, but their crew fared badly at the hands of the natives, as narrated by John Davis of Arctic fame, who was the pilot of the ship. "We came to Saldanha Bay on the 11th November, and traded with the natives at very easy rates, obtaining fat oxen and sheep for old nails and pieces of iron. The Dutch having done them some injuries they absented themselves for three days, and having in the meantime alarmed the country by fires from the mountains, they returned again on the 19th bringing a large number of cattle with them. But while the Dutch were bartering with them, they made a sudden and furious assault upon them, slaying thirteen in a moment with hand darts. The rest of the Dutch saved themselves by flight. They embarked and went under way the same evening."

The Dutch Captain, Paulus van Caerden, came, in the year 1599, to a bay situated a few miles to the eastward of Table Bay, where he

stayed six days. He was again in Table Bay in April, 1606 and 1609. It is he who is credited with having arranged caches on Robben Island for the exchange of letters between the outward- and inward-bound vessels of the Dutch fleets.

In the year 1601, the Dutch Admiral, Joris van Spilbergen, who had left Holland in May with the *Ram*, the *Schaap*, and the *Leeuw*, landed at St. Helena Bay, from where he set sail on November 20th, and came on the 28th to a small island, which he named Elizabeth Island, but which was afterwards called Dassen Island. He weighed anchor on the 29th, and reached Robben Island and Table Bay on December 2nd. He seems not to have met any aborigines in the bay, although he is said to have sent some people into the country to get cattle. He departed on January 1, 1602, and changed in his new map the name of Saldanha Bay into Table Bay (it was the Portuguese, Antonio Saldanha, who had discovered the present Table Bay in 1503), but the name *Saldania* was retained by the English long after that change.

In 1604, the ships *Zirikzee*, *Hollandsche Tuin*, and *Gans*, still following the Portuguese itinerary, came to Saldanha Bay, where they remained till the end of September, and enjoyed much friendship from the Hottentots.

The Dutch Admiral, Cornelis Matelief, came on April 7, 1606, into Table Bay—no longer Saldania for the Dutch. He is said to have found on Robben Island several English names of 1604, and one of December 28, 1607, engraved on the stones.

Matelief commanded the *Orange*, *Middelburgh*, *Mauritius*, *Swarte Leeuw*, *Wilte Leeuw*, *Groote Son*, *Kleyne Son*, *Amsterdam*, *Nassauw*, *Erasmus*, and *Provincien*.

By this time it had become customary for the English and Dutch Commanders to bring from the mainland some of the bartered sheep and cattle to Robben Island, for the benefit of the other vessels calling, who in turn restocked the island by leaner beasts. Thus, Alexander Sharpey, in July, 1608, "took twenty fat sheep from the island, which had been left there by the Dutch, and put some oxen on it."

Paulus van Caerden commanding the *Banda*, *Bantam*, *Ceylon*, *Walcheren*, *Ter Veere*, *China*, and *Patana*, anchored March, 1609, etc., etc. And from that date onwards the Dutch continued to touch for refreshments, as did also the English. The two English fleets under the command of Andreas Shilling, and Humphrey Fitzherbert, which were going to Surat and Bantam, found on their arrival at Table Bay, on July 1, 1620, a Dutch fleet of nine ships

bound likewise for Bantam. It will be remembered that these bold commanders took possession of the country in the name of King James. The Dutch are said to have been present when they executed that resolution, and entered no protest against it.

The relations of the Dutch, and perhaps also of the Danes, with the Hottentot aboriginals were evidently by that time not all that could be desired.

Beaulieu's statement of the bodies of Europeans found slain by his men in 1620 goes to prove this; and even five years later, in William Minors's account of the homeward voyage of the *Scout*, we find that on the arrival of the vessel in Table Bay in November, 1625, the Dutch ship *Leiden*, bound for Batavia, and nine months out from Holland, came into the roadstead. She supplied the *Scout* with necessaries, "as also wee imparted unto them beefes and sheepe which wee goat ashoare and they by their evill useadge of the blacks could not obtain."

It is highly probable that the Dutch followed in the early days the example of the English, and left inscriptions recording the date of arrival and departure of their ships. But of these none have been found recording the names of the vessels already mentioned.

On the other hand we find in an account of Revett, who was in the waters of Table Bay with the English ships *Ascension* and *Union*, from April 12th to June 22, 1608, the following entry: "There was found upon the island [*i.e.* Robben Island] the Flemish General's name [Cornelis Matelief] written upon tynn in the month of April last, so that we imagine they had a favourable and quick passing."

The number of the graved Dutch inscriptions recovered hitherto is five, the first in date being a very fragmentary one.

Stone XIV.

HIER
ENRICK . . . IENSC. R
MAN OP

Rudely carved across these letters is the date 1618, and the letters

VINCENT
STA GEAERT

Valentyn, the historian of the Dutch Indies, does not give the name of the Commander of the 1618 squadron. His vessels were:

De Orangieboom, Postpaard, Eendragt, Walcheren, Enkhuysen, Het Wapen van Zeeland, Eenhoord, and *Fortuyn.*

It is plain that the graved remnants of words cannot apply to the names of the ships; and the second inscription graved across the first seems to indicate that it is anterior to the date 1618.

Stone XV.

The second inscription is very fragmentary, that is to say it is only one part of the original, but the words left are mostly very legible.

Fig. 19.

37 cm. × 9 cm.

15. PIETER DIRCKSE DE. . . H. E. R. CORNELIS FRAMS I. O. . . MMET STOLCK EN . . . VAN ROTTER.

We find in Valentyn: "After the amendment of the Company's (Oost Ind. Comp.) Charter dated 13 March, 1623, it pleased the States General to do as much injury as possible to the Spaniards and Portuguese in the South Seas also, by sending out a fleet of eleven ships under Admiral Jacob l'Heremite and his junior geen Huigen Schapen Ham, which was called the Nassau Fleet. Of

that fleet which sailed from Rotterdam, was the ship *Amsterdam* with Admiral Leendert Stolk as 'Schipper.'"

These two names, *Stolk* and *Rotterdam*, figure in the inscription, but not those of the principal officers of the *Amsterdam*, such as the commander of the soldiers, Engelbregt Schutte; the Merchant, Pietervan Rynegom; the Naturalist, Johannes van Wallbecht; Justus de Vogelaar, etc., and as none of these names approximate those figuring in the inscription, one must conclude that the inscription is not that of the *Amsterdam*, but of another vessel of the "Nassau" fleet.

Stone XVI.

The third inscription only incidentally refers to the call of the ship *Holland* in 1624, it being an epitaph.

FIG. 20.
62 cm. × 37 cm.

HIER LEIT BEGRAVEN JAN GERRITSEN VAN AMSTERDAM OPPER STUURMAN OF HET SCHIP HOLLAND STARF DEN 24 APRIL ANNO 1624.

(Here lies buried Jan Gerritsen of Amsterdam chief pilot of the ship *Holland*, died the 24 April of the year 1624.)

This inscription was found on the removal of an old house at the corner of Strand Street, opposite the present "Grand Hotel," and

at a very short distance from and almost in a line with what is believed, with very good reason, to have been the landing-place from the Dutch occupation onwards. One of the steps cut into the slate rock is now preserved in the Museum.

At that time there ran from the bottom of Strand Street a series of sand-dunes of considerable height which reached to the Green Point Vlei, now drained, and afforded shelter against the violent south-east winds prevailing in summer. It is under the shelter of these sand-mounds that van Riebeek first anchored, and moved thence further into Table Bay, at the time of his taking possession of what was to become the Cape of Good Hope. And thus the burial-party that interred the remains of Jan Gerritsen, the navigating officer of the ship *Holland*, had not far to go to lay him to his rest.

Stone XVII.

The third Dutch inscription is graved with care, and is therefore easily legible. It is written on the reverse of the stone bearing the record of Richard Arnott, Commander of the *London*, bearing the date 1631.

Fig. 21.

58 cm. × 32 cm.

It reads as follows :—

HIERONDER LEGGEN BRIEVEN VAN DER COMMAND(EUR) D. V. LEE, EN VICE COMD P. C. ROOCK, MET DE SCHEPEN NASSAU, FRED. HENDRIK, NIMEGEN, WESSEL EN DE GALIAS ALHIER DEN 9. APRIL 1632 VAN BATTAVIA. GEARIVEERT ☽TROCKEN DEN 15 DITTO.

Dirk van der Lee, Secretary of the High Government, left Batavia, as we are told by Valentyn, in 1632 with the ships *Nassau*, *Nimegen*, *Wezel*, *Frederik Hendrik*, the Galioot S. *Gravenhage*, from Surat, and *Ter Veer*.

The *Ter Veer* is not mentioned in the inscription and had therefore not arrived at the rendezvous when van der Lee left after six days' sojourn in Table Bay.

Stone III.

The next and last Dutch inscription is, like that of van der Lee, graved on block of stone bearing another record, but this time it is

FIG. 22.
22 cm. × 52 cm.

1634 BANDA . WASSENAER . EN D(E) EGMONT . SYN. DEN . XI . APRIL VERTROCKE . SOECKT . BRIEF.

the French undated one (Stone III.), the missing part of which had already been broken, before the Dutch graving was added to the reverse, as proven by its completeness.

Danish Inscription.

Stone XVIII.

At about the same time as the Dutch, the Danes also founded an East India Company, and the French did likewise.

Of what port of call the Danes made use is not very well known; but that they touched at the Cape is proved by Kerridge and Beaulieu's accounts.

There has, however, been found an inscription which may be considered as Danish. It is unfortunately very fragmentary.

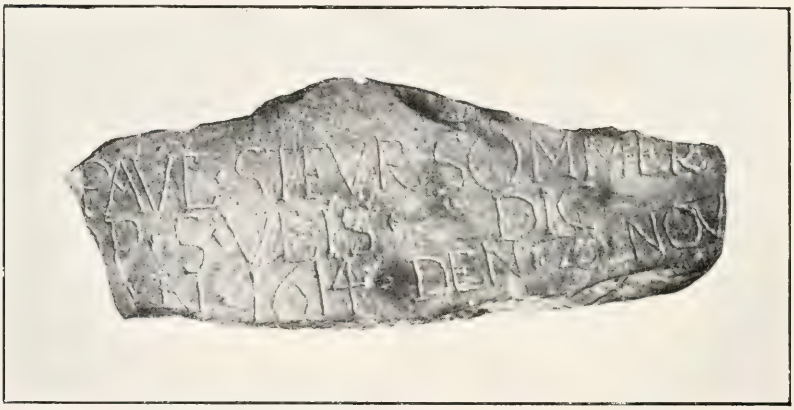


Fig. 23.
23 cm. × 13 cm.

It reads:—

PAUL . STEUR SOMMER.
P. S. UEIS. DIG.
N. 1614. DEN NOV.

The date is, however, very plain, and thus the Danes were not far behind the English and the Dutch in their enterprises of Merchant Adventurers trading by sea with the East.

From the above account it will be seen that the rediscovered inscriptions left by early European navigators date from 1485 to 1632.

Twenty years after (1652) Cape Town is founded by the first Dutch Governor, Johan van Riebeek, and the records of passing ships are no longer recorded by inscriptions graved on stones. A new order of things has begun. It may seem a prosaic one for those who read in these brief letters the tales untold of hardship and misery; of courage and devotion; of heroism and also of motives sordid.

2.—*On a New Lark from the Cape Province.*—By W. R. Ogilvie-Grant.

Through the kindness of Dr. L. Péringuey, the Director of the South African Museum, I have recently received for examination examples of a species of lark procured by Mr. H. L. Hare, near Philipstown, in July, 1912. The birds prove to be closely allied to the rare and little-known *Calandrella sclateri*, from Great Namaqualand, described and figured by Shelley [cf. Birds of Africa, iii., p. 136, pl. 22, fig. 3 (1902)]. The bill in all five birds from Philipstown is dark blackish horn colour, while in Andersson's specimens, including the type of *C. sclateri*, the culmen is of a pale brownish horn colour.

I propose to distinguish this form under the following name :—

Family ALAUDIDAE

Gen. CALANDRELLA, Kaup.

Calandrella sclateri capensis, sub-sp. n.

Adult male and female. Closely allied to *C. sclateri*, Shelley, but distinguished by the shorter bill with the culmen dark blackish horn colour instead of light brownish horn colour. The markings on the lores and down the cheeks are black and much more pronounced than in *C. sclateri*, which is evidently a rather paler western form.

C. sclateri.		*C. s. capensis.*	
Culmen (from nostril to tip).	Wing.	Culmen (from nostril to tip).	Wing.
♂ (Type) 12 mm.	85 mm.	♂ 11 mm.	85 mm.
		♂ 10½ ,,	82 ,,
		♀ 10½ ,,	81 ,,
		♀ 10 ,,	77 ,,

Hab. Near Philipstown, Cape Province.

3.—*Report upon the Oligochaeta in the South African Museum at Cape Town.*—By W. Michaelsen (Hamburg).

My stay at Cape Town in the year 1911 being too short for studying the rich collection of Oligochaeta in the South African Museum, Mr. Péringuey, Director of that Museum, offered to send the collection to me in Hamburg for a more exact examination. The present paper is a rather short report upon this collection. A more detailed treatise with figures will be published elsewhere, combining the Oligochaets of the South African Museum with those collected by myself in the year 1911, and with those of the Natal Museum at Pietermaritzburg.

The main value of the present collection is to be seen in the circumstance that it contains the types of Beddard's *Acanthodrilus* species published in his paper: "On a Collection of Earthworms from South Africa belonging to the Genus *Acanthodrilus*" (in P. Zool. Soc., London, 1897). This paper of Beddard still belongs to that period in which only a few species with acanthodriline sexual organs were known, and in which all these acanthodriline species were put into the large genus *Acanthodrilus* in the ancient and primordial sense. Beddard accordingly did not lay any stress upon the marks of a generic division created in much later time. Consequently it is questionable to which of the genera strictiora of younger date some of these ancient species belong. Furthermore, at the time of Beddard's publication there were known only a few acanthodriline species which might be separated easily by a small number of characters. Therefore we look in the diagnoses of Beddard in vain for certain categories of characters which at the present time we regard as necessary parts of a good diagnosis. The examination of this collection thus enables me to give a more modern statement of most of these *Acanthodrilus* species.

It may be noted that there is no doubt of any kind that the specimens examined by myself in every case are the same which

Beddard had in hand when he labelled the different bottles. Every bottle has inside a piece of paper with the scientific name in Beddard's handwriting, and outside on the label an exact note written by Dr. Purcell, saying how many specimens the bottle contained, firstly when sent to Beddard, and secondly when returned to the Museum. This second note in all cases was in accord with what I found. If there is now much confusion, the cause of it must be seen in two rather gross mistakes of Beddard. Firstly, with one exception (*Acanthodrilus photodilus* and *A. lucifuga*), Beddard took it for granted a priori that each bottle contained only a single species, whilst most of the bottles in fact contained more than one. Beddard apparently has examined only a small number of specimens out of each bottle, and then labelled the whole according to his views on this small part only. Secondly, Beddard took it for granted a priori that the different bottles in each case contained different species, whilst in fact this or that species occurs in different bottles. It might be assumed that later the contents of different bottles became mixed. But I am sure that this is not the case. Two circumstances are against this view, viz. firstly the exactitude of Dr. Purcell's registration, and secondly all species from Knysna are found only in the bottles with the label "Knysna," all species whose distribution really is restricted to the Cape Flats are found only in the bottles labelled "Cape Flats." If there indeed had been any intermingling, it could not be conceived why it was restricted in each case to the bottles of the same locality. This statement was necessary to justify my list of synonymies of the species in question.

In the following I give a list of the Oligochaets of the South African Museum at Cape Town, together with short but sufficient diagnoses of the new or insufficiently known species, and with synonymical list and localities.

Family HAPLOTAXIDAE.

Pelodrilus africanus, Mich.

1905. *Pelodrilus africanus*, Michaelsen in Deutsche Südpolar-Exp., 1901–1903, ix., Zool., i., p. 19.

Loc. Newlands slope of Table Mountain, near Cape Town; Dr. F. Purcell, leg. viii., 1886.

Family MEGASCOLECIDAE.

Sub-Family ACANTHODRILINAE.

Eodrilus arundinis (Beddard).

1897. *Acanthodrilus arundinis* + *A. arenarius* + *A. falcatus*, Beddard in P. Zool. Soc., London, 1897, pp. 339, 340, 341.

1900. *Notiodrilus arundinis* + *N. arenarius* + *N. falcatus*, Michaelsen in Tierreich, x., pp. 132, 133.

1907. ? *Eodrilus* (? *Microscolex arundinis* + *Eodrilus arenarius* + ? *Eodrilus* (? *Microscolex*) *falcatus*, Michaelsen in Fauna Südwest-Australiens, i., pp. 141, 143.

Loc. Cape Flats, Ronde Vley, near Zeekoe Vley (types of *Acanthodrilus arundinis*), E. from Wynberg (types of *A. arenarius*), and 1 mile E. from Retreat Station (types of *A. falcatus*).

Cape Flats, near Zeekoe Vley; Dr. F. Purcell, leg. 16, xii., 1898.

Cape Flats, $\frac{3}{4}$ mile SE. to S. from Retreat Station; Dr. F. Purcell, leg. 16, xii., 1898.

Cape Flats, 1 mile SE. from Retreat Station; Dr. F. Purcell, leg. 16, xii., 1898.

External Characters. Length 35–60 mm., thickness 1–3 mm., number of segments 12–103.

Colour yellowish grey; without pigmentation.

Head epilobous.

Setae separated, in general $aa : ab : bc : cd = 5 : 3 : 5 : 6$; dd = ca. $\frac{2}{7}$ μ; ab diminishing toward the male pores.

Clitellum ring-shaped, at the $\frac{1}{2}$ 13 or 13–16 segments.

Prostate pores in *b*.

Seminal furrow laterally convex.

Spermathecal pores at 7/8 and 8/9 in *b*.

Copulatory tubercles varying in number and in arrangement, mostly unpaired, at the 8–11 and 16–23 segments or a part of them, often together with paired ones which most frequently are found at the male area, but sometimes also at the 10 segment.

Internal Anatomy. Septa 6/7–11/12 very little thickened.

Alimentary tract: A small but distinct and glittering gizzard in the 5 segment; no calciferous glands.

Excretory organs: Meganephridia without terminal bladder.

Male organs: Two pairs of free testes and spermiducal funnels. Three pairs of sperm-sacs in the 9, 11, and 12 segments at the septa 9/10, 10/11, and 11/12. (In the 10 segment free masses of develop-

ing sperm, but no sperm-sacs.*) Prostates tubelike, occupying some (3 or 4?) segments, with rather long and nearly straight duct, and a thicker, serpentine glandular part. Penial setae ca. 1 mm. long and in the middle ca. 25 μ thick, slowly getting thinner towards the distal end which is about 13 μ thick; distal quarter curved to about a quarter of a circle; distal end abruptly much more slender than the adjacent part, quite smooth, with very fine tip bent in the form of a hook; the interruption at the proximal end of the slender distal part of the seta is caused by a short and broad chisel-like or scale-like protuberance or tooth semi-encircling the seta (noted in none of the three species of Beddard, but occurring in all type specimens examined by myself, as well as in all other examined specimens assigned to *Eodrilus arundinis*); at the part proximal to this protuberance the seta is ornamented by a small number of smaller protuberances, about 8, standing at the proximal end of small scar-like recesses.

Spermathecae: Ampulla pear- or sac-shaped; duct egg-shaped, sharply separated from the ampulla, about half as long and a quarter as thick as the ampulla; from the middle of the duct arise generally 2, rarely 3, or even 4 diverticula, which are nearly as long as the ampulla, and consist of a cylindrical seminal-tube and a thin, and short stalk.

Eodrilus peringueyi, n. sp.

Loc. Moddergat, near Lynedoch in the Stellenbosch district; L. Péringuey, leg.

External Characters. Length 60–70 mm., maximal thickness $3\frac{1}{3}$–$3\frac{1}{2}$ mm., number of segments 126–134.

Colour dirty grey.

Head epilobous (ca. $\frac{3}{4}$).

Setae at the ends of the body enlarged, in general ventrally widely paired, dorsally very widely paired; in the middle of the body *aa : ab : bc : cd :* = 7 : 4 : 8 : 6, at the ends of the body about *aa : ab : bc : cd* = 6 : 4 : 6 : 6. Towards the male pores *ab* slowly diminishing; *dd* = $\frac{1}{3}$–$\frac{2}{7}$ μ.

Prostate pores at the 17 and 19 segments in *b*.

Seminal furrows slightly bent, laterally convex.

Spermathecal pores at 7/8 and 8/9 in *b*.

Copulatory papillae transversely oval, one pair at the hinder

* In all his species in the paper in question Beddard noted these free sperm-masses erroneously as sperm-sacs. I mention this fact here, but it also refers to other species as well as this one.

part of the 9 segment laterally of and close by the lines of the setae *b*.

Internal Anatomy. Septa 6/7–13/14 thickened, 9/10–11/12 rather strong.

Alimentary tract: A large gizzard in the 5 segment. No calciferous glands.

Male organs: Two pairs of spermiducal funnels free in the 10 and 11 segments. Two pairs of grape-like sperm-sacs in the 11 and 12 segments at the septa 10/11 and 11/12. Prostate confined each to one segment; glandular part thick and narrowly serpentine; duct short and thin. Penial setae in two different forms: (1) slender form very long (ca. 1·75 mm.) and extraordinarily thin (ca. 7 μ), thread-like, only a little bent, quite smooth, if not ornamented by a small number of short and clumsy, slightly bent teeth; distal tip simply pointed; (2) clumsier form ca. 0·9 mm. long, and proximally 9 μ thick, distally thinner; slightly bent; distal part with exception of the slender and simply pointed tip ornamented by widely and irregularly scattered rather large and clumsy teeth, which are placed at the proximal end of longitudinal scar-like recesses, and form the distal end of longitudinal convex protuberances; these longitudinal recesses and protuberances being placed alternately at two sides of the seta, the latter appears to be sepentine at the distal half.

Spermathecae: Ampulla slender, sac-shaped, opening through a very short conical duct; into the latter open two rather large club-shaped diverticula with short and narrow stalk, and not quite as long as the ampulla; seminal chamber of the diverticula not quite simple, but with slightly folded walls.

Eodrilus purcelli, n. sp.

Loc. Newlands slope of Table Mountain near Cape Town; Dr. F. Purcell, leg.

External Characters. Length 28 mm., thickness 0·9–1·3 mm., number of segments ca. 90.

Colour yellowish grey.

Setae ventrally widely paired, dorsally very widely paired; *ab* somewhat diminished towards the male pores; $aa \geqq bc \geqq cd$ = ca. $1\frac{1}{4}$–2 *ab*; *dd* = ca. $\frac{1}{2}$ μ.

Clitellum ring-shaped at the 14–16 segments, covering also small parts of the 13 and the 17 segments.

Prostate pores at the 17 and 19 segments in *b*.

Seminal furrows bent rather strongly, laterally convex.

Spermathecal pores at 7/8 and 8/9 in *b*.

Internal Anatomy. Alimentary tract: A rather large glittering gizzard in the 5 segment. No calciferous glands.

Male organs: Two pairs of free spermiducal funnels in the 10 and 11 segments. Three (?) pairs of sperm-sacs in the 9, 11, and 12 segments (?). Prostates tube-like, restricted to 1 segment or to 2 segments; glandular part irregularly wound; duct rather short, quite straight, about half as thick as the glandular part. Penial setae in two different forms: (1) slender form ca. 0·9 mm. long and proximally ca. 8 μ thick, distally $3\frac{1}{2}$ μ thick, slightly and simply bent; distal end flattened and somewhat broadened (to about 5 μ), somewhat hollowed, ending in two clumsy tips between which is expanded a plane with concave edge; distal end of seta ornamented with some scarce and small clumsy teeth or knobs, which are placed in the proximal ends of longitudinal scar-like recesses, and hardly project above the general surface of the seta; (2) clumsier form ca. 0·4 mm. long and proximally 10 μ thick, in the middle still 9 μ. thick, and quickly diminishing not long before the distal end; in general nearly straight, but distal end bent to the form of a spiral, with a simple tip; distal part of the seta, with the exception of the bent tip, ornamented by rather gross scale-like protuberances at the proximal end of rather deep scar-like recesses.

Spermathecae: Ampulla longitudinally sac-like; duct sharply separated from the ampulla, about as long and as thick as the latter; somewhat above the distal opening of the duct the latter is entered by a diverticulum, which is somewhat shorter than the ampulla, and which has the shape of a forked tube; the two ends of this forked diverticulum are of somewhat different length, and the longer one is about as long as the common basal part.

Eodrilus drygalskii, Mich., var. nov. castelli.

Loc. Kasteels Poort Gorge, Table Mountain, near Cape Town; Dr. F. Purcel, leg. Northern slope of Table Mountain, near Cape Town; Dr. W. Michaelsen, leg.

External Characters. Length 48–58 mm., maximal thickness 3–$3\frac{1}{2}$ mm., number of segments 110–150.

Copulatory organs wanting or two unpaired transversely oval glandular cushions medially-ventrally at the 17 and 19 segments, and one pair of transversely oval papillae at the hinder part of the 6 or the 9 segment, or an additional unpaired similar one at one side of the 21 segment.

Internal Anatomy. Penial setae in general shaped like those of the typical form, but differing in the shape of the ornaments, which in this variety are not sharply pointed smooth thorns, but more clumsy protuberances, the distal slope of which is roughened by a rather large number of very small roundish or pointed knobs.

Spermathecae: Ampulla apparently constantly with a neck-like contraction at the middle.

In other respects like the typical form.

Chilota capensis (Bedd.).

1885. *Acanthodrilus capensis*, Beddard in Proc. Phys. Soc., Edinburgh, viii., p. 370.

1886. *Acanthodrilus capensis*, Beddard in P. Zool. Soc., London, 1885, p. 170.

1895. *Anthodrilus capensis*, Beddard in A Monograph of the Order of Oligochaeta, Oxford, 1895, p. 539.

1900. *Chilota capensis*, Michaelsen in Tierreich, x., p. 147

Loc. Cape Colony (without further notes, types of *Acanthodrilus capensis*), Moddergat, near Lynedoch in the Stellenbosch district; L. Péringuey, leg.

External Characters. Length 90–110 mm., maximal thickness 6–7 mm., number of segments 80–146.

Colour dorsally light brownish grey, like smoke.

Head tanylobous.

Setae at the hinder end somewhat enlarged, in general ventrally narrowly or widely paired, dorsally separated; at the 8 segment $aa : ab : bc : cd = 6 : 4 : 8 : 9$; at the hinder end $aa : ab : bc : cd = 6 : 4 : 6 : 6$; ab towards the male pores diminishing; dd = ca. $\frac{1}{3}$ μ.

Nephridial pores generally in *c*.

Clitellum at $\frac{1}{3}$ 13–18 segments ($= 5\frac{1}{2}$).

Prostate pores in *b* upon small papillae.

Seminal furrows slightly bent, laterally convex, passing the 18 segment laterally from the setae *ab* which here are normally developed.

Spermathecal pores at 7/8 and 8/9 in *b*.

Copulatory organs: Ten pairs or less of copulatory cushions or papillae at or near the ventral pairs of setae (at a part of the segments 7–21).

Internal Anatomy. Septa 6/7–13/14 thickened, the septa 9/10 and 10/11 very strong.

Alimentary tract: A large gizzard in the 5 segment. No calciferous glands.

Male organs: A pair of grape-like sperm-sacs in the 11 segment (in the 9 segment no sperm-sacs seen—wanting?). Prostates tube-like, occupying only a few segments. Glandular part forming some windings; duct short and thin. Penial setae 2–2½ mm. long and proximally ca. 30 μ thick, distally slowly diminishing, being 20 μ thick a little before the distal end, nearly straight in the proximal three quarters; distal quarter bent at a blunt and rounded angle, flattened and somewhat broadened, smooth at the extreme end, or else ornamented by rather densely crowded slender triangular spinelets.

Spermathecae: Ampulla sac-like, distally narrowed. Duct shorter than the ampulla and proximally about half as thick, distally thinner. The duct arises from the ampulla at a right-angle and bears at its proximal end a moderately large unstalked diverticulum which is bent down and is lying just in the line of the ampulla. The diverticulum is provided with some seminal chambers which are placed peripherally and are separated only incompletely from the main central chamber of the diverticulum.

Chilota bergvlietanus, Mich.

1908. *Chilota bergvlietanus*, Michaelsen in Denksch. Jena, viii., p. 37, Taf. v., figs. 5–9.

Loc. Table Mountain near Cape Town.

Chilota vanhöffeni, Mich.

1905. *Chilota Vanhöffeni*, Michaelsen in Deutsche Südpolar-Exp., 1901–1903, ix., Zool. i., p. 42, Taf., figs. 8a, 9.

Loc. Table Mountain near Cape Town; Dr. F. Purcell, leg.

Chilota montaguanus, n. sp.

Loc. Montagu Pass, 3 miles N. from George; Dr. F. Purcell, leg.

External Characters. Length 63–72 mm., thickness 2½ mm., number of segments, 126 and 116.

Head tanylobous.

Setae ventrally widely paired, dorsally separated, in general $aa : ab : bc : cd = 3 : 2 : 3 : 3$. Towards the male pores *ab* diminishing. dd = ca. $\frac{2}{7}$ μ.

Nephridial pores in the lines of setae *c*.

Clitellum at the 13–16 segments (= 4), ring-shaped, but at 16 interrupted by the male area.

Male area at the 16–20 segments.

Prostate pores upon moderately large papillae medially from *b*, but apparently only pressed medially in consequence of the contraction of the male area, originally probably in *b*.

Seminal furrows nearly straight, at the 18 segment dislocated laterally.

Spermathecal pores in *b*.

Internal Anatomy. Alimentary tract: A large gizzard in front of the male organs.

Male organs: Two pairs of sperm-sacs in the 9 and 11 segments. Prostate tube-like, coiled, occupying only a few segments. Penial setae about 1·1 mm. long and proximally ca. 60 μ thick, diminishing towards the distal end, strongly bent with a curve corresponding to a quarter of an ellipse. Distal end flattened not broadened, about 35 μ broad, ending in a sharp roundish edge. With exception of the extreme distal end the distal two-third parts of the penial seta are ornamented at the convex side of the bending by densely crowded transverse rows of fine and slender spinelets (often inconspicuous).

Spermathecae: Ampulla nearly globular; duct about half as thick and twice as long. Into the distal end of the duct opens a rather shortly and narrowly stalked diverticulum with a thick kidney-shaped or flattened heart-shaped seminal chamber. The stalk of the diverticulum arises from the sinus of the seminal chamber. The latter is provided with a large number of small seminal chambers which are only imperfectly separated from the main central chamber.

Chilota excavatus (Bedd.).

1897. *Acanthodrilus excavatus*, Beddard in P. Zool. Soc., London, 1897, p. 342.

1900. *Chilota excavata* + ? *Ch. sclateri*, Michaelsen, Tierreich, x., p. 156, p. 148.

Loc. Knysna forest (types of *Acanthodrilus excavatus* and *A. sclateri*), Knysna, main forest; Dr. E. Warren, leg. Jan., 1911.

External Characters. Length 35–50 mm., thickness 1·2–1·5 mm., number of segments 78–95.

Head epilobous.

Setae ventrally widely paired, dorsally separated, in general *aa : ab : bc : cd : dd* = 8 : 5 : 8 : 10 : 20. Width of ventral pairs *ab* diminishing slowly towards the 18 segment. *dd* = ca. $\frac{4}{15}$ μ.

Nephridial pores in the lines of setae *c*.

Clitellum at the 13–16 segments (= 4), in general ring-shaped.

Male area a rounded pentagon, in front intruding somewhat into the 16 segment.

Prostate pores upon nearly hemispherical papillae in the lines of setae *b*.

Seminal furrows nearly straight, passing the 18 segment laterally from the setae *ab* which are normally developed.

Spermathecal pores in the lines of setae *b*.

Internal Anatomy. Alimentary tract: A very small but distinct gizzard in the 5 or 6 segment. No calciferous glands.

Male organs: Two pairs of sperm-sacs in the 9 and 11 segments. Prostates with very thick and irregularly wound glandular part, occupying not much more than the 17 and 19 segments respectively. Penial setae very long and slender, switch-like, about 1·5 mm. long and in the middle 13 μ thick, proximally thickened to about 18 μ, distally diminishing to a thickness of about 5 μ, proximally bent only a little, distally bent strongly in the form of a wide spiral. Distal end a little broadened, two-edged, flattened or even a little hollowed at the concave side, with indistinct granulation at the concavity. The distal tip of the penial seta is simple.

Spermathecae: Main pouch pear-shaped with short and narrow, indistinctly separated duct. Into the latter opens a diverticulum which is larger than the main pouch. The diverticulum has the shape of a thick tube bent to form a knee, with a rounded protuberance at the prominent angle of the knee.

Chilota lucifuga (Bedd.).

1897. *Acanthodrilus lucifuga*, Beddard in P. Zool. Soc., London, 1897, p. 343, fig. 2.

1900. *Chilota lucifuga*, Michaelsen in Tierreich, x., p. 146.

Loc. Knysna forest (type of *Acanthodrilus lucifuga*), Knysna main forest; Dr. E. Warren, leg. Jan., 1911.

External Characters. Length 65 mm., thickness $1\frac{1}{2}$–2 mm., number of segments about 103.

Head tanylobous.

Setae ventrally widely paired, dorsally separated, in general $aa : ab : bc : cd = 7 : 5 : 8 : 8$. dd = ca. $\frac{1}{4}$ μ. Width of ventral pairs diminishing towards the male pores slowly but finally more rapidly.

Nephridial pores in the lines of setae *c*.

Clitellum ring-shaped, at the 13–17 segments (= 5).

Prostate pores between the lines of setae *a* and *b*, nearer to the latter.

Seminal furrows laterally convex, passing the 18 segment laterally from the setae *ab*, which here are normally developed.

Spermathecal pores in *b*.

Copulatory organs: Unpaired copulatory cushions ventral and median in the 11–21 segments, and in addition more or less indistinct paired ones in all or some of the segments: 7, 8, 9 and 15.

Internal Anatomy. Alimentary tract: A large gizzard in front of the male organs. No distinct calciferous glands.

Male organs: Two pairs of sperm-sacs in the 9 and 11 segments. Prostates very long, reaching backwards about as far as to the 30 segment, straight or forming some slight windings, in the whole length attached to the long sacs of the penial setae, with relatively long and slender duct. Penial setae very long and slender, string-like, about 6 mm. long and only 14–15 μ thick, slightly bent. Distal end often bent somewhat more strongly (but not in a spiral or like a corkscrew), slightly broadened and flattened, somewhat hollowed at one side, nearly spoon-shaped (with some transverse rows of very fine spinelets?).

Spermathecae: Ampulla globular or pear-shaped, with a short and narrow duct. Into the duct opens a large tubular diverticulum, which is much longer than the ampulla and swollen at the proximal end to form a simple seminal chamber. This seminal chamber is pear-shaped or globular.

Chilota photodilus (Bedd.).

1897. *Acanthodrilus photodilus*, Beddard in P. Zool. Soc., London, 1897, p. 343.

1900. *Chilota photodila*, Michaelsen in Tierreich, x., p. 148.

Loc. Knysna forest (types of *Acanthodrilus photodilus*). Knysna, main forest; Dr. E. Warren, leg. Jan., 1911.

External Characters. Length 60–145 mm., thickness about 3·5–3·6 mm., number of segments 102–158.

Head tanylobous.

Setae ventrally widely paired, dorsally very widely paired as far as separated. In general $aa : ab : bc : cd = 3 : 2 : 3\text{–}4 : 3$. Width of ventral pairs a little diminished towards the 18 segment. dd = ca. $\frac{2}{7}$ μ.

Nephridial pores in the lines of setae *c*.

Clitellum ring-shaped, at the 13–16 segments (= 4).

Prostate pores in *b*.

Seminal furrow laterally convex, passing the 18 segment just lateral from the setae *ab*, which here are normally developed.

Spermathecal pores in *b*.

Copulatory organs: Apparently constantly an unpaired copulatory cushion placed intersegmentally at 21/22, rarely a second at 20/21, in addition some smaller paired copulatory cushions or papillae at the hinder part of the 9 segment or at the hinder part of the 8 and the fore part of the 9 segment.

Internal Anatomy. Septa 8/9–10/11 thickened.

Alimentary tract: A distinct gizzard in the 5 segment. No distinct calciferous glands.

Male organs: Two pairs of sperm-sacs in the 9 and 11 segments. Prostates long, tubular; glandular part coiled at least in the distal part, sometimes stretched in the proximal part, and here attached to the sacs of the penial setae. Duct short and thin. Penial setae very long and slender, about 5–8 mm. long and proximally ca. 35 μ thick, distally diminished in thickness, somewhat before the distal end 10 μ thick. Distal end widely bent like a corkscrew, flattened, without ornamentation.

Spermathecae: Ampulla pear-shaped; duct thin and slender, longer than the ampulla. At the proximal end of the duct is an unstalked diverticulum, which is attached to the duct along the greater part of its length and free only at the smaller extreme end. The outer border of the diverticulum has two or three slight notches.

Formae. The specimens collected by Dr. E. Warren differ in length and in the arrangement of the setae somewhat from the type specimens; they may be separated as a distinct form.

f. *typicus:* Length 60–80 mm., thickness $3\frac{1}{2}$ mm.; *aa : ab : bc : cd* = 3 : 2 : 3 : 3.

n.f. *castaneus:* Length about 145 mm., thickness 6 mm.; *aa : ab : bc : cd* = 3 : 2 : 4 : 3.

Chilota priesti, n. sp. f. typicus.

Loc. Avontuur, Uniondale division; Mr. Priest, leg.

External Characters. Length 200 mm., thickness 7–9 mm., number of segments ca. 162.

Head tanylobous. Segments of the fore body, with exception of the first 4, divided each into two segment-like ringlets.

Setae rather small, widely paired. In general *aa : ab : bc : cd :*

dd = 3 : 2 : 4 : 2 : 6. Width of ventral pairs diminished towards the 18 segment. *dd* = ca. $\frac{1}{4}$ μ.

Nephridial pores in the lines of setae *c*.

Prostate pores in *b*.

Spermathecal pores in *b*.

Internal Anatomy. Septa 6/7–12/13 strongly thickened, 13/14 slightly thickened, 14/15 hardly thickened.

Alimentary tract: A large gizzard in the 6 segment. No distinct calciferous glands.

Male organs: Prostates very long, thin tubular, wound, with rather long and thin duct. Penial setae ca. 2·1–2·4 mm. long and proximally 60–66 μ thick, straight, distally flattened and distinctly broadened to a breadth of about 0·1 mm., and somewhat enrolled from the edges to form a chisel; distal tip a little narrowed, ending in a sharp concave edge. The distal two-third parts, with exception of the distal tip, are ornamented; they bear densely crowded transverse rows or ringlets of fine and slender spinelets.

Spermathecae: Ampulla pear-shaped, rising from the upper part of the hinder side of a thick cylindrical duct, the free proximal extremity of which is rounded and represents the single diverticulum. The ampulla contains a number of small seminal chambers embedded in the thick wall.

Chilota priesti, Mich., f. minor, n.f.

Loc. Knysna forest; Dr. F. Purcell, leg.

External Characters. Length 100–140 mm., thickness 4 mm., number of segments 112–126.

Clitellum at the 13–16 segments (= 4), ring-shaped.

Seminal furrow laterally convex, passing the 18 segment laterally from the setae *ab*, which are normally developed.

Copulatory organs: Paired copulatory cushions at the 10, 11, 12 and 21 segments, an unpaired one at the 18 segment.

Internal Anatomy apparently like that of the typical form.

Chilota algoensis, Mich.

1899. *Chilota algoensis*, Michaelsen in Mt. Mus., Hamburg, xvi. p. 104, fig. 22.

Loc. Table Mountain near Cape Town.

Chilota purcelli (Bedd.).

1897. *Acanthodrilus purcelli*, Beddard in P. Zool. Soc., London, 1897, p. 337, f. 1.

1900. *Chilota purcelli,* Michaelsen in Tierreich, x., p. 147.
1905. *Chilota montanus,* Michaelsen in Deutsche Südpolar-Exp. 1901–1903, ix., Zool., i., p. 40, Taf. i., fig. 6a, 7.

Loc. Newlands slope of Table Mountain near Cape Town (types of *Acanthodrilus Purcelli*).

Table Mountain near Cape Town; Dr. F. Purcell, leg.

St. James, False Bay.

Simonstown, at the waterfall.

Remarks. Besides the statement of the identity of *Chilota Purcelli* (Bedd.) and *Ch. montanus,* Mich., resulting out of the comparison of the types, we need no further description of the species, as we have already an exact one under the title of *Ch. montanus.*

Chilota africanus (Bedd.).

1897. *Acanthodrilus africanus,* Beddard in P. Zool. Soc., London, 1897, p. 344, fig. 3.
1900. *Chilota africanus,* Michaelsen in Tierreich, x., p. 147.

Loc. Knysna in George (types of *Acanthodrilus africanus*). Knysna, main forest; Dr. E. Warren, leg. Jan., 1911.

External Characters. Length 42–52 mm., thickness, $2\frac{1}{2}$–$3\frac{1}{3}$ mm., number of segments 78–94.

Head tanylobous.

Setae ventrally widely paired, dorsally separated. In general $aa : ab : bc : cd = 5 : 3 : 6 : 6$. Towards the 18 segment *ab* diminishes. dd = ca. $\frac{1}{4}$ μ.

Nephridial pores in *c.*

Clitellum ring-shaped, at the 13–17 segments (= 5), only very slightly developed at the 13 and at the 17 segment.

Prostate pores in *b.*

Seminal furrows nearly straight, slightly convex laterally.

Spermathecal pores in *b.*

Copulatory organs: A single unpaired copulatory cushion ventrally at the 21 segment.

Internal Anatomy. Alimentary tract: Gizzard rather large.

Male organs: Two pairs of sperm-sacs in the 9 and 11 segments. Prostates restricted each to a single segment; glandular part coiled, duct short and very thin, strongly bent. Penial setae about 1·75 mm. long and proximally ca. 35 μ thick, diminishing in breadth only a little towards the distal end, being 20 μ thick a little before the distal tip. Middle part of the seta somewhat flattened, two-edged, with a more convex upper side and a flatter under side. Extreme distal end

for a length of about 0·2 mm. flattened and broadened (40 μ broad), distally ending in an edge which is rounded at the side and deeply incised in the middle. The whole seta is bent like a fishing-hook. The more convex upper side of the middle part is ornamented by transverse groups or rows of fine and slender spinelets. Besides this ornamentation the penial seta shows in its distal quarter with exception of the flattened extreme distal end an annulation, depending upon the internal structure.

Spermathecae: Ampulla egg-shaped, duct about one-third as thick and half as long. Into the proximal part of the duct opens an unstalked, nearly globular or thickly kidney-shaped diverticulum which contains some rather large seminal chambers. These seminal chambers may be seen externally, causing more or less distinct flat protuberances at the surface of the diverticulum.

Chilota faucium, n. sp.

Loc. Table Mountain near Cape Town, Kasteels Poort Gorge; Dr. F. Purcell, leg.

External Characters. Length ca. 30 mm., thickness ca. $1\frac{2}{3}$ mm., number of segments 77–84.

Head tanylobous.

Setae at the ends of the body a little enlarged, in general ventrally very widely paired, dorsally separated or nearly so. At the middle part of the body $aa : ab : bc : cd = 24 : 13 : 18 : 17$. Towards the hinder end the width of the pairs enlarges still more; towards the 18 segment the width of the ventral pairs diminishes slowly but finally rather considerably. dd = ca. $\frac{2}{7}$ μ.

Nephridial pores in the lines of the setae *c*.

Clitellum ring-shaped, at the $13–\frac{1}{2}$ 17 segments ($= 4\frac{1}{2}$).

Prostate pores upon small papillae between the lines of the setae *a* and *b*, perhaps somewhat nearer to the latter.

Spermathecal pores in *b*.

Internal Anatomy. Septa 5/6 tender, 6/7–14/15 thickened, but even the thicker middle ones not considerably.

Alimentary tract: A small glittering gizzard in the 5 segment. No distinct calciferous glands.

Male organs: Two pairs of sperm-sacs in the 9 and 11 segments. Prostates restricted each to one segment or to two neighbouring ones; glandular part serpentine; duct short, strongly bent. Penial setae ca. 1·2 mm. long and proximally 30 μ thick, at the distal end about 18 μ thick, simply but strongly bent; distal part flattened and

broadened, ca. 40 μ broad, ending in a rounded and a little thickened edge, somewhat hollowed at one side. Distal part at the flat side occupied by irregularly scattered small triangular spinelets which are placed each at the proximal end of a small scar.

Spermathecae: Ampulla pear-shaped, duct about as long as the ampulla, thin, tubular. Into the distal end of the duct there opens at the fore-side a diverticulum, which has the shape of a forked tube; the diverticulum is strongly bent and closely applied to the duct of the ampulla.

Chilota knysnanus, n. sp.

1897. ? *Acanthodrilus sclateri*, part ?, Beddard in P. Zool. Soc., London, 1897, p. 342.

1897. ? *Chilota sclateri*, part ?, Michaelsen in Tierreich, x., p. 148.

Loc. Knysna forest (types of *Acanthodrilus sclateri* ?).

External Characters. Length 52 mm., thickness 1–1½ mm., number of segments 85.

Head epilobous (ca. $\frac{4}{7}$).

Setae of the dorsal pairs at the hinder end and at the middle segments of the anteclitellar part of the body much enlarged, considerably larger than the ventral setae of the same segments. Setae ventrally more or less widely paired, dorsally separated. At the middle part of the body $aa : ab : bc : cd = 3 : 2 : 3 : 3$; at the hinder end $aa : ab : bc : cd = 3 : 2 : 5 : 5$, at the 8 segment $aa : ab : bc : cd = 3 : 2 : 5 : 4$.

Nephridial pores in the lines of the setae *c*.

Prostate pores in *b*.

Seminal furrows somewhat bent, laterally convex, passing the 18 segment laterally from the setae *ab*.

Spermathecal pores in *b*.

Internal Anatomy. Alimentary tract: A very small gizzard in front of the male organs. No calciferous glands.

Male organs: Prostates small, irregularly coiled. Penial setae ca. 0·75 mm. long, and proximally ca. 25 μ thick, at the distal end 10 μ thick, strongly bent in the distal half, whip-like or like a cork-screw; distal end a little flattened, but not much; no ornamentation.

Spermathecae: Ampulla thickly pear-shaped; duct short, thinner distally than proximally. Into the proximal part of the duct open two thick and unstalked diverticula which have the appearance of sac-like protuberances of the duct. The diverticula are provided with a large number of very small seminal chambers which are not perfectly separated from the central lumen of the diverticulum.

Chilota parvus, n. sp.

Loc. Newlands slope of Table Mountain near Cape Town; Dr. F. Purcell, leg. Aug., 1886.

External Characters. Length 26–30 mm., thickness ca. 2 mm., number of segments 80–90.

Head indistinctly tanylobous.

Setae at the hinder end of the body somewhat enlarged, in general widely paired or separated. At the fore-end of the body $aa : ab : bc : cd : dd = 5 : 3 : 5 : 5 : 10$, $dd = \frac{1}{4}\ \mu$; at the hinder end $aa : ab : bc : cd : dd = 4 : 3 : 4 : 4 : 6$.

Clitellum at the 13–17 segments (= 5), ring-shaped.

Prostate pores between the lines of the setae *a* and *b*.

Spermathecal pores in *b*.

Internal Anatomy. Septum 4/5 complete; all septa tender, but 6/7–14/15 somewhat thicker than the others.

Alimentary tract: A small glittering gizzard in the 5 segment. No calciferous glands.

Male organs: Two pairs of sperm-sacs in the 9 and 11 segments. Prostates restricted to a single segment; glandular part serpentine, duct short and narrow. Penial setae about 0·6 mm. long, and proximally 18 μ thick, distally 15 μ thick, somewhat bent at the ends. Distal end flattened and broadened like a spatula, about 28 μ broad. Distal part with exception of this spatula occupied by numerous toothed transverse ridges which are placed at the crossing-points of two systems of spiral lines.

Spermathecae: Ampulla irregularly pear-shaped; duct thin, tubular, somewhat shorter than the ampulla. Into the distal end of the duct open at its fore-side by means of a common mouth two nearly globular unstalked diverticula which are separated from each other only imperfectly. The diverticula are provided with numerous very small seminal chambers which are only imperfectly separated from the central lumen of the diverticula.

[Acanthodrilus] sclateri, Bedd., spec. inquir. aut. spuria.

1897. *Acanthodrilus sclateri*, Beddard in P. Zool. Soc., London, 1897, p. 342.

1900. *Chilota sclateri*, Michaelsen in Tierreich, x., p. 148.

Loc. Knysna forest (types of *Acanthodrilus sclateri*).

Remarks. The bottle labelled by Beddard as *Acanthodrilus sclateri* contained, besides 3 fragments, 12 intact specimens out

of 19 specimens sent to Beddard. None of these 12 intact specimens can be regarded as the type of *A. sclateri* (spermathecae with two long tubular diverticula). These 12 specimens mostly belong to the species *Chilota excavatus* (Bedd.), whilst one proved to represent the new species *Chilota knysnanus* (see above); another specimen belongs to *Chilota lucifuga* (Bedd.), and the last one either to the same species, or to *Ch. photodilus* (Bedd.). The 3 fragments probably are *Ch. excavatus*. The real type of *Acanthodrilus sclateri*, if there existed a single type, perhaps has been totally dissected by Beddard, unless it forms a part of those specimens retained by him. I cannot help suspecting that *A. sclateri* is no real species at all, but that the diagnosis of it is composed out of the characters of different species, probably among them a *Microscolex* —or an *Eodrilus*—species; for in these genera the occurrence of "two long tubular diverticula" at the spermathecae is less rare than in the genus *Chilota*. *Acanthodrilus sclateri*, therefore, must be regarded as a "species inquirenda," if not as a "species spuria."

Family GLOSSOSCOLECIDAE.

Microchaetus peringueyi, n. sp.

Loc. Nieuwoudtville in the Bokkeveld Mountains, Calvinia Division.

External Characters. Length 330 mm., thickness 6–10 mm., number of segments ca. 445.

Head prolobous. 4–9 segments divided each into two segment-like ringlets.

Setae very tender, laterally beginning behind the clitellum, ventrally beginning apparently at the 9 segment. Setae very strictly paired. Behind the clitellum $aa : bc : dd = 4 : 6 : 8$; at the hinder end of the body $aa : bc : dd = 4 : 5 : 6$. Ventral setae of the clitellar region transformed to sexual setae, about 0·9–1·0 mm. long, and in the width 50–55 μ thick, bent like an "S," without nodule, roundly tri-carinated and simply pointed at the distal end, without ornamentation.

Nephridial pores considerably beneath the lines of the setae *c*, but much nearer to these than to the lines of the setae *b*.

Clitellum at the (12) 13–25 segments (= 13, if not = 14), apparently saddle-shaped. At each side a broad copulatory cushion extending

over the 17–20 segments. The ventral pairs of setae of the 25–27 segments placed upon transversely oval glandular papillae ; some of the ventral pairs of setae in the fore-part of the clitellar region on similar but more indistinct papillae.

Spermathecal pores in groups of 2 to 6 at each side of the intersegmental furrows 12/13–16/17, in the lines of the nephridial pores, and dorsally from them.

Internal Anatomy. Septa 4/5, 5/6, and 6/7 very strongly thickened, 7/8 and 8/9 moderately thickened, the following tender, and only 9/10 a little thicker than the very tender ones which follow it.

Alimentary tract : A large gizzard in the 7 segment. A large, nearly globular swelling of the oesophagus apparently restricted to the 10 segment represents the calciferous gland.

Male organs : Two pairs of spermiducal funnels in the 10 and 11 segments, each pair enclosed in an unpaired transverse seminal vesicle ; each of the latter is laterally continued into a spermsac-like appendix. Two pairs of sperm-sacs in the 11 and 12 segments communicate with these appendices of the seminal vesicles.

Spermathecae pear-shaped, shortly and narrowly stalked.

Glands of sexual setae 16 pairs in the 12–17 segments. The glands have the shape of a slightly bent thick sausage, opening through a narrow and rather short duct.

Microchaetus benhami, Rosa.

1891. *Microchaeta benhami*, Rosa in Ann. Hofmus. Wien, vi., p. 382, Taf. xiii., fig. 1.

1900. *Microchaetus benhami*, Michaelsen in Tierreich, x., p. 451.

Loc. Moddergat, near Lynedoch, in the Stellenbosch district ; L. Péringuey, Sept. 13, 1910.

Farm Bergvliet, near Constantia, S. of Cape Town ; Dr. F. Purcell, Aug., 1909.

Remarks. The locality in which the type of this species has been found was unknown. This is the first record of the native locality of this species.

Family LUMBRICIDAE.

Helodrilus (Eisenia) rosea, (Sav.).

1900. *Eisenia rosea*, Michaelsen in Tierreich, x., p. 478.

Loc. George ; Dr. F. Purcell.

Helodrilus (Bimastus) constrictus, (Rosa).

1900. *Helodrilus (Bimastus) constrictus*, Michaelsen in Tierreich, x., p. 503.

Loc. Table Mountain near Cape Town; Dr. F. Purcell.

The paper alluded to by Dr. Michaelsen on page 43 has been published in the Zoologischer Jahrbücher for June, 1913. The descriptions of the new species have thus precedence over those of the present issue.

All types of species herein described, save that of form *castaneus*, Mich. of *Chilota photodilus* (Bedd.), are, of course, in the S.A. Museum Collection.

L. P.

4.—*Note on the Occurrence of the Euplectellid Sponge* Regadrella phoenix *O. Schmidt, off the South African Coast.*—By R. Kirkpatrick.

(Plate I.)

[Printed by permission of the Trustees of the British Museum.]

Dr. L. Péringuey, Director of the South African Museum, has recently sent to the Natural History Museum, London, for identification, two portions of specimens and a photograph of a more complete example of the Euplectellid sponge *Regadrella phoenix* O. Schmidt, dredged from a depth of 250–320 fathoms off Cape Morgan, near East London, Cape Colony; bottom broken shells.

The original examples of the sponge, which were described by Oscar Schmidt in "Die Spongien des Meerbusen von Mexico," came from Barbados (221 and 228 fms.), and Sta Cruz (248 fms.). He called the genus "*Regadrella*" after the Spanish name for a watering-pot, and the species "*phoenix*," because he found young sponges growing on and within the basal part of old dead ones.

In *Regadrella* the strands of spicules which form the lattice-like skeleton of the tube run mainly in a longitudinal direction and somewhat irregularly. In *Euplectella*, on the other hand, the framework is formed of regularly arranged longitudinal and transverse and oblique strands.

In *Regadrella*, the spathulate ends of the secondary rays of the beautiful little floricorne spicules, are prolonged into several sharp claw-like spines.

A characteristic flesh-spicule of the present species is the onychaster, a hexaster with fine claw-like spines at the ends of the secondary rays.

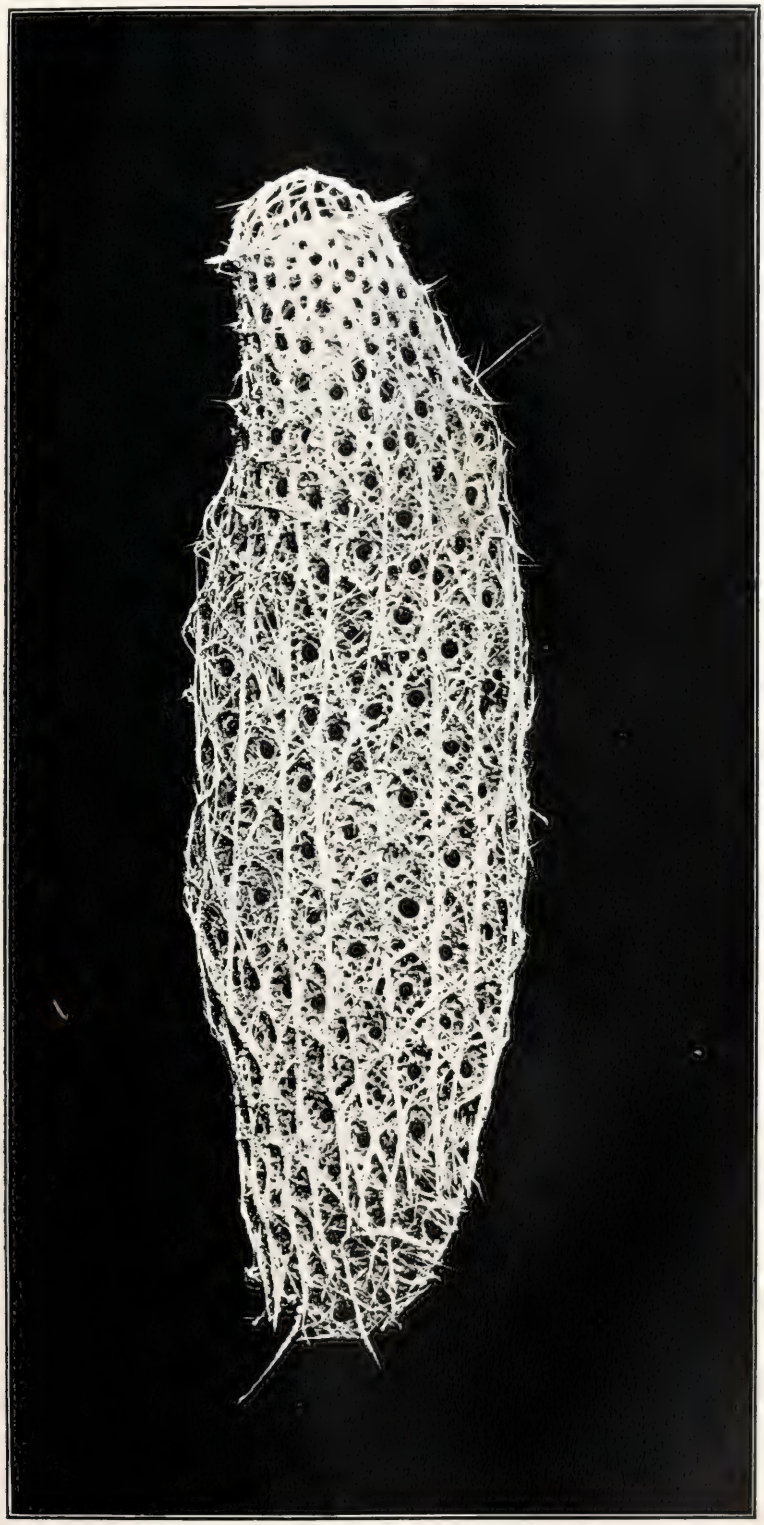
The well-marked sieve-plate is surrounded by a fringe of bristles formed by the distal rays of stout hexactins.

Specimens grow firmly fixed on rocks and stones, and do not form a root-tuft such as *Euplectella* possesses.

The base of the sponge is hard, and fixed on a firm foundation. Consequently, usually only the upper and softer portions of specimens are obtained.

The finding of *R. phoenix* off the south-eastern coast of South Africa is very interesting, for now there is a record of the occurrence of the species in the Atlantic, Indian Ocean, and Pacific, viz., from West Indies, Azores, Bay of Biscay, Atlantic Coast of Morocco (from 220–768 fms.), from Coast of Chile (1,754 fms.), Galapagos (393 fms.), and from off Cape Morgan (250–320 fms.).

According to F. E. Schulze there are only three well-marked species of *Regadrella*, viz., *R. phoenix* O. Schmidt, *R. okinoseana* Ijima, and *R. komeyamai* Ijima, the last two being found in Sagami Bay, Japan.



West. Newman.

REGADRELLA PHOENIX O. SCHMIDT
FROM CAPE MORGAN, S. AFRICA. × $\frac{6}{5}$.

5.—*Descriptions of Fishes from the Coast of Natal* (Part IV.*). —By J. D. F. Gilchrist, M.A., D.Sc., Ph.D., and W. Wardlaw Thompson, F.Z.S.

The following is a further contribution to the description of a collection of fishes from Natal.

Family PERCIDAE.

Gen. LUTIANUS, Bl.

Lutianus quinquelinearis, Bl.

Ausl. Fisch. iv. p. 84, 1785.

Teeth, a pair of moderate-sized canines on premaxillaries; an outer row of curved canine-like teeth on each jaw, those on the upper jaw being the largest; villiform teeth in Λ-form on vomer, a band on palatines. Depth of body $2\frac{1}{2}$ times in total length excluding caudal, length of head 3 times. Snout equals diameter of eye, which is $3\frac{3}{10}$ times in length of head, and $1\frac{1}{4}$ times interorbital width; maxillary reaches to vertical of anterior third of orbits, the distance of the eye from its upper edge being a little more than $\frac{1}{2}$ diameter of orbit; vertical limb of preoperculum strongly emarginate, finely serrated, the angle rounded and with stronger serrations, lower limb strongly serrated; a strong opercular knob, middle spine of operculum strong; scapula serrated.

Dorsal xi 14; spines moderately strong, increasing in length to 4th, which is nearly $\frac{1}{2}$ length of head, remainder decreasing to the last, which about equals diameter of eye; longest soft rays equal $\frac{1}{2}$ the length of base of fin. Pectorals nearly as long as head, reaching to anal. Ventrals $\frac{2}{3}$ length of head, reaching to vent. Anal iii 8; 2nd spine strongest and longest, about the same length as longest

* Parts I. and II. appeared in the Annals S. African Museum, vol. vi., and Part III. in vol. xi.

dorsal spine; longest soft rays equal length of base of fin; lower edge of fin rounded. Caudal emarginate. Scales in oblique rows above the lateral line, in horizontal rows below it; superiorly they extend forward to above anterior third of eye; suborbital ring scaled and one or two scales on preorbital. Lat. l. 56, lat. tr. $\frac{8}{15}$.

Colour (of preserved specimen), pale brown, slightly darker above than below, with a more or less circular dark patch on lateral line below the last dorsal spines and the anterior rays; 3 narrow bluish streaks or lines from eye to below dorsal fin, one from upper edge of operculum to base of posterior soft rays of dorsal, one below it along the body traversing margin of caudal peduncle, another from opercular spine to base of caudal passing along middle of caudal peduncle.

One specimen, 96 mm. in length, from Mr. Romer Robinson, Natal.

Gen. EPINEPHELUS, Bl.

Epinephelus praeopercularis, Blgr.

Proc. Zool. Soc. Lond. 1887, p. 654, 1887.

Teeth in narrow bands, in 2 series on the sides of the mandible; canines strong. Depth of body $2\frac{9}{10}$ times in total length excluding caudal, length of head $2\frac{3}{5}$ times. Snout $1\frac{3}{5}$ times diameter of eye, which is $5\frac{3}{5}$ times in length of head and equals interorbital width; lower jaw projecting; maxillary reaches scarcely to posterior margin of eye, the width of its distal extremity $\frac{4}{5}$ diameter of eye; vertical limb of preoperculum serrated, emarginate above the angle which is feebly produced and armed with strong spines; middle opercular spine nearer to lower than to upper, lower much further back than upper, opercular flap pointed; head nearly entirely covered with cycloid scales, maxillary naked. Gillrakers (removed in specimen).

Dorsal xi 15, originating above base of pectorals; 3rd spine longest, nearly $\frac{2}{3}$ length of head, last spine a little more than $\frac{1}{4}$ length of head; longest soft rays a little less than longest spine. Pectorals a little more than $\frac{1}{2}$ length of head. Ventrals a little more than $\frac{2}{5}$ length of head and not quite reaching anus. Anal iii 8; 2nd spine slightly longer and much stronger than 3rd, a little more than $\frac{3}{5}$ longest dorsal spine and much shorter than soft rays. Caudal truncate, $\frac{1}{2}$ length of head. Scales 125, ciliated. Lat. l. 68, lat. tr. $\frac{16}{54}$.

Colour (of preserved specimen), light greyish brown, darker above than below; sides with small dark spots sparsely scattered in irregular rows; 2 dark lines from lower and posterior margin of eye

passing downwards and backwards over preopercle to opercular margin.

One specimen, 358 mm. in length, from Mr. Romer Robinson, Natal.

EPINEPHELUS FLAVOCAERULEUS, Lacep.

Hist. nat. Poiss. iv. p. 367, 1802.

Var. *melanometopon*, Blkr.

Poll. & v. Dam. Faun. madag. iv. p. 17, 1874.

Teeth in narrow bands, in 2 series on the sides of the mandible, the inner row larger, a strong outer row on maxilla, inner teeth on symphysis of upper jaw long and sharp-pointed; canines small. Depth of body $2\frac{2}{5}$ times in total length excluding caudal, length of head $2\frac{4}{5}$ times. Snout $1\frac{3}{4}$ times diameter of eye, which is 6 times in length of head and $1\frac{2}{5}$ times in interorbital width; lower jaw projecting beyond upper, maxillary reaches to slightly beyond posterior margin of eye; preoperculum serrated on vertical limb, more coarsely so on its rounded angle which is feebly produced; middle spine of operculum nearer lower than upper, lower further back than upper, opercular flap pointed; gillrakers 18 on lower part of anterior arch; head nearly entirely covered with small cycloid scales, scales on posterior portion of maxilla.

Dorsal xi 16; spines moderately strong, 4th longest, $\frac{2}{5}$ length of head, remainder decreasing gradually to the last which is a little lower than adjoining ray. Pectorals $\frac{3}{5}$ length of head; ventrals a little shorter, not reaching anus. Anal iii 8; 2nd spine stronger but a little shorter than 3rd, which is a little more than $\frac{1}{4}$ length of head and $\frac{2}{3}$ longest soft rays. Caudal emarginate, $\frac{2}{3}$ length of head. Scales 130, those on body ctenoid, scales on chest and abdomen very small; 18 rows between lateral line and 6th dorsal spine. Lat. l. 65, lat. tr. $\frac{2}{6}\frac{2}{6}$.

Colour (of preserved specimen), dark brown; pectorals yellow; caudal yellow, with black tips to lobes; soft dorsal and anal yellow-tipped on posterior rays; ventrals dark on upper side, light with a dark tip on lower side.

One specimen, 282 mm. in length, from Mr. Romer Robinson, Natal.

EPINEPHELUS MACULATUS, Bl.

Ausl. Fisch. iv. p. 96, pl. 242, fig. 3, 1790.

Teeth in narrow bands, in 2 series on sides of mandible, canines strong. Depth of body $3\frac{1}{5}$ times in total length excluding caudal,

length of head 3 times. Snout $1\frac{1}{2}$ times diameter of eye, which is 6 times in length of head; interorbital width $6\frac{7}{10}$ times in length of head; nostrils close together; lower jaw projecting; maxillary reaches to a little beyond posterior border of eye, width of its distal extremity $\frac{4}{5}$ diameter of eye; vertical limb of preoperculum finely serrated, obtusely angulate, a little produced at angle which is armed with enlarged serrae; middle opercular spine nearer to lower than to upper, lower further back than upper, opercular flap obtusely pointed; head, including maxillary, nearly entirely covered with small cycloid scales; gillrakers (removed in specimen).

Dorsal xi 17, originates above pectoral; 4th spine longest, nearly $\frac{1}{2}$ length of head, $1\frac{3}{5}$ as long as last spine and $1\frac{1}{3}$ as long as longest soft rays. Pectorals $\frac{3}{5}$ length of head. Ventrals $\frac{1}{2}$ length of head, reaching to anus. Anal iii 8; 2nd spine slightly shorter but much stronger than 3rd, which is $\frac{3}{5}$ longest dorsal spine; soft rays $\frac{2}{5}$ length of head. Caudal subtruncate, nearly $\frac{3}{5}$ length of head. Scales 110, ciliated. Lat. l. 58 (circa), $\frac{1}{2}\frac{4}{1}$.

Colour (of preserved specimen), light brown; large dark spots in more or less longitudinal rows on body and on head, belly and isthmus without spots; pectoral fins with large dark spots in irregular lines, outer half whitish; dorsal and anal fins blackish.

One specimen, 358 mm. in length, from Mr. Romer Robinson, Natal.

Gen. DENTEX, Cuv.

Dentex rivulatus, Rüpp.

Neue Wirbelt. Fisch. p. 116, pl. 29, f. 2, 1837.

Teeth, canines strong, a series of conical teeth on the sides. Depth of body $2\frac{2}{5}$ times in total length excluding caudal, length of head $3\frac{1}{10}$ times. Snout $1\frac{1}{3}$ times diameter of eye, which is 3 times in length of head and $\frac{4}{5}$ interorbital width; maxillary reaches to anterior nostril; preorbital naked, its depth about equal to diameter of eye; 4 series of scales between preorbital and angle of preoperculum; hind limb of preopercle feebly emarginate, entire, with a few serrations at its rounded angle; opercle with a blunt inconspicuous spine.

Dorsal x 10; spines increasing in length to 3rd, which is $\frac{1}{3}$ length of head, the remainder decreasing in length; middle soft rays about $1\frac{1}{3}$ times as long as longest spine. Pectorals a little more than $\frac{4}{5}$

length of head, reaching to anal. Ventrals $\frac{3}{4}$ length of head, reaching a little beyond vent. Anal iii 10; 2nd spine stronger but shorter than 3rd, which is $\frac{1}{5}$ length of longest dorsal spine. Caudal forked. Lat. l. 47, lat. tr. $\frac{7}{17}$.

Colour (of preserved specimen), uniform grey, top of head darker and brown; a narrow curved brown band across base of pectorals and a faint one across nape; a dark brown spot on upper margin of each eye; one or two curving dark lines on preorbital.

One specimen, 294 mm. in length, from Mr. Romer Robinson, Natal.

Family SPARIDAE.

Gen. LETHRINUS, Cuv.

Lethrinus chrysostomus, Rich.

Voy. Erebus and Terror, Fishes, p. 118, pl. 60, figs. 6 and 7, 1846.

Teeth, 4 moderately strong canines on each jaw; the lateral teeth on each jaw pointed in front but more or less rounded posteriorly, especially those of the upper jaw, the last one being very molar-like. Depth of body $2\frac{2}{3}$ times in total length excluding caudal, length of head $2\frac{1}{5}$ times. Snout $2\frac{2}{3}$ times diameter of eye, which is $4\frac{3}{5}$ times in length of head and $1\frac{1}{3}$ times in interorbital width; cleft of mouth lateral, maxillary scarcely extends to vertical of anterior nostril and is concealed by preorbital, the height of the latter being twice the diameter of the eye; preoperculum entire, the angle rounded; operculum with 2 blunt inconspicuous spines; a slight protuberance before upper anterior angle of orbits.

Dorsal x 9; spines strong, increasing in length to 3rd or 4th, which is $\frac{1}{3}$ length of head; longest soft rays nearly $\frac{2}{5}$ length of head. Pectorals as long as head, anterior rays longest and reaching beyond origin of anal. Ventrals $\frac{2}{3}$ length of head, reaching to anal. Anal iii 8; 3rd spine longest, about $\frac{9}{10}$ longest spine of dorsal. Caudal emarginate, scaly on base. Lat. l. 47, lat. tr. $\frac{6}{17}$.

Colour (of preserved specimen), brown, silvery beneath; scales, especially on upper part of the body, with a black centre forming longitudinal streaks on the body; fins whitish.

One specimen, 336 mm. in length, from Mr. Romer Robinson, Natal.

Gen. CYPHOSUS, Lacep.

Cyphosus cinerascens, Forsk.

Descr. Anim., No. 66, p. 53, 1775.

Teeth, a single row of flat cutting teeth, their horizontal portion longer than their vertical; minute rounded teeth on vomer and palatines. Depth of body $2\frac{3}{10}$ times in total length excluding caudal, length of head $4\frac{1}{10}$ times. Snout $1\frac{3}{10}$ times diameter of eye, which is $3\frac{1}{5}$ times in length of head and $1\frac{1}{2}$ times in interorbital width; maxillary reaches to vertical of anterior margin of eye; preoperculum feebly serrated at angle, which is rounded; body oblong, compressed, a slight swelling in front of orbits; snout obtuse.

Dorsal xi 14; spines flexible, increasing in length to 5th, which is $\frac{1}{3}$ length of head and about same length as longest soft ray. Pectorals $\frac{3}{5}$ length of head and about same length as ventrals. Anal iii 13; 3rd spine longest, a little more than $\frac{1}{2}$ length of longest dorsal spine and $\frac{1}{2}$ as long as longest soft ray of anal; both anal and soft dorsal are covered with small scales. Caudal forked. Lat. l. 64, lat. tr. $\frac{10}{19}$; 17 scales between lateral line and ventral, 10 between lateral line and 6th spine of dorsal.

Colour (of preserved specimen), light olive-brown, darker above than below; a dark line between each row of scales; fins darkish; a light band below eye.

One specimen, 228 mm. in length, from Mr. Romer Robinson, Natal.

Family TRACHINIDAE.

Gen. LATILUS, C. & V.

Latilus doliatus, C. & V.

Hist. Nat. Poiss. v. p. 371, 1830.

Teeth, a series of sharp-pointed teeth, with 4 canines at symphysis and a posterior canine on each side of upper jaw, and 2 posterior canines on each side of lower jaw. Depth of body $3\frac{3}{5}$ times in total length excluding caudal, length of head 4 times. Snout as long as eye, which is prominent, placed high in the head, and is $2\frac{3}{4}$ times in length of head; interorbital width $\frac{7}{8}$ diameter of eye. Profile of head flat on top, rounded before orbits and descend-

ing abruptly to end of snout; a ridge on nape from above centre of orbits to origin of dorsal; preorbital depth $\frac{2}{3}$ diameter of eye; preoperculum finely serrated on its vertical limb and on the rounded angle; cleft of mouth slightly oblique, maxillary reaches to vertical of anterior margin of eye.

Dorsal vi 16; commences above base of pectorals, spinous portion lower than soft; posterior soft rays longest, $\frac{2}{3}$ length of head, the 14th ray prolonged and nearly $1\frac{1}{4}$ times as high as adjacent rays. Pectorals falcate, reaching to anal, the 6th ray longest and as long as head. Ventrals $\frac{1}{2}$ as long as head, not reaching to vent. Anal ii 12; rays increasing in length to the penultimate, which is about $\frac{3}{5}$ length of head. Caudal emarginate, a little more than $\frac{3}{4}$ length of head. Scales ciliated, extending over opercles and cheeks, and on top of head as far as the centre of the orbits. Lat. l. 102, lat. tr. $\frac{8}{29}$.

Colour (of preserved specimen), reddish; 15 dark brown bands across upper part of body; a black opercular spot.

One specimen, 198 mm. in length, procured by the Cape Government trawler *P. Faure* (s.) off the Natal coast, in 50 fms.; Tugela River mouth, N. $19\frac{1}{2}$ miles.

Family BATRACHIDAE.

Gen. BATRACHUS, Klein.

Batrachus apiatus, C. & V.

Hist. Nat. Poiss. xii. p. 477, 1837.

Teeth in 3 rows on each jaw anteriorly, a single series laterally, the teeth on mandibles largest and directed a little inwards; an irregular double row on vomer, a single series on palatines. Depth of body $5\frac{1}{4}$ times in total length excluding caudal, length of head $3\frac{3}{10}$ times. Longitudinal diameter of eye $4\frac{3}{10}$ times in length of head, and equal to snout, which is broad, depressed, and surmounted by short tentacles which are most distinct along the mandibles; vertical diameter of eye $5\frac{2}{3}$ times in length of head and equal to the width of the bony ridge between the orbits, maxillary reaches to vertical of posterior margin of eye, lower jaw projects; no tentacles above the orbits; 4 backwardly directed spines on gill-covers, situated 2 on the operculum and 2 on sub-operculum; anterior nostril with a tubular flap ending in a bunch of filaments; head with loose folds of skin on nape.

Dorsal iii 20; 1st dorsal triangular, middle spine $\frac{1}{5}$ length of head; soft dorsal higher than spinous, longest rays about $\frac{1}{2}$ length of head. Pectorals $\frac{2}{3}$ length of head, reaching to anal; no foramen in the axil. Ventrals $\frac{2}{3}$ length of head. Anal 14. Caudal truncate. A series of pores along the body, with a slight vertical fold of skin on each.

Colour (of preserved specimen), yellowish, dotted with faint dark spots and with 3 or 4 faint dark cross-bands; tips of dorsal and anal rays brown; pectorals spotted with brown in irregular cross bands.

One specimen, 142 mm. in length, procured by the Cape Government trawler *P. Faure* (s.) off the Natal coast, in 54 fms.; Port Natal, W. by N. $6\frac{1}{2}$ miles.

Batrachus diemensis, Lesueur.

Journ. Acad. Nat. Sc. Philad. iii. p. 402, 1823.

Teeth in 3 rows anteriorly on each jaw, a single series laterally; a band on vomer and palatines. Depth of body 4 times in total length excluding caudal, length of head $2\frac{3}{4}$ times; head broad, its width nearly equalling its length. Longitudinal diameter of eye 3 times in length of head, vertical diameter $3\frac{2}{5}$ times length of head and $1\frac{1}{3}$ times as long as snout; width of bony ridge between the the eyes narrow, $8\frac{1}{5}$ times in length of head; maxillary reaches to vertical of middle of eyes, lower jaw projects; no tentacles above the orbits; gill-covers with 4 spines, 2 of which belong to the operculum and 2 to the sub-operculum; anterior nostrils with a bunch of filaments on each; no tentacles on snout, which is short, obtuse, and its upper border parabolic; a row of large open pores along lower edge of mandibles, on preorbital, across opercles, and round orbits.

Dorsal iii 20; 1st dorsal triangular, middle spine nearly $\frac{1}{4}$ length of head. Pectorals $\frac{3}{4}$ length of head, reaching to anal, no foramen in the axil. Ventrals with outer ray much longer than inner, tapering, $\frac{4}{5}$ length of head. Anal 16. Caudal truncate. Loose folds of skin on head and cheeks, and on the body, especially along base of anal fin.

Colour (of preserved specimen), brown; spinous dorsal dark, with a dark patch on anterior soft rays; pectorals covered with minute dark spots forming irregular bars.

One specimen, 45 mm. in length, procured by the Cape Government trawler *P. Faure* (s.) off the Natal coast, in 50 fms.; Umhlangakulu River, NW. by N. $7\frac{1}{2}$ miles.

Family PEDICULATI.

Gen. LOPHIUS, L.

Lophius upsicephalus, Smith.

Illustr. Zool. S. Afr. p. 9, pl. 9, 1849.

Teeth arranged in 2 alternate series; a minute patch on vomer, with a strong tooth on each side; a single series of strong, slightly recurved teeth on palatines. Head disproportionately large, depressed, broad and flat. Depth of body $2\frac{1}{4}$ times in total length excluding caudal, length of head $1\frac{7}{10}$ times; width of head nearly $\frac{9}{10}$ its length. Snout $1\frac{1}{5}$ times as long as eye, which is $6\frac{3}{5}$ times in length of head and about equals the interorbital width; lower jaw projects beyond upper, cleft of mouth wide and reaches to vertical of anterior margin of eye, upper lip fringed with a row of cirri, lower lip with a fringe of branched filaments; 4 strong spines on preorbital, 2 on each side of symphysis of jaw; orbital ridge with coarse serrations, with a strong spine behind posterior upper angle of each orbit; a short, strong, upright spine on preoperculum; a strong humeral spine with 3 points; a spine on top of head on each side.

Dorsal iii + iii 8; the first 3 spines distinct and situated on the head; the 1st consists of a simple filament, $\frac{3}{10}$ length of head, terminating in a few cirri and a long simple flap, and is inserted just behind the lip; the 2nd spine rises close behind it and is longer, nearly $\frac{2}{5}$ length of head, with a row of soft spines on its anterior margin, and with short stalks or filaments branching off the main stem; the 3rd spine is about the same height as the 1st and is inserted midway between the posterior margin of dorsal fin and 2nd spine, which latter it resembles, but the branches are fewer and less developed; the 4th spine is a little more than $\frac{2}{5}$ length of head, originates in line with base of humeral spine, and is a little apart from but connected by a low membrane with the remaining 2 spines. Pectorals $\frac{1}{4}$ length of head, the carpal bones being much produced form a sort of arm to the fin. Ventrals about same length as pectorals. Anal 6; posterior rays longest and about $\frac{1}{5}$ length of head. Caudal truncate, nearly $\frac{1}{2}$ length of head.

Colour (of preserved specimen), light yellowish brown, with a few small dark spots; membrane of the 3 posterior spines of dorsal blackish.

One specimen, 77 mm. in length, procured by the Cape Government trawler *P. Faure* (s.) off the Natal coast, in 54 fms.; Cape Natal, W. by N. $6\frac{1}{2}$ miles.

Family COTTIDAE.

Gen. HOPLICHTHYS, Günth.

Hoplichthys langsdorfi, C. & V.

Hist. Nat. Poiss. iv. p. 264, pl. 81, 1829.

Teeth, a narrow band of minute villiform teeth on each jaw and on vomer and palatines. Depth of body $3\frac{1}{3}$ to $3\frac{3}{4}$ times in total length excluding caudal, length of head 3 to $3\frac{1}{3}$ times; width of head between base of preopercular spines $3\frac{1}{2}$ to 4 times. Head greatly flattened; snout wide, produced, and rounded anteriorly, 3 to $3\frac{2}{5}$ times in length of head; diameter of eye 4 to $4\frac{3}{10}$ times in length of head; interorbital space very narrow, deeply channelled; mouth inferior, the lower jaw shorter than upper, everywhere included; maxillary reaches to vertical of anterior margin of eye. Lateral profile of head formed by a sharp dentigerous ridge divided into 4 lobes, in each of which the posterior spine is longest and strongest; preoperculum strongly produced at the angle where it terminates in a strong sharp spine, vertical margin marked by a double ridge with strong serrations; opercle with 2 strong ridges radiating from its upper angle, each armed with strong serrations and ending in a strong opercular spine; a strong humeral spine; orbital ridge strongly and coarsely serrated; occiput with a sharp spine pointing backwards, and with a cluster of 3 smaller spines anteriorly on each side of nape.

Dorsal vi 15; 1st dorsal longest anteriorly, its 1st spine strongest and about $\frac{1}{4}$ length of head; 2nd dorsal higher than the 1st and with the rays slightly filamentous. Pectorals 13 + 3; with 3 simple rays almost free but joined to each other and to the rest of the fin by a very low membrane at the extreme base; upper rays filamentous, $\frac{2}{3}$ length of head. Ventrals a little more than $\frac{2}{5}$ length of head, inserted in advance of pectorals. Anal 17; similar to soft dorsal. Body naked with the exception of a single series of large lateral plates, 27 in number, which extend over the greater part of the back and sides from occiput to caudal; each plate is armed at its inner angle with a strong backward-pointing spine, with 2 much smaller ones below it.

Colour (of preserved specimens), light yellowish brown; a black ocellus on membrane of 1st dorsal from 2nd to 4th spines; 2 dark patches crossing the back through posterior extremity of soft dorsal; ends of pectoral rays dark; caudal with 2 or 3 faint dark bars.

Three specimens, 56 mm., 109 mm., 143 mm. in length respectively, procured by the Cape Government trawler *P. Faure* (s.) off the coast of Natal, in 63 fms.; Tugela River mouth N. 22 miles.

Gen. LEPIDOTRIGLA, Günth.

Lepidotrigla faurei, n. sp.

Teeth in narrow villiform bands on jaws and vomer. Depth of body 4 to $4\frac{1}{10}$ times in total length excluding caudal, length of head $3\frac{1}{10}$ to $3\frac{1}{5}$ times. Snout slightly elongate, feebly concave, $1\frac{1}{3}$ to $1\frac{1}{2}$ times diameter of eye, which is $3\frac{1}{2}$ to $3\frac{3}{5}$ times in length of head and $1\frac{2}{5}$ times interorbital width; space between orbits concave, superciliary ridges strong, with 2 small spines at supero-anterior angle of orbit and with a deep groove behind each orbit; preorbital projecting feebly beyond snout, with 2 strong spines on each side anteriorly; preoperculum striated and granulated, angle feebly produced and jagged but without distinct spines; operculum striated, with a strong spine; a strong humeral spine; suprascapula with serrated upper margin and a ridge ending in a strong spine; maxillary reaches vertical of anterior margin of eye.

Dorsal viii 16, the first 3 or first 2 spines serrated anteriorly; 3rd spine longest, $\frac{7}{10}$ length of head and equal to the distance between point of snout and posterior margin of eye. Pectorals 11 + 3, 1 to $1\frac{1}{8}$ times length of head and reaching to vertical from 5th or 6th anal ray. Ventrals $\frac{4}{5}$ length of head. Anal 16, situated below soft dorsal, of equal length but lower. Caudal deeply emarginate, $\frac{2}{3}$ to $\frac{4}{5}$ length of head. Scales of moderate size, with spines on their free margin. Twenty-three spines along base of dorsal fin. Lat. l. 60–61, with radiating tubes but without armature. Lat. tr. $\frac{3-3\frac{1}{2}}{13}$.

Colour (of preserved specimens), uniform pale yellow, or grey with a green tinge on head and spinous dorsal; pectorals dark underneath, with or without diagonal rows of dark ocelli near base.

Three specimens, procured by the Cape Government trawler *P. Faure* (s.) off Natal coast; 1 of 120 mm. in length, in 40 fms., Tugela River mouth N. by W. $\frac{3}{4}$ W. $15\frac{1}{2}$ miles; 2 of 120 mm. and 146 mm. in length respectively, Tugela River mouth N. 22 miles, in 63 fms.

LEPIDOTRIGLA NATALENSIS, n. sp.

Teeth in villiform bands on jaws and vomer. Depth of body $5\frac{1}{10}$ times in total length excluding caudal, length of head $3\frac{1}{4}$ times. Snout elongate, upper profile straight, $1\frac{1}{2}$ times diameter of eye, which is $3\frac{2}{3}$ times in length of head and $1\frac{1}{3}$ times interorbital width; space between orbits concave, superciliary ridges strong with 2 inconspicuous spines at supero-anterior angle of orbits and with a short deep groove behind each orbit; preorbital flattened, truncated anteriorly and armed with a row of strong spines on the margin; preoperculum radiated and striated, with a small flat inconspicuous spine at the angle; operculum radiated and striated, with a strong spine; a strong humeral ridge ending in a spine; suprascapula serrated on its upper margin, with a prominent ridge ending in a strong spine, and with a short detached ridge between it and the orbit; maxillary reaches to vertical of anterior margin of eye.

Dorsal ix 17, first 3 spines serrated anteriorly; 3rd spine longest, $\frac{3}{5}$ length of head and equal to the distance between point of snout and posterior margin of eye. Pectorals 11 + 3, $1\frac{1}{10}$ times length of head, reaching to vertical from 5th anal ray. Ventrals $\frac{4}{5}$ length of head. Anal 15, situated below soft dorsal, of equal length but lower. Caudal emarginate, $\frac{7}{10}$ length of head. Scales cycloid, large. Twenty-four prominent spines along base of dorsal fin. Lat. l. 58, with radiating tubes but no armature, the scales larger than on rest of the body. Lat. tr. $\frac{3\frac{1}{2}}{13}$.

Colour (of preserved specimen), uniform grey; pectorals dark underneath.

One specimen, 130 mm. in length, procured by the Cape Government trawler *P. Faure* (s.) off the Natal coast, in 40 fms.; Tugela River mouth N. by W. $\frac{1}{2}$ W. 16 miles.

GEN. TRIGLA, L.

TRIGLA NATALENSIS, n. sp.

Teeth in villiform bands on jaws and vomer. Depth of body $5\frac{1}{2}$ times in total length excluding caudal, length of head $3\frac{1}{2}$ times. Snout elongate, slightly concave, $1\frac{3}{5}$ times diameter of eye, which is $3\frac{1}{2}$ times in length of head and nearly twice the interorbital width, the space between the orbits concave; preorbital obtuse anteriorly, granulated and striated, with a ridge across to the preopercular angle which ends in a short spine; opercular spine feeble; a strong

humeral spine; suprascapula with a strong granular ridge ending in a blunt spine and with a small detached ridge between it and the orbit; 2 strong spines on supero-anterior angle of orbits; maxillary reaches scarcely to vertical of anterior margin of eye.

Dorsal ix 15; first 3 spines tubercular; 2nd spine longest, a little more than $\frac{1}{2}$ length of head and equal to the distance between anterior nostril and posterior margin of eye. Pectorals 10 + 3, a little longer than head, reaching to vertical from the 5th ray of anal. Ventrals a little more than $\frac{3}{4}$ head, reaching to anal. Anal 15, situated below soft dorsal and of same length, but not so high. Caudal emarginate, $\frac{4}{5}$ length of head. Scales very small, cycloid. Twenty-five spines along base of dorsal fin. Lat. l. 65. (The lateral line on the right side of this specimen bifurcates about the middle of the caudal peduncle, one branch passing upwards and backwards to the median line of the back at the caudal.)

Colour (of preserved specimen), pale greyish brown, slightly darker above than below, head with a reddish tinge; pectorals dark brown underneath on the upper portion and pale yellow on the lower, with a few small ocellated spots; caudal and ventrals yellowish, dorsal whitish.

One specimen, 204 mm. in length, procured by the Cape Government trawler *P. Faure* (s.) off the Natal coast, in 48 fms.; Cape Natal W. by N. $6\frac{1}{2}$ miles.

Trigla capensis, C. & V.

Hist. Nat. Poiss. iv. p. 53, 1829.

Teeth in villiform bands on jaws and vomer. Depth of body 5 to $5\frac{2}{5}$ times in total length excluding caudal, length of head $3\frac{3}{10}$ to $3\frac{1}{2}$ times. Snout elongate, upper profile straight, about twice diameter of eye, which is 4 times in length of head and $1\frac{2}{3}$ to $1\frac{4}{5}$ times interorbital width, the space between the orbits concave; preorbital produced anteriorly and ending in about 4 prominent points or spines, with a keel along the lower margin extending across preoperculum to the angle where it ends in 2 spines, one at the angle and a shorter diverging one just below it, many radiations branch upwards from a point about midway along this keel or ridge; operculum with a sharp strong spine; suprascapula with a strong spine and with a short detached ridge between it and the orbit; 2 spines on supero-anterior angle of orbits; maxillary reaching to vertical of anterior margin of eye.

Dorsal ix 16; 1st spine smooth or slightly granular; 2nd spine

longest, $\frac{1}{2}$ to $\frac{3}{5}$ length of head and slightly more than the distance between anterior nostril and angle of preoperculum. Pectorals 11+3, 1 to $1\frac{3}{10}$ length of head, reaching to the vertical from 6th or 7th ray of dorsal. Ventrals $\frac{3}{4}$ to $\frac{4}{5}$ length of head. Anal 16, similar to soft dorsal. Caudal emarginate or slightly forked, $\frac{7}{10}$ to $\frac{3}{4}$ length of head. Scales very small, cycloid. Twenty-four to 25 spines along the base of dorsal fin. Lat. l. 70–74, without armature.

Colour (of preserved specimens), greyish, darker above than below; pectorals blackish, with a few oval spots on the lower half. The smallest specimen was of a uniform light green, the fins—except the pectorals—being of a darker green; the pectorals were blackish with a few white spots.

One specimen, 104 mm. in length, from Durban, Natal.

Three specimens, procured by the Cape Government trawler *P. Faure* (s.); 1 of 234 mm. in length, from Inner Harbour, Durban; 1 of 238 mm. in length, caught in 40 fms., Tugela River mouth N. by W.$\frac{1}{2}$ W., 16 miles; 1 of 254 mm. in length, caught in 46 fms., Tugela River mouth N. by W., 18 miles.

Trigla peroni, C. & V.

Hist. Nat. Poiss. iv. p. 53, 1829.

Teeth in narrow villiform bands on jaws and vomer. Depth of body 5 times in total length excluding caudal, length of head $3\frac{1}{5}$ times. Snout elongate, upper profile nearly straight, $1\frac{1}{5}$ times diameter of eye, which is $3\frac{2}{3}$ times in length of head and nearly twice interorbital width; space between the orbits concave; preorbital strongly striated and produced anteriorly into 2 broad plates slightly projecting beyond snout, each with about 4 obtuse points and some fine serrations, a keel or ridge extends along the lower margin across preopercle to the angle of the latter where it is toothed or roughened and ends in a sharp spine with a smaller diverging spine below it; opercle with a sharp spine; a strong sharp humeral spine; suprascapula with a strong spine; orbital ridge strongly marked, with 2 strong spines at supero-anterior angle of eye, the posterior angle bluntly produced and crenellated; maxillary reaches to vertical of anterior margin of eye.

Dorsal ix 16; 1st spine smooth, about the same length as 2nd, which is $\frac{1}{2}$ length of head and equals the distance between anterior nostril and angle of preoperculum. Pectorals 11+3; $1\frac{1}{4}$ times length of head and reaching to vertical from 7th ray of dorsal. Ventrals about as long as head, reaching to anal. Anal 16, similar

to soft dorsal. Caudal truncate, $\frac{3}{4}$ length of head. Scales small, cycloid. A series of 24 spines along each side of base of dorsal fins. Lat. l. 65, without armature.

Colour (of preserved specimen), light or pale reddish brown, with a few small dark specks on body; pectorals black, with indistinct whitish spots; ventrals and tip of spinous dorsal blackish; distal extremity of caudal blackish.

One specimen, 74 mm. in length, from Mr. Romer Robinson, Natal.

Family SCOMBRIDÆ.

Gen. ECHENEIS, L.

Echeneis naucrates, L.

Syst. Nat. 10th ed., p. 261, 1758.

Teeth, mandible pointed and covered superiorly with rows of villiform teeth directed backwards and forming a more or less triangular toothed space in advance of the upper jaw, which latter is pointed; a similar band of villiform teeth in upper jaw; a band on vomer and palatines; a curved row on tongue. Depth of body $11\frac{3}{5}$ times in total length excluding caudal, breadth of body between pectorals $8\frac{1}{4}$ times; length of head, with disk nearly $3\frac{3}{5}$ times, without disk $5\frac{1}{5}$ times; width of head nearly $\frac{1}{2}$ its length. Eyes transversely oval, directed obliquely outwards and downwards, distance apart superiorly $3\frac{1}{2}$ diameters from end of snout, inferiorly $3\frac{2}{3}$ diameters; 9 times in length of head with disk. Lower jaw longer than upper, maxillary reaches to vertical of 3rd lamina of disk.

Dorsal xxiii 37; 1st dorsal forming an elliptical disk rather broader posteriorly than anteriorly, its greatest width nearly $\frac{2}{5}$ its length, which is nearly 4 times in total length excluding caudal; 23 transverse laminae, each with a toothed posterior margin, the teeth being in 3 rows, a smooth elevation dividing the disk along the central line; the anterior laminae are directed slightly forwards, the succeeding ones nearly transverse, the posterior directed slightly backwards; external to the disk is a moderately wide fleshy membrane, which posteriorly extends to the distal half of the pectorals and anteriorly does not quite reach point of snout. The 2nd dorsal is situated opposite the anal, commencing midway

between point of snout and base of caudal; highest anteriorly, about $\frac{2}{5}$ length of disk. Pectorals $\frac{2}{3}$ length of disk, situated behind head in line with 19th lamina of disk. Ventrals $\frac{3}{5}$ length of disk, equal to the distance between point of snout and posterior margin of eye. Anal 37; similar to soft dorsal but higher anteriorly, Caudal with emarginations, nearly $\frac{3}{5}$ length of disk.

Colour (of preserved specimen), uniform reddish brown; external margin of caudal and anterior tips of dorsal and anal edged with white; pectorals deep brown; centre of caudal nearly black.

One specimen, 348 mm. in length, from Durban Museum.

Family GOBIIDÆ.

Gen. GOBIUS, L.

Gobius obscurus, Peters.

Wiegm. Arch. 1855, p. 250.

Teeth small, villiform, outer row slightly enlarged; no canines. Depth of body 5 times in total length excluding caudal, length of head $3\frac{1}{2}$ to $3\frac{2}{3}$ times; height of head $\frac{3}{4}$ its breadth, which is contained $1\frac{1}{10}$ to $1\frac{1}{8}$ times in its length. Snout slightly convex, $1\frac{1}{7}$ to $1\frac{3}{5}$ times diameter of eye, which occupies the 2nd quarter of length of head, is 1 to $1\frac{3}{4}$ times interorbital width and 3 times in length of head; cleft of mouth slightly oblique, maxillary reaches to below anterior margin of eye and does not ascend to the level of the eye; lips thick, the upper slightly overhanging lower.

Dorsal vi, i 8–9; 2nd spine of 1st dorsal longest, nearly $\frac{1}{3}$ to $\frac{1}{2}$ length of head; soft rays longest posteriorly, $1\frac{1}{6}$ to $1\frac{1}{4}$ height of longest spine. Pectorals $\frac{4}{5}$ length of head, reaching to anus, the upper rays silk-like. Ventrals about same length as pectorals. Anal i 8; similar to soft dorsal but not quite as high. Caudal wedge-shaped, $\frac{4}{5}$ length of head Scales feebly ctenoid, extending on to crown of head; 16 anterior to 1st dorsal, 14 between origin of 2nd dorsal and anal. Lat. l. 38.

Colour (of preserved specimens), pale brown, with dark spots on body; dorsal, anal and caudal with small dark spots; a dark spot at upper angle of axil of pectorals.

Two specimens, 44 mm. 80 mm. in length respectively, from Mr. Romer Robinson, Natal.

GOBIUS MALABARICUS, Day.

Proc. Zool. Lond. 1865, p. 27; Fishes Malab. p. 111, pl. 7, fig. 2, 1865.

Teeth in a villiform band, the outer row enlarged and strong; no canines. Depth of body nearly 5 times in total length excluding caudal, length of head $3\frac{1}{2}$ times; height of head about $\frac{9}{10}$ its width, which is contained $1\frac{1}{4}$ times in its length. Snout slightly longer than the eye, which is $4\frac{2}{3}$ times in length of head and $1\frac{1}{2}$ times interorbital width; cleft of mouth oblique, lower jaw longer than upper, maxillary extends to below middle of eye. Head naked, 2 rows of pores or warts on each side of lower jaw and many rows on cheeks.

Dorsal vi, i 10; 2nd and 3rd spines of 1st dorsal highest, nearly $\frac{1}{2}$ length of head, and about same height as posterior rays of 2nd dorsal, which is lower anteriorly, the rays gradually increasing in length. Pectorals $\frac{1}{5}$ length of head, scarcely reaching anal. Ventrals $\frac{3}{5}$ length of head, not reaching vent. Anal i 10; similar to soft dorsal but lower. Caudal rounded, $5\frac{3}{10}$ times in total length. Lat. l. 50. Sixteen rows of scales between bases of 2nd dorsal and anal fins, 10 rows anterior to 1st dorsal fin.

Colour (of preserved specimen), brown, with dark irregular spots on body and head; dorsals with a light band running along lower third of each fin, with a row of dark spots above and below it; pectorals with a dark curved band on upper half and a dark crescentic band with a white upper border on lower part of fin stretching across base of first 7 or 8 rays.

One specimen, 73 mm. in length, from Mr. Romer Robinson, Natal.

GEN. PERIOPTHALMUS, Bl. Schn.

PERIOPHTHALMUS KOELREUTERI (Pall.).

Spic. Zool. viii. p. 8, pl. 2, fig. 1, 1769.

Teeth strong, conical, pointed. Depth of body 5 to 6 times in total length excluding caudal, length of head 4 to $4\frac{1}{4}$ times; width of head $\frac{3}{4}$ to $\frac{4}{5}$ its length. Snout $1\frac{1}{5}$ to $1\frac{1}{4}$ times as long as eye, profile very abrupt, the skin forming fleshy flaps; eyes very prominent, situated on upper margin of head, diameter 4 times in length of head and twice the interorbital width, outer eyelid well developed; cleft of mouth almost horizontal, upper lip slightly over-

hangs lower, maxillary extends to below vertical of anterior third of eye.

Dorsal xvi–xvii 11–12; anterior rays of 1st dorsal longest and about $\frac{2}{3}$ length of head; 2nd dorsal not as high as 1st. Pectorals $\frac{2}{3}$ length of head, with a long, scaly, muscular base. Ventrals very small, almost entirely separated from each other. Anal 12. Caudal with its lower edge obliquely truncated. Scales 75–80.

Colour (of preserved specimens), greyish or bluish brown; lower half of dorsal fins with numerous white spots, above them on the 1st dorsal is a dark band or patch—deeper on anterior rays—near to and parallel with the whitish margin of the fin; on the 2nd dorsal the band is narrow, brown, and edged with white above and below; anal fin whitish. Two of the specimens have indistinct brown cross-bars, and many silvery specks on body.

Two specimens, 66 mm. 78 mm. in length respectively, from Mr. Romer Robinson, Natal.

Two specimens, 66 mm. 72 mm. in length respectively, from Durban Bay.

Gen. TRYPAUCHEN, C. & V.

Trypauchen vagina (Bl. & Schn.).

Syst. Ichth. p. 73, No. 20, 1801.

Teeth, an outer row of rather distantly placed, moderately long, conical, feebly curved teeth on either jaw, behind which is a single series of small teeth on the upper jaw and 2 rows on the lower. Depth of body 8 to $8\frac{1}{5}$ times in total length excluding caudal, length of head $6\frac{1}{7}$ to $6\frac{3}{5}$ times. Body elongated, compressed; occipital crest elevated; width of head $\frac{2}{3}$ to $\frac{7}{10}$ its length, height slightly more than its length behind the eyes. Snout $3\frac{3}{4}$ to $3\frac{4}{5}$ times in length of head and 3 times diameter of eye, which is very small and situated in anterior fourth of head; interorbital width $1\frac{1}{2}$ times diameter of eye; cleft of mouth oblique, lower jaw longer than upper, maxillary reaches to vertical of anterior margin of eye.

Dorsal vi 43–46; commences a little behind pectorals, spines and rays about $\frac{1}{4}$ length of head, posterior rays filamentous. Pectorals $\frac{3}{10}$ length of head, the lower 5 rays short and unbranched. Ventrals a little longer than pectorals. Anal 44–46, similar to soft dorsal. Caudal pointed. Dorsal and anal fins confluent with caudal. Scales 70, cycloid, striated, in rather irregular rows, lightest at their edge and sometimes depressed in their centre.

Colour (of preserved specimens), uniform flesh-colour; fins whitish.

Two specimens, 83 mm. 114 mm. in length respectively, procured by the Cape Government trawler *P. Faure* (s.) in 12–14 fms., off South Head of Tugela River, Natal.

Family MUGILIDAE.

Gen. MYXUS, Günth.

Myxus barnardi, n. sp.

Teeth fine, villiform, in a single series on each jaw, those of the upper jaw overlapping those of the lower; a narrow cross band on vomer. Depth of body $3\frac{3}{4}$ times in total length excluding caudal, length of head 3 times. Snout as long as diameter of eye, moderately depressed, its upper profile ascending in the same curve in which the lower descends; eye with an adipose lid more strongly developed anteriorly than posteriorly, diameter of eye $4\frac{3}{5}$ times in length of head and $1\frac{2}{5}$ times in interorbital width, which is slightly convex; preorbital serrated inferiorly and posteriorly; nostrils as far apart as they are distant from the eye and snout respectively; cleft of mouth $\frac{3}{4}$ as deep as broad, slightly oblique, upper lip overlapping lower which is sharp-edged; maxillary scarcely reaching vertical of anterior margin of eye, concealed; mandibles meet at an obtuse angle, notched at symphysis; uncovered space below the chin lanceolate.

Dorsal iv, i 8, commences midway between front edge of eye and base of caudal; 1st spine of anterior dorsal longest and strongest, about $\frac{1}{2}$ length of head; base of 2nd dorsal $\frac{3}{5}$ its height, which about equals that of longest spine of 1st dorsal. Pectorals inserted above middle of depth of body and reaching to vertical of origin of 1st dorsal fin, $\frac{3}{5}$ length of head. Ventrals inserted in vertical of midway between base of pectorals and origin of dorsal fin. Anal iii 8; having its anterior half situated before origin of 1st dorsal, 3rd spine $\frac{3}{5}$ length of longest spine of dorsal. Depth of free portion of tail $3\frac{1}{5}$ times in length of head. Lat. l. 41, lat. tr. 15; 23 rows of scales between snout and origin of 1st dorsal fin; the 11th and 23rd scales of the lateral line correspond to the origin of the 1st and 2nd dorsal fins; no enlarged axillary scale; vertical fins not scaly.

Colour (of preserved specimen), silvery, dark above; scales with

dark streaks on centre, forming indistinct longitudinal lines on the body; top of head and snout covered with minute dark brown specks.

One specimen, 47 in length, from Durban Bay; K. H. Barnard.

Family CHIASMODONTIDAE.

Gen. CHAMPSODON, Günth.

Champsodon capensis, Regan.

Trans. Linn. Soc. Lond. Zool. xii. p. 244, 1908.

Fine, curved, villiform teeth on each jaw; a patch on vomer, some of the teeth on each side anteriorly being enlarged; tongue strongly toothed. Depth of body $5\frac{2}{5}$ to 6 times in total length excluding caudal, length of head $3\frac{1}{5}$ to 4 times; depth of head about $\frac{2}{3}$ its length. Snout $3\frac{1}{2}$ to 4 times in length of head, distance from tip of snout to end of maxillary about $\frac{2}{3}$ length of head; eye $4\frac{1}{2}$ to 5 times in length of head, situated in a notch of the upper profile, with one or two filaments on the eyeball at its superior posterior angle, least distance between eye and maxillary much less than diameter of eye; interorbital width about $\frac{7}{10}$ diameter of eye, feebly concave, with 2 rows of pores down the centre; cleft of mouth exceedingly wide, about $\frac{2}{3}$ length of head and extending beyond posterior margin of eye, lower jaw projecting and bent upwards; praemaxillaries with a double notch anteriorly; preoperculum with a few fine serrations on vertical limb, angle armed with a strong lanceolate spine curving upwards; opercular margin very thin, fringed and striated; preorbital with 2 sharp diverging spines on anterior margin; a ridge from snout passing along upper margin of each orbit and across nape to suprascapula, where it ends in a small spine; one or two detached ridges on head behind eye.

Dorsal v 18–20; spines of 1st dorsal feeble, slightly filamentous, highest anteriorly and about $\frac{2}{5}$ to $\frac{1}{2}$ length of head; soft dorsal higher than spinous, rays slightly filamentous. Pectorals small, $\frac{2}{5}$ length of head. Ventrals $\frac{4}{5}$ length of head, reaching to vent, 3rd and 4th branched rays longest and considerably higher than the 1st. Anal 17, similar to soft dorsal. Caudal truncate, about $\frac{4}{5}$ length of head. Scales small, strongly toothed on their posterior margin; covering

the whole body, head, maxillary, cheeks, and opercles; 2 lateral lines marked by rows of pores and both provided with 24 vertical branches, also marked by a row of pores and passing over the back.

Colour (of preserved specimens), light brown, darker above than below; a dark patch on base of caudal.

Three specimens, 76 mm. 70 mm. 64 mm. in length respectively, procured by the Cape Government trawler *P. Faure* (s.) off the Natal coast; the two larger in 46 fms., Tugela River mouth N. by W. 18 miles, the smallest in 54 fms., Cape Natal W. by N. 6½ miles.

Family CENTRISCIDAE.

Gen. CENTRISCUS, L.

Centriscus humerosus, Rich.

Voy. Erebus and Terror, Fishes, p. 56, pl. 34, figs. 5 and 6, 1846.

(Trumpet-fish, Bellows-fish.)

Height of the body contained 1⅓ times in the distance of the operculum from the base of the caudal fin, the length of the head is slightly less than its distance from the caudal. Head elevated posteriorly, compressed into a ridge above and produced anteriorly into a long compressed tube terminating in a small mouth; cleft of mouth oblique, extremity of lower jaw prominent, maxillary broad and triangular. Eye large, equals length of postocular part of head, the skin which covers the iris is provided with small ctenoid scales except on anterior portion; margin of orbit smooth; interorbital space smooth, slightly convex, nearly ⅗ diameter of eye in width; nostrils close together, situated one before the other at a short distance from the orbit; preoperculum with its posterior margin descending obliquely forward, partly confluent with orbit, and indistinctly denticulated or roughened, the angle strongly produced backwards. The scales advance very far on the rostral tube. The body is strongly compressed and much elevated, its greatest depth is above the ventrals; the upper profile makes a slight bulge on the nape, behind which is a patch of bristles, and then ascends gradually to dorsal fin, descending abruptly from 2nd spine to the free portion of the tail; lower profile of body semicircular between throat and end of anal fin.

Dorsal vii 14; 1st spine minute, its distance from caudal fin $\frac{4}{5}$ its distance from occiput; 2nd spine very strong, compressed, striated, grooved along posterior margin and movable, its length equals $\frac{1}{3}$ distance of opercle from caudal, and the spine points obliquely upwards and backwards; the remaining spines are short and their connecting membrane strong. Soft dorsal higher than long, its distance from caudal equals $\frac{3}{4}$ the length of its base; anterior rays highest. Pectorals with a short oblique base, inserted about the middle of the depth of the body and extending almost to end of ventrals. Ventral fins small, close together and received into a common groove on the belly. Anal 17; commences immediately behind vent in the vertical from the posterior spines of dorsal and extends as far back as posterior margin of soft dorsal, but is much lower. Caudal truncate, composed of 9 undivided rays, the others on the upper and lower side of its base being rudimentary. Body covered with small rough scales, each of which ends in a weak spine posteriorly; 2 series of bony plates on the sides of the back, each of 4 plates which have a centre with vertical and horizontal stripes radiating from it; the lower series commences in the scapulary region, the upper runs in a parallel line above it. Margin of thorax cuirassed with 3 similar plates, the belly with a single series; edge of thorax and belly sharp.

Colour (of preserved specimen), yellowish brown, slightly darker above than below.

One specimen, 197 mm. in length, from Durban Museum.

Family LABRIDAE.

Gen. PLATYGLOSSUS, Klein.

Platyglossus robinsoni, n. sp.

Teeth, a posterior canine, 4 strong canines at symphysis of each jaw, slightly curved and directed a little outwards. Depth of body $3\frac{3}{5}$ times in total length excluding caudal, length of head 4 times. Snout $2\frac{5}{6}$ times in length of head and $1\frac{7}{10}$ times diameter of eye, which is nearly 5 times in length of head and about $1\frac{1}{4}$ times in interorbital width; jaws about equal; maxillary reaches to vertical of anterior nostril.

Dorsal ix 13; spines weak, slightly increasing in length to the last which is a little more than $\frac{2}{5}$ length of head; soft rays gradually

increasing in length from the last spine, the longest ray being $\frac{3}{5}$ length of head. Pectorals nearly $\frac{3}{4}$ length of head. Ventrals a little more than $\frac{4}{5}$ length of head. Anal iii 12, similar to soft dorsal; 3rd spine longest, $\frac{3}{5}$ length of longest spine of dorsal. Caudal with the outer lobes slightly produced, the posterior margin of fin enclosed between them being rounded in the middle. Lat. l. 27, lat. tr. $\frac{2}{8}$; tubes of lateral line strongly marked and radiate. Scales comparatively large, cycloid; 2 rows of scales on the cheeks, the rest of the head naked.

Colour (of preserved specimen), uniform yellowish brown; dorsal fin with a black oval spot at the base of the membrane between 1st and 2nd spines, and with a dark basal band, the upper edge of which is emarginate and edged with a narrow pale yellow border, a similar but narrower band occurs on the upper third of the fin, the distal margin of the fin is whitish, and there is a row of 8 or 9 small ocellated olive spots near the extremity of the posterior soft rays; anal with 2 longitudinal bands similar to those on the dorsal fin; caudal with curved transverse bands and reticulations; 2 dark streaks from eye to mouth on each side, a dark streak across chin from one corner of the mouth to the other, 2 or 3 irregular dark streaks on the cheeks; 2 more or less indistinct dark streaks from the preoperculum to the caudal, the upper one following the dorsal curve; scales dark in the centre.

One specimen, 133 mm. in length, from Mr. Romer Robinson, Natal.

Family GADIDAE.

Gen. BREGMACEROS, Thomps.

Bregmaceros macclellandi, Thomps.

Charlesw. Mag. Nat. Hist. iv. p. 184, fig., 1840.

Teeth minute on both jaws, a few on vomer. Depth of body 7 times in total length excluding caudal, length of head about 6 times. Body fusiform, compressed posteriorly; snout equals interorbital width, 4 times in length of head; eye $3\frac{1}{2}$ times in length of head; upper jaw slightly the longer, extending to behind vertical of centre of eye.

Dorsal i, 16+ x +15; 1st dorsal rises on the occiput in the form of a single slender ray, which is slightly longer than the head and

filamentous; 2nd dorsal commences in the middle third of the total length and is highest in front, the 4th ray longest and about the length of the head, each ray is unbranched but articulated and slender, the membranes deeply notched, the last 10 rays are very short and slender, almost like a distinct fin, the posterior rays are lengthened and extend nearly to the base of the caudal. The dorsal and anal rays can be laid backwards in a groove formed by the scales along the base of these fins. Pectorals $\frac{7}{10}$ length of head. Ventrals arise under the throat; 6 rays, the outer 3 being compressed and elongated, $3\frac{1}{2}$ times in length of head and reaching to about 21st ray of anal. Anal $22+x+20$; similar to 2nd dorsal. The vent is situated at the end of the anterior third of the total length. Scales cycloid, small. Lat. l. 64, lat. tr. $\frac{6}{8}$.

Colour (of preserved specimen), silvery, back brownish, sides faint greenish yellow; minutely dotted with brown.

One specimen, 59 mm. in length, procured by the Cape Government trawler *P. Faure* (s.) 11 miles off Cape Natal; depth 185 fms.

Family OPHIDIIDAE.

Gen. SELACHOPHIDIUM, Gilchr.

Selachophidium guentheri, Gilchr.

Mar. Inv. S. Afric. ii. 1903, p. 209, pl. 17.

Teeth in a villiform band on each jaw, and on vomer and palatines. Depth of body $6\frac{3}{4}$ times in total length excluding caudal, length of head $5\frac{2}{5}$ times. Longitudinal diameter of eye $2\frac{2}{3}$ times in length of head; vertical diameter of eye $4\frac{7}{10}$ times in length of head, scarcely shorter than length of snout and slightly longer than interorbital width; head conical, slightly depressed in front of the eyes; snout wedge-shaped, blunt and projecting beyond mouth; maxillary reaches to vertical of posterior third of eye, dilated posteriorly; glandular tissue on preoperculum, with one large pore; a sharp spine on operculum; mouth large, inferior, horizontal; gillrakers 15 on lower part of anterior arch, those next the angle long, the last 7 mere knobs. Inside of mouth and gill-chambers black.

Dorsal 115; commence a little behind pectorals, about equal in height throughout, rays about $\frac{1}{3}$ length of head. Pectorals

$\frac{7}{10}$ length of head. Ventrals situated behind posterior edge of preoperculum, consisting of a single ray about $\frac{1}{2}$ the length of the head. Anal 88; commences immediately behind vent, which is situated well in front of the middle of the body. The dorsal and anal fins are confluent; there are thin scales on anterior part of dorsal, reaching to about $\frac{1}{2}$ its height. Lateral line slightly curved, runs parallel with upper margin of body, well marked anteriorly but only to be traced with difficulty to the caudal; about 12 series of scales between lateral line and base of middle of dorsal fin.

Colour (of preserved specimen), uniform light reddish brown; caudal and posterior extremity of dorsal and anal fins black-edged.

One specimen, 216 mm. in length, procured by the Cape Government trawler *P. Faure* (s.) in 440 fms. off the Natal coast; Cape Natal, N. by E. 24 miles.

Gen. NEOBYTHITES, Goode & Bean.

Neobythites macrops, Günth.

Challenger Reports, xxii. p. 102, pl. 20, fig. A, 1887.

Teeth in villiform bands; vomerine teeth in a chevron-shaped band, palatine teeth in a long band which tapers posteriorly and in the middle is slightly wider than the maxillary band. Depth of body $5\frac{3}{4}$ times in total length, length of head 5 times. Eye rather large, its longitudinal diameter $4\frac{1}{7}$ times in length of head and equal to length of snout, its vertical diameter $5\frac{3}{5}$ times in length of head and slightly less than the interorbital width; interocular space flat and scaly; head oblong, as deep as broad, the obtusely rounded snout overlapping the lower jaw; maxillary reaches to vertical of posterior margin of eye; preoperculum armed with 2 short spines, one at the angle and the other a little above it, both pointing backwards; operculum with a strong finely pointed spine; mouth large, inferior, horizontal; upper part of head covered with small scales nearly to extremity of snout, small scales on skin between rami of mandibles. Gillrakers, 15 on lower part of anterior arch, those at the angle very long and the remainder decreasing in length until the last 6 exist as mere knobs.

Dorsal 100 (circa), commences behind root of pectorals; rays about equal in length throughout, $\frac{1}{3}$ length of head. Pectorals $\frac{7}{10}$ length of head. Ventrals bifid, the inner filament being the

higher and $\frac{1}{2}$ length of head; inserted nearly opposite to angle of preoperculum, somewhat distant from each other and not reaching as far back as the pectorals do. Anal 85; commences immediately behind vent, which is situated well in front of the middle of the body. Dorsal and anal fins confluent with caudal. Thin scales on anterior part of dorsal fin, reaching to about $\frac{1}{2}$ its height. Lateral line slightly curved, runs parallel to upper margin of body, very indistinctly marked posteriorly; about 8 or 9 scales in transverse series between it and base of 1st ray of dorsal fin.

Colour (of preserved specimen), light yellowish brown, speckled; anal, caudal and posterior extremity of dorsal fin black-edged.

One specimen, 184 mm. in length, procured by the Cape Government trawler *P. Faure* (s.) off Natal coast, in 440 fms.; Cape Natal, N. by E. 24 miles.

Family SYNGNATHIDAE.

Gen. SYNGNATHUS, Art.

Syngnathus zanzibarensis, Günth.

Fishes Zanzibar, p. 140, pl. 20, fig. 5. 1887.

Depth of body slightly greater than its breadth. Length of head nearly 11 times in total length; distance from snout to vent about $\frac{1}{2}$ the distance between the vent and caudal; snout $5\frac{3}{5}$ times as long as eye, which is 10 times in length of head and slightly less than interorbital width; interocular space concave; operculum swollen, finely radiated; occiput and nape with a median ridge.

Dorsal with 26 rays, which are slightly less than depth of body; base of fin elevated and stands on 6 rings; length of base equals length of snout from centre of eye. Pectorals $\frac{1}{10}$ length of head. Anal minute and situated immediately behind vent, which is placed below the middle of the dorsal fin. Caudal minute. Osseous rings 22, 63. Trunk rather deeper than broad, with a slight swelling in the middle; osseous shields without spines; tail tetrahedral, tapering but not terminating in a point, width of upper surface slightly less than that of lower and the former feebly and the latter distinctly concave.

Colour (of preserved specimen), brown, with a few darker spots on sides and snout.

One specimen, 270 mm. in length, procured by the Cape Government trawler *P. Faure* (s.) 2½ miles off Umhlanga River, on the Natal coast; depth 22 fms.

Family SCLERODERMI.

Gen. OSTRACION, L.

Ostracion cornutus, L.

Syst. Nat., 10th ed., p. 331, 1758.

Carapace 4-ridged, forming a broad bridge across the back of the tail; a long conical spine above each orbit, directed forwards; each ventral ridge terminates posteriorly in a similar spine pointing backwards; each dorsal ridge with a slight prominence, which is not developed into a spine, in the middle of its length; median line of the back slightly raised in the middle but not forming a spine; interorbital space very concave; profile of snout high and concave; 10 teeth on each jaw, conical and rather weak; eye ½ length of snout and 2⅔ times in distance from snout to gill-opening. Nine scutes from gill-opening to tail, 5–6 transversely, 7 across ventral surface. Depth of body ¾ its greatest width.

Dorsal 9; situated wholly in advance of anal; highest anteriorly, nearly 5 times in total length excluding caudal. Pectorals ¾ length of head. Anal 9; similar to dorsal but slightly lower. Caudal truncated, ⅖ length of body. Surface of scutes granulated and striated, but without prickles or spines.

Colour (of preserved specimen), light brown on back, yellowish on sides and belly.

One specimen, 73 mm. in length, from Natal; Dr. Gilchrist.

Ostracion diaphanus, Bl. Schn.

Syst. Ichth., p. 501, 1801.

Carapace 4-ridged, the bridge across back of tail formed by 4 transverse series of scutes; a pair of short conical spines above the orbit, feebly divergent and pointing forwards; a short curved spine in the middle of the back, with a shorter spine on each dorsal ridge opposite to it; ventral ridge terminating posteriorly in a short strong spine

and with 2 smaller spines on the side, one below the dorsal fin and the other below the spine on the dorsal ridge; interorbital space very concave; profile of snout high and slightly concave; 10 teeth on upper jaw, 8 on lower; eye nearly $\frac{1}{2}$ length of snout and 3 times in distance between point of snout and gill-opening. Ten scutes between gill-opening and tail, 6 transversely, 10 across ventral surface. Depth of body slightly less than its greatest width.

Dorsal 9; situated wholly in advance of anal, highest anteriorly, $5\frac{3}{5}$ times in length of body. Pectorals $\frac{7}{10}$ length of head. Anal 9; similar to dorsal but slightly lower. Caudal truncate, slightly longer than head and $\frac{3}{10}$ length of body. Surface of scutes granulated but without prickles or spines.

Colour (of preserved specimen), dark bluish above, reddish yellow on belly.

One specimen, 84 mm. in length, from Natal; Dr. Gilchrist.

Ostracion concatenatus, Bl.

Ausl. Fisch, pl. 131, 1785.

Carapace 3-ridged, forming a broad continuous bridge across the back of the tail. Dorsal ridge with 2 compressed spines placed close together; each ventral ridge with 4 compressed spines, 2 of which are near each other and in the vertical of the dorsal spines, the others being one at each extremity of the ventral ridge; supra-orbital edge with 2 sharp spines pointing backwards and outwards, (All these spines become less prominent with age, and only traces of them can be discovered in adult examples (8–10 inches), Günther.) Interorbital space feebly concave; profile of snout high and concave; eye $\frac{2}{3}$ length of snout and $2\frac{1}{4}$ times in distance between point of snout and gill-opening; 8 scutes from gill-opening to tail, 8 transversely, 10 across ventral surface. Depth of body about equals its width.

Dorsal 9, situated in advance of anal; highest anteriorly, $4\frac{1}{2}$ times in total length excluding caudal. Pectorals more than $\frac{1}{2}$ length of head. Anal 10, similar to dorsal and situated immediately behind anus. Caudal truncated, $\frac{1}{4}$ length of body. Surface of scutes striated, but without prickles or spines.

Colour (of preserved specimen), uniform whitish.

One specimen (immature), 17 mm. in length, procured by the Cape Government trawler *P. Faure* (s.) in 20 fms., off Natal coast; False Bluff, N.E., $4\frac{3}{4}$ miles.

Family GYMNODONTES.

Gen. TETRODON, L.

Tetrodon immaculatus, Bl. Schn.

Syst. Ichth., p. 507, 1801.

Teeth equal on both jaws. Length of head nearly equals its distance from dorsal fin and is $2\frac{3}{4}$ times in the total length excluding caudal. Eyes comparatively small, situated high up and about midway between gill-opening and end of snout, and $3\frac{3}{5}$ times in length of snout, which is slightly more than $\frac{1}{2}$ length of head; interorbital space flat, its width slightly less than length of snout, the osseous part about 3 times diameter of eye in width; 2 solid nasal papillae on each side of an impervious nasal fossa.

Dorsal 11; situated in posterior third of distance from snout to base of caudal fin, length of base of fin equals $\frac{1}{2}$ its height, anterior rays longest and $\frac{1}{2}$ length of head. Pectorals 18; a little more than $\frac{1}{3}$ length of head. Anal 11; situated midway between posterior margin of dorsal fin and base of caudal, of similar shape to dorsal fin but smaller. Caudal truncated, $\frac{1}{4}$ length of body. Spines cover the whole body except the snout and the caudal peduncle, strongest and most numerous on the belly.

Colour (of preserved specimen), olive-brown on back, shading to light brown on sides, belly white; pectorals straw-colour, situated in the middle of a large round black spot which also extends on to their base and covers the gill-openings; anus in a black ring.

One specimen, 310 mm. in length, from Mr. Romer Robinson, Natal.

INDEX.

6.—*Two New Species of* Marginella *from South Africa.*—By Lewis J. Shackleford.

Marginella kerochuta, n. sp.

Shell four to five whorls, fusiformly ovate, considerably recurved at the base, pure white, very shining, no markings or sculpturing. Spire obtusely conical, whorls somewhat tumid. Suture somewhat slightly impressed. There is a callus which extends from the shoulder up the whorls of the spire, giving the appearance of a slight varix. Aperture long and narrow. The columella has four oblique plaits, the two at the base being slightly grooved. The outer lip is

bent back at the shoulder and at the base, and is feebly denticulated within. Margin rounded and broader at the shoulder and base than in the centre.

Long. 13 mm.; max. diam. 7 mm.

Hab.—Cape Point (S. Africa), NE. $\frac{1}{4}$ N., 18 miles, 135 fathoms, 2 specimens, s.s. *Pieter Faure.*

A pretty volute-like shell of the contour of *zeyheri*, Kr., and *laevigata*, Braz., but much larger than either. The specific name is derived from the appearance of the shell, which looks as though it had been moulded of white wax (κηρος and χεω).

MARGINELLA BROCKTONI, n. sp.

Shell five whorls, oblong ovate, pale maize colour, somewhat diaphanous, highly polished with margin, base, and suture of a pale fulvous brown. Spire exserted, obtusely conical. Suture but moderately impressed. Whorls slightly convex. Columella with three very oblique plaits. Aperture long and narrow, but broadening at base. Outer lip curved back at the shoulder and the base, slightly margined, smooth within. There is the indication of a callus at the shoulder. Base somewhat recurved.

Long. 17 mm. ; max. diam. 8 mm.

Hab.—Cape Point (S. Africa), N. 50° E., 18½ miles, 180 fathoms, 2 specimens, s.s. *Pieter Faure.*

This species, except for the plicæ, has some likeness to *biplicata*, Kr., but is double the size of that species. It has also some resemblance to *succinea*, Conrad. The specific name is chosen out of respect for Mr. J. R. le Brockton Tomlin, whose researches on the genus are well known.

The type specimens of both species are in the S.A. Museum (Nos. A1954 and A1956 respectively).

7.—*Notes on South African Mollusca.*—By M. Connolly.

I.—Some South African *Tiarinae.*

In explanation of the above title, I would point out that, as the "Museum Boltenianum," 1798, is now accepted as valid in questions of nomenclature, Bolten's Genus *Tiara* * must take precedence of *Melania*, Lamarck, 1799.†

Bolten placed in *Thiara* five species:

The first is *Helix amarula*, Linné.

The second, which he named *cancellata*, appears to be identical with *setosa*, Swainson, ‡ in which case Bolten's name has priority.

The other three names are nude.

As *amarula*, Linné, was selected by Lamarck as the Type of *Melania*, and is the only species included by him when founding his Genus, it is obvious that *Melania* becomes a synonym for *Tiara* s.s., and is not even entitled to sub-generic rank.

The Subfamily *Melaniinae* therefore becomes *Tiarinae*, and, if the group of shells formerly classed as *Melaniidae* be considered worthy to rank as a distinct Family, *Melaniidae* gives place to *Tiaridae*.

I say *if*, because Bouvier § has shown that the nervous system and other portions of the anatomy in such species as *costata*, Q. & G., *amarula*, Lin., and *tuberculata*, Müll., present almost exactly the same relations as in *Cerithium vulgatum*, Brug., and Moore,‖ in his article on the Family *Melaniidae*, transfers this whole group to the *Cerithiidae*, as constituting simply the freshwater contingent of that Family. It seems doubtful, however, whether the generality of conchologists will concur in uniting two groups, one

* Mus. Boltenianum, Hamburg, 1798, part ii. p. 109 (as *Thiara*).
† Mém. Soc. Hist. Nat. Paris, 1799, p. 75.
‡ Quart. Journ. Sci. Lit. Arts, 1824, xvii. p. 13.
§ Ann. Sci. Nat. Paris, 1887, iii. pp. 125, 127, 153–156.
‖ Proc. Mal. Soc., 1899, iii. p. 230.

marine and the other freshwater, which have so long been kept separate, and if the distinction is to be preserved, the name *Tiaridae* must be introduced.

With regard to the spelling, Bolten took his name *Thiara* from the French *thiare*, but the classical version, both in Greek and Latin, is *Tiara*, and as this has been adopted by H. & A. Adams* and Geoffrey Nevill,† among other authorities, the omission of the letter "h" is no innovation on my part.

Melania amarula (Lin.) was included in my "Revised Ref. List of South African non-marine Mollusca" on the strength of shells from Izezela and Umkomaas, which had been identified with that species.

I had not seen the examples in question, but, through the kindness of Mr. H. C. Burnup, have now been privileged to examine specimens from the Amanzintoti River, which he assures me are conspecific with those previously mentioned.

They are far smaller than typical *amarula*, and the spikes of the tiara are much less pronounced. I hardly think it possible to class them as *amarula*, Lin., and that species should therefore be removed from the South African list.

It is now necessary to find a name for these Natal shells.

They are unquestionably identical with the *Melania coacta* (Meusch.) ‡ of von Martens,§ recorded in 1897 from several parts of Zanzibar and the East Coast of Africa, and already included in the South African list, as it was found by Junod in Lorenzo Marques.

Even if Meuschen's species could be fully recognized, however, his name cannot stand, as the "Mus. Geversianum," in which he published it, has been ruled inadmissible from a binomial standpoint.

Brot || and Mörch ¶ have, on various occasions, associated *coacta*, Meusch., with *M. thiarella*, Lam.,** but there seems to be no actual proof of their identity, and *thiarella*, which was described from "Les grandes Indes," seems to be quite distinct from the East African species.

I think it may hence be concluded that (i) the name *coacta*, of Meuschen, being published in an inadmissible work, is void, and available for re-employment if desired; (ii) that it had not been

* Gen. rec. Moll., i. 1854, p. 294.
† Hand List, ii. 1884, p. 278.
‡ Museum Geversianum, 1787, p. 294 (as *Strombus coactus*).
§ Deutsch-Ost-Afr., 1897, p. 197. Pl. VI, f. 36.
|| Conch. Cab., 1877, p. 291.
¶ J. de C., 1872, xx. p. 319.
** Hist. nat. An. s. Vert., viii. p. 432.

re-employed in such a manner as to invalidate it from future use, prior to 1897; (iii) that the African species of *Tiara*, now under consideration, had not been described or named until the year just mentioned; that von Martens established the name *coacta* by adopting it for a definite species; and that, as Meuschen is inadmissible and his idea of *coacta* open to doubt, the present species must be known by the name of *Tiara coacta* (von Martens).

Before quitting the subject it may be advisable to deal with Bolten's second species, *Tiara cancellata*.*

He gave this name to the large, broad-based, flat-spired variety, listed by Gmelin† as *H. amarula*, var. *β*, and badly, though recognizably, figured by Chemnitz,‡ which now passes as *setosa*, Swainson.

In 1824 Swainson described§ under this name an immature shell from Mauritius, which forthwith became the subject of a heated controversy between himself and Gray.‖ This ended by Gray proving, at least to his own satisfaction, that *setosa* was the species figured by Chemnitz, a view subsequently adopted by Brot.¶

Judging from Swainson's original figure and locality, it appears doubtful whether his *setosa* does not represent the young state of *amarula*, rather than the species which now passes under Swainson's name, but, even if Gray's application of it is correct, Bolten's *Tiara cancellata* has priority by twenty-six years, so that it must obviously be adopted for the species in question.

Postscript.—Since the foregoing Note was written, Suter has adopted the family name *Thiaridae* in his work on New Zealand Mollusca.** For reasons already given it seems desirable to modify the spelling, but in any case the authorship of the name must be attributed to him

* Mus. Boltenianum, Hamburg, 1798, part ii. p. 109.
† Syst. Nat. Ed. 13, 1790, i. 6, p. 3656, No. 126β.
‡ Conch. Cab., 1786, ix. p. 159. Pl. CXXXIV, f. 1220, 1221.
§ Quart. Journ. Sci. Lit. Arts, 1824, xvii. p. 13.
‖ Zool. Journ., 1824–5, i. pp. 253, 399, 523.
¶ Conch. Cab., 1877, p. 297.
** Man. N.Z. Moll., 1913, pp. xviii, 235.

II.—The Genus *Marinula*, King, *with Diagnosis of an undescribed Species.*

Little notice has been taken of this genus for over thirty years, while much that was written by earlier authors is erroneous. I therefore hope that the following notes, made during the elucidation of the species hereinafter described, may be of use to future students of *Auriculidae*.

The genus *Marinula* was founded by King in July, 1832 (not 1835, the date usually quoted), to receive a new species from the Island of Chiloe, off the extreme south coast of Chili, which he named *Marinula pepita*.

His diagnoses of the genus and genotype are :—

"MARINULA. Nov. Genus.

T. ovato-producta, sub-solida; apertura ovata, integra; columella bidentata, et basin versus uniplicata; dentibus magnis sub-remotis conniventibus, superiore maximo; operculum nullum.

Marinula pepita.

M. t. ovato-producta, viridi-fuscâ; anfractibus sub-tumidis; spira brevi; ap. nigricante; dentibus plicâque albidis; long. $\frac{7}{16}$; lat. $\frac{4}{16}$ poll.

Hab. ad ins. Chiloe. Mus. Brit. nost. Brod. G. Sowerby." *

Several writers have attributed to King the statement that the animal differs from that of *Pedipes* in its foot not being transversely divided, but there is no mention of this in his published writings.

No difficulty should ever have arisen over King's genus or species. He mentions that there is a typical set in the British Museum, and it is there to this day, agreeing well with his description and labelled "Chiloe; Captain P. P. King, R.N.," but, instead of *pepita*, the name on the front of the tablet is *nigra*, Phil.

The explanation of this mistake is as follows :—

In the Cuming collection are three tablets; on one is the Type set of *Auricula recluziana*, Petit, from Colombia, labelled in Pfeiffer's writing "*pepita*, King"; on each of the others is a set of, apparently, a smaller form of the same species, but one is labelled *pepita*, King (Hab. Chile), and the other, *acuta*, Orb. (no Hab. given). These shells are neither *pepita* nor *acuta*; in fact, they do not belong

* Zool. Journ., 1832, v. pp. 343, 344.

to *Marinula* at all; but it was on two of these sets that writers of the mid-Victorian period based their idea of King's genus. In the Cuming collection also are two sets of the true *pepita*, labelled respectively, "*M. marinella*, King, Chili" (an apparent misspelling of the Generic name), and "*Marinula nigra*, Phil. *var.*, Chiloe." Now, in 1844, Küster described and figured as *Auricula pepita* a shell from Chili, similar to those wrongly labelled *pepita* in the Cuming collection; and also described *Auricula nigra*, Philippi from Chiloe, afterwards substituting the name *A. marinella*, King, which he thought had priority.

The figure is very bad, but the description is that of the true *pepita*, which came from the same locality as the *M. nigra* and *marinella* published by Küster; and the substitution of the latter name is obviously due to the above-mentioned misspelt label.

Although Gray more than once* mentioned *Marinula*, the first authors to make prominent use of it were H. & A. Adams, who, in 1854† included in the genus;—*pepita*, King (=*triplicatus*, Anton); *patula*, Lowe; *marinella* (=*nigra*); *callaoënsis*, Petit (nomen nudum); *recluziana*, Petit; *cymbaeformis*, Récluz (also nomen nudum); *punctata*, Bivona (=*villosa*, Fér. and *firminii*, Payr.); *aequalis*, Lowe (cum var. *gracilis*, Lowe), and a new species, *xanthostoma*, from Moreton Bay.

In 1855‡ they practically repeated the foregoing list, but founded a new subgenus *Monica*, to contain *aequalis*, Lowe (Type), *firminii* and *gracilis*.

These three species appear to have no connection with typical *Marinula*, but I hardly see how they can be considered even subgenerically distinct from *Phytia*, Gray (=*Alexia*, Leach, 1847, *nec* Stephens, 1835). If they are, *Monica* stands ready to receive them.

In 1855 Swainson created a genus *Cremnobates*§ for three Tasmanian shells, which he described under the names of *C. cornea*, *parva* and *solida*. Hedley & Suter‖ have shown that *cornea* and *solida* are respectively synonyms of *Ophicardelus australis*, Q. & G., and the *M. patula*, Lowe, of Pfeiffer, and therefore propose *parva* as Type of Swainson's genus; but *parva* appears to be a true *Marinula*, in which case *Cremnobates* can only be relegated to synonymy.

* Syn. Brit. Mus., 1841, p. 91 and P.Z.S., 1847, p. 179.
† P.Z.S., 1854, p. 35.
‡ Gen. rec. Moll., ii. p. 246.
§ Papers and Proc. Roy. Soc. Van Diemens Land, 1855, iii. part i. p. 42.
‖ Proc. Mal. Soc., 1910, ix. p. 151.

Pfeiffer, both in 1856 * and 1857 † placed in *Marinula*:—*pepita* (=*triplicatus* and *recluziana*); *acuta*, d'Orb; *nigra*, Phil. (=*marinella* and *callaoënsis*); *patula*, Lowe (=*xanthostoma*, Ads. and ? *ovulus*, Fér.); *cymbaeformis*; *firmini*; *aequalis*; *gracilis*; and *abbreviata*, Beck; while in 1876 ‡ he included *vulcani*, Morelet, in the genus.

In 1864 Souverbie described a "*Marinula* an *Pedipes forestieri*, Montr.," from the New Caledonian Archipelago; in 1877 Vélain described *M. maindroni* and *M. nigra*, var. *minor*, from St. Paul's and Amsterdam Islands, and in 1878 Hutton described *M. filholi*, from New Zealand.

In 1880 von Martens § placed in *Marinula*:—*elongata*, Parreyss; *affinis*, Fér., and *conica*, Pease. In 1889, Paetel || further included *pellucida*, Cooper, and *subula*, Q. & G.; while finally, Pilsbry, in 1910, described *Marinula rhoadsi* from Mexico.

The following writers have also made special mention of the genus under discussion:—

1867 Paiva, Mon. Moll. Mad. p. 151.
1878 Wollaston, Test. Atlant. p. 267.
1880 Fischer & Crosse, Miss. au Mex. ii. pp. 3–5, 16, 27.
1882 Crosse & Fischer, J. de C. xxx. p. 179. Pl. VIII, f. 6.

The first two of the above papers relate to Madeiran shells, which have been wrongly attributed to *Marinula*; the third is of no special value as far as concerns that genus; but in the fourth the authors, dealing with the gradual absorption of the columellar folds during the growth of various genera of *Auriculidae*, state that in typical *Marinula* the destruction of the internal partitions attains its highest pitch, the interior of the shell being smooth, polished, and glossy red-brown.

Now if the shell of *Marinula* is to be separated on external characters from those of nearly allied genera, the points to be observed are:—

(i) Shell fairly solid, unicoloured.
(ii) Spire shorter than aperture.
(iii) Whorls few, comparatively convex.
(iv) No trace of tooth or plait on outer lip, which is not thickened; and not more than three folds, or plaits, on the columella.

* Mon. Auric. p. 59.
† Cat. Auric. p. 44.
‡ Mon. Pneum. iv. p. 331.
§ Meeresfauna Mauritius, p. 207.
|| Catalog, ii. p. 381.

Insistence must be laid on the inflated whorls and short spire, as otherwise there is hardly any conchological feature by which certain species of *Phytia* can be separated from *Marinula*, although the genotypes are quite distinct.

If the foregoing tests are applied to each of the 31 species which have been referred to King's genus, the following 17 can be at once eliminated; I give the earliest reference in each case, the letters *D*, *F*, *L*, *N*, *A*, & *R* signifying, respectively, Description, Figure of shell, Locality, Note, Anatomy, and Radula.

Ovatella punctata, Bivona, 1832. Effem. Sci. Lett. Sic. p. 58. Pl. I, f. 6. *D.F.*
A synonym of *Phytia firmini*.

Melampus aequalis, Lowe, 1832. Zool. Journ. v. p. 288. Pl. XIII, f. 1–5. *D.F.*
A Madeiran species which should apparently be placed in *Phytia*.

Auricula firminii, Payraudeau, 1826. Cat. Moll. Corse, p. 105. Pl. V, f. 9, 10. *D.F.*
A Mediterranean species of *Phytia*.

Melampus gracilis, Lowe, 1832. Zool. Journ. v. p. 288. *D.*
Another Madeiran shell, of which *vespertina*, Morelet, and *loweana*, Pfr., are considered synonyms, and itself, according to Wollaston, very nearly related to *Phytia myosotis* (Drap.)

Cremnobates cornea, Swainson, 1855. Pap. and Proc. Roy. Soc. V.D. Land, iii. 1, p. 43. Pl. VII, f. 1. *D.F.*
A synonym of *Ophicardelus australis*, Q. & G.

Auricula acuta, d'Orbigny, 1835. Mag. de Zool. p. 23. *D.*
Described from Guayaquil, and best placed in *Phytia*.

Pythia abbreviata, Beck, 1838. Index Moll. p. 105 (*without characters*).
Marinula abbreviata, Beck, Pfr. 1856. Mon. Auric. p. 65. *N.*
Pfeiffer remarks: "Absque ullâ indicatione, ex loco speciei inter *Pythiam aequalem* et *patulam* assignato forsan huc referenda?"; but whatever may be its true genus, as the shell is said to come from the Antilles it is quite unlikely to be a *Marinula*.

Auricula vulcani, Morelet, 1860. Notice sur l'Hist. Nat. des Açores. p. 207. Pl. V, f. 8. *D.F.*
Placed by Wollaston in the synonymy of *Phytia aequalis*, Lowe.

Pedipes forestieri (Montr.), Souverbie, 1864. J. de C. xii. pp. 41, 261. Pl. X, f. 1. *D.F.*

An immature shell from the New Caledonian Archipelago, the length of whose spire clearly separates it from *Marinula*.

Auricula elongata (Parreyss), Küster, 1845. Conch. Cab. p. 53. Pl. VIII (1844), f. 6. *D.F.*

A Sandwich Island species placed by Kobelt, 1898, in *Auriculastra*.

Pedipes affinis, Fér., 1821. Tabl. Syst. Moll. 3. p. 109 (or 113). *D.*

Correctly placed by its author in *Pedipes*.

Laimodonta conica, Pease, 1862. P.Z.S. p. 242. *D.*

Also correctly placed, but *Laimodonta*, Ads., being preoccupied, has given place to *Enterodonta*, Sykes, 1894.

Auricula pellucida, Cooper, 1841. Microscop. Journ. p. 16. *D.*

This microscopic species has been shown by Hedley* to be a *Leuconopsis*. Specimens of *xanthostoma* having been erroneously circulated as *pellucida* gave rise to the misclassification.

Auricula subula, Quoy & Gaimard, 1832. Voy. Astrolabe, ii. p. 171. Pl. XIII, f. 39, 40. *D.F.*

Probably correctly placed by Kobelt, 1898, in *Auriculastra*.

Marinula rhoadsi, Pilsbry, 1910. Proc. Acad. Nat. Sci. Phila., lxii. p. 148, f. 1. *D.F.*

A Californian species, differing from *Marinula* in its less convex whorls and consequently more regular spire, while there is usually a banding of colour round the shell. It is perhaps best placed in *Phytia*.

Conovulus triplicatus and *Auricula recluziana* will be dealt with later on.

The names now remaining will be found to unite in a fairly homogeneous group, comprising seven Antarctic species whose shells all bear considerable resemblance to one another, and six, at least, of which are typical representatives of King's genus.

Taking them in geographical sequence from West to East, they are:—

pepita, King (=*nigra* (Phil.) Küst., *marinella*, "King" and *callaoënsis* (Petit) Ads.).

* Proc. Linn. Soc. N.S.W. xxxviii. 1913. p. 332. Pl. XIX, f. 85.

tristanensis, nov. (=*nigra*, Auctt., *nec* Küst.).
velaini, nom. mut. (=*nigra*, var. *minor*, Vélain).
maindroni, Vélain.
parva, Swainson.
filholi, Hutton.
xanthostoma, H. & A. Adams (=*solida*, Swainson; ? *cymbaeformis* Récluz, and ?? *patula*, Lowe).

I believe that I have examined every printed reference to these shells, and append all of any considerable importance; those which I have omitted are of a more or less check-list nature.

Genus MARINULA, King, 1832.
Zool. Journ. v. 19. p. 343.
(=*Cremnobates*, Swainson, 1855, *pars*.)

Marinula pepita, King.

1832 ?? *Melampus patulus*, Lowe, Zool. Journ. v. 19. p. 289. *D.*
,, *Marinula pepita*, King, Zool. Journ. v. 19. p. 344. *D.*
1841 *Auricula nigra*, Phil., Küster, Conch. Cab. p. 23. Pl. III, f. 4, 5. *D.F.*
,, ,, *marinella*, King, Küster, Conch. Cab. p. 24. Pl. III, f. 4, 5. *D.F.*
1842 ,, *pepita*, King, Rve., Conch. Syst. ii. Pl. CLXXXVII, f. 1. *F.*
1854 *Marinula marinella*, King, Ads., P.Z.S. p. 35.
,, ,, *callaoënsis*, Petit, Ads., P.Z.S. p. 35.
1856 ,, *nigra*, Phil. (*pars*) (=*marinella* and *callaoënsis*), Pfr., Mon. Auric. p. 61. *D.*
1857 ,, ,, ,, ,, Pfr., Cat. Auric. p. 45. *D.*
1878 *Auricula pepita*, King (=*nigra*, Phil.), Sow., Conch. Icon. Pl. V, f. 33. *D.F.*

Shell small, conic-ovate, imperforate, fairly solid, blackish-brown, interior rather milky. Spire produced, moderately acute, a little shorter than the aperture, apex very small, but sharp. Whorls 4, slightly convex, rapidly increasing, very faintly striate parallel to the lines of growth. Suture well marked but shallow. Aperture ovate, outer margin sharp, simple, edentulate; inner margin very slightly paler than exterior of shell, furnished with 3 white dental processes; —(i) a prominent, slightly incurved, receding tooth about 3 mm. from, and parallel to, the outer lip; (ii) a smaller, straight tooth at right angles to its base, nearly half-way between the foregoing

and the base of the columella; (iii) a hardly visible columellar plait just below the second tooth.

Dimensions of middle shell in Type set:—Long. 10·4; lat. 6·0; apert. 7·1 × 4·5; last whorl, 9·3 mm.

Other examples of the same set measure:—

Long. 10·3; lat. 6·2; apert. 7·0 × 4·2; last whorl, 9·4 mm.
„ 9·3; „ 5·5; „ 6·0 × 3·9; „ „ 8·0 „

Animal unknown.

Hab. South America. Chiloe Island, San Carlos Bay (King).

Type in British Museum.

In Pfeiffer's description of *M. nigra* he mentions that the right margin is sometimes furnished with several very indistinct transverse ridges; but I can see no trace of these in any of the shells which I have examined, and think it possible that the statement was based on imperfectly cleaned specimens.

It is so easy to confound Chile with Chiloe that it may be wiser to omit any of the more northerly localities which have been quoted for *M. pepita*. *M. callaoënsis* has never been described or figured, and although H. & A. Adams mention the species as being in the British Museum, I have been quite unable to find the shells in question. Pfeiffer was entirely mistaken about the true *pepita*, but his identification of *callaoënsis* with *nigra* may probably be accepted as correct.

Whether Lowe's *M. patulus* was really founded on this species, in which case the name would have priority, is discussed under *M. xanthostoma*, Ads.

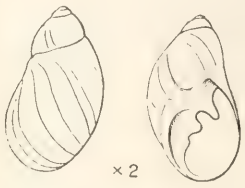
Marinula tristanensis, nov., 1915.

1856 *Marinula nigra*, Phil. (*pars*), Pfr., Mon. Auric. p. 61. *L.*
1857 „ „ „ „ „ Cat. Auric. p. 45. *L.*
1877 „ „ „ Vélain, Arch. Zool. Exper. vi. p. 126. *N.*
1907 „ „ „ Melv. & Stand., Edinb. Trans. R. Soc. p. 142. *L.*
1910 „ „ „ Hedley & Suter, Proc. Mal. Soc. ix. p. 151. *L.*

Shell small, elongate-ovate, imperforate, solid, epidermis purple-black, interior and columella paler. Spire moderately produced, about two-thirds the length of the aperture; sides rather convex, apex minutely pointed. Whorls $3\frac{3}{4}$, not very convex, rapidly increasing, with fine, irregular striation following the lines of growth. Suture very shallow. Aperture acuminate-ovate, outer

lip thin, simple, inner furnished with three white dental processes—(i) a prominent, linguiform tooth parallel to, and about 1·7 mm. from the outer lip; (ii) a short, rather conical tooth about half-way between the upper one and the base; (iii) a minute columellar fold rather nearer the second tooth than the base.

Long. 10·4; lat. 5·5; apert. 6·7 × 4·7; last whorl 9·6 mm.



Marinula tristanensis, sp. nov.

Epidermis purple-black; lines of growth eroded white.

Mr. G. C. Robson has very kindly examined the anatomy, on which I am therefore enabled to present the subjoined report:—

On the Anatomy of Marinula tristanensis.—By G. C. Robson, B.A.

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It was hoped that the ample material representative of this species, received for examination from Dr. Péringuey, would have afforded an excellent opportunity for giving a complete account of the anatomy of this interesting form, the generic position of which is now treated for the first time from the anatomical standpoint. It is to be regretted, however, that the specimens obtained were in such a state of contraction as to render dissection of anything more than the gross anatomy an impossibility. It was possible to make out a certain amount by sections stained with Haematoxylin and Methylene Blue, but the time available for continuing this method not being forthcoming the author is compelled to publish only such descriptions as may serve to indicate approximately the systematic position of the genus, together with a few other notes.

The *radula* (Fig. 1) differs in many well-marked characters from those of the genera usually regarded as closely akin to *Marinula*. There are in each row numerous teeth—about 230—the general form and disposition of which readily place it among the *Auriculidae*. The lateral teeth present a simple rounded main cusp with a slightly hollowed interior edge. The basal plate is produced very far beyond

the upper edge of each tooth and in a slanting direction. A transition to the marginal type of tooth is effected by the appearance on or about the thirty-fifth tooth of a small interior cusp on the acutely

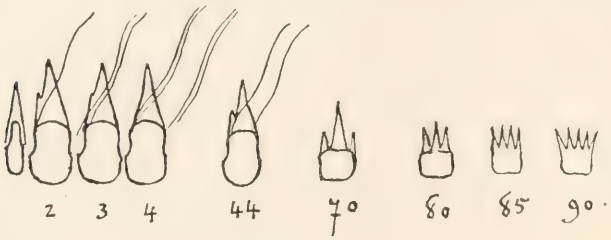


FIG. 1.

Marinula tristanensis. Radula. (4 × $\frac{1}{12}$ Homog. imm.)

pointed second cusp. The latter gradually divides into two and eventually more cusps appear until at about the 90th tooth four or five small, equal cusps are found arising from a somewhat amorphous basal plate.

The radula thus described clearly is distinguishable from that of *Melampus* and *Phytia*, although a family likeness is obviously present in all three.

The *jaw* (Fig. 2) is a typically Auriculid structure consisting of numerous loosely arranged fibres. It differs from that of *Melampus*, however, in being of a regular gently arcuate form slightly upturned at the extremities. At the latter the fibres are better developed and more regularly arranged than in the median area of the jaw.

The *genitalia* (Fig. 3). The organs of reproduction do not offer any singular departure from the usual Auriculid type although they are substantially different in disposition and form from those of *Melampus*, *Phytia*, and *Pythia*.

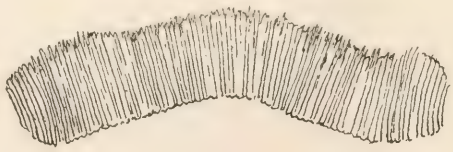


FIG. 2.

Marinula tristanensis. Jaw. (4 × 6 obj.)

The male genitalia do not differ very markedly from those of the three genera alluded to above in the presence or absence of any essential part. On the whole it is more like the slender delicate

system found in *Melampus*. It differs, however, from all three in having a number of muscle fibres inserted into the penis half-way down from the external aperture.

The female reproductive system appears to be considerably simpler than in any of the three other genera, and, if the author's

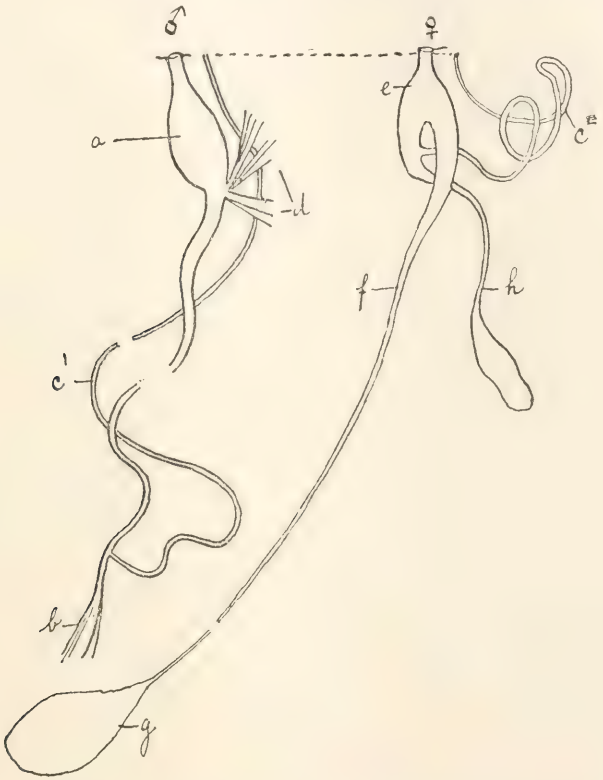


Fig. 3.

Marinula tristanensis. Genitalia. (2 × a³ Binoc. Zeiss.)

a. Penis. *b*. Penis muscle. *c*. Vas deferens; *c'*, continuation of same. *d*. Accessory penis muscles. *e*. Vagina. *f*. Hermaphrodite duct. *g*. Gonad. *h*. Spermatheca (?).

interpretation is accepted, somewhat specialized, as the vas deferens, instead of splitting off the spermoviduct, has become completely separated from it and issues from the base of an accessory organ *

* This organ may possibly be an accessory glandular structure. If it is ultimately proved to be the spermatheca, then the absence of other accessory organs in the female generative system compares strangely with the condition seen in *Melampus*, *Phytia*, &c.

which appears to represent the spermatheca. If this interpretation is ultimately found to be correct the spermatozoa must be carried down the common duct to the vagina where they are separated from the ova and ultimately find their way to the exterior after traversing part of the spermathecal duct.

It remains to make one or two disconnected observations upon isolated points of anatomy.

(*a*) Portions of the resorbed shell septa are found in a superficial position in various parts of the body enclosed in epithelial pockets.

(*b*) The anterior edge of the mantle is supplied on the right-hand side with hard semi-calcified pads which no doubt act as protection against the rather formidable teeth of the shell aperture. The anus opens in a groove in one of these pads.

(*c*) The animal is apparently omnivorous, as the lower part of the intestine contained a variety of foraminiferan skeletons together with sand granules and fragments of a red crystalline substance.

Hab. Inaccessible Island, Tristan d'Acunha (Keytel (Type) and others). Gough Island (Scotia Expedition, fide Melvill & Standen). South Africa. Camps Bay (Dale; McBean); Dassen Island (Lightfoot).

Type in South African Museum.

This species has long been known in collections under the name of *Marinula nigra* (Phil.), but as the last is merely a synonym of *M. pepita*, from Chiloe, a new name is necessary for the Tristan form.

The shell very closely resembles that of *pepita*, but the early whorls are rather less convex and the small columellar fold is, on the average, slightly more pronounced than in King's species, which, from its widely different locality, should surely be distinct.

I have not seen the examples mentioned by Melvill & Standen, but have no reason to doubt their identity with *tristanensis*, while their appearance on Gough Island furnishes a stepping-stone between Tristan d'Acunha and South Africa.

Only three specimens of *Marinula*, probably referable to *tristanensis*, have so far been collected in the last-mentioned subcontinent. Two of these, picked up at Camps Bay, near Cape Town, are somewhat beach-rolled, while the third, taken alive below high-water mark on the rocky shore of Dassen Island, is so

eroded as almost to have lost its shape; but taken together the shells appear to be a little longer in the spire and less solid than the generality of Tristan examples, and the interior is bright corneus instead of purple-brown. However, the difference in colour may be due to the effect of alcohol on the Tristan shells, while the length of spire is not a constant feature among specimens from the last-named locality, so that there are no good grounds for regarding the South African form as distinct from *M. tristanensis*, unless a larger series can be collected and proves to be specifically different.

Marinula velaini, nom. nov., 1915.

1877 *Marinula nigra*, Phil., var. *minor*, Vélain, Arch. Zool. Exper. vi. p. 125 Pl. IV, f. 25. *D.F.*

Shell small, ovate-acuminate, imperforate, not very solid, dark corneous. Spire short, acute, sides very slightly convex. Whorls $3\frac{1}{2}$, very rapidly increasing, very slightly convex, with no sculpture except an occasional growth-line. Aperture large, acuminate-ovate, outer lip thin, simple. Columella furnished with 3 dental processes—(i) a long, curved tooth near, and parallel to, the outer lip; (ii) a shorter, curved tooth, at right angles to the columella and half-way between the upper tooth and base; (iii) a minute projection just below the foregoing.

Dimensions of a specimen in the British Museum: Long. 6·8; lat. 4·2; apert. 5·0 × 2·2; last whorl 6·3 mm.

Animal unknown.

Hab. St. Paul's and Amsterdam Islands (Vélain; McGillivray).

Type *ubi ?*

The Type measured 7·5 × 4·5 mm., and the author states that the maximum size observed was 9·0 × 5·0 mm.

Vélain also remarked: "This *Marinula* is identical with that described from the Island of Tristan d'Acunha by Philippi under the name of *M. nigra*, but it is of much smaller size and must be considered as a var. *minor* of this species."

But even if *M. tristanensis* has reached the Atlantic coast of Africa, it is most unlikely to have found its way round the Cape and halfway to Australia; in addition to which, the disparity in size between it and Vélain's var. *minor* is constant and considerable.

On both geographical and conchological grounds, therefore, the latter should be separated from the Tristan shell, and, if really distinct from *M. maindroni*, it appears fully worthy of specific rank. I venture to name it in honour of its original describer.

MARINULA MAINDRONI, Vélain.

1877 *Marinula maindroni*, Vélain, Arch. Zool. Exper. vi. p. 126. Pl. IV, f. 26. *D.F.*

1901 „ „ „ Kob., Conch. Cab. p. 284. Pl. XXXIII, f. 24. *D.F.*

I have been unable to discover the whereabouts of the Type or a single example of this species. Vélain's diagnosis runs:—"**Shell** thin, short and globular, semitransparent, coloured bright brown; surface smooth and shining. Spire small, very acuminate, almost completely concealed by the last whorl, which is rounded and greatly developed. Aperture large, swollen towards the base; columellar margin not thickened, marked with much sharper folds than in the preceding species; outer margin thin and sharp, not sinuous. The shell measures $4 \times 3\frac{1}{4}$ mm."

Animal unknown.

Hab. AMSTERDAM ISLAND. "Dans les vacuoles des laves, assez rare."

I cannot help suspecting that the description might possibly refer to the young of the preceding species, but if such were the case Vélain would hardly have separated them, and it is only just to accept his verdict.

MARINULA PARVA (Swainson).

1855 *Cremnobates parva*, Swains., Pap. & Proc. Roy. Soc. V.D. Land, iii. 1. p. 44. Pl. VII, f. 3. *D.F.*

1901 *Ophicardelus parvus*, Swains., Tate & May, Proc. Linn. Soc. N.S.W. xxvi. p. 420. *L.*

1910 *Cremnobates parva*, Swains., Hedley & Suter, Proc. Mal. Soc. ix. pp. 151, 152. *D.F.A.R.*

1913 „ „ „ Suter, Man. N.Z. Moll. p. 594. *D A.R.*

Shell small, imperforate, prolonged ovate-acuminate, rather thin, brown, corneous. Spire moderately produced, about one-third the length of the aperture; apex acute. Whorls 4, rather convex, very rapidly increasing, showing no sculpture except faintest irregular growth-marks. Suture fairly deep. Aperture ovate, peristome whitish, outer lip simple, acute, making almost a right angle, and thus appearing perceptibly swollen, at its junction with the paries. Columella white, thickened, with two dental processes;—the upper sharp and prominent, jutting out at right angles, equidistant between the apex of the aperture and the second tooth, which is shorter and

thicker, situate a little less than half-way from the base to the apex of the aperture.

Dimensions of a typical specimen from Tasmania, in the British Museum: Long. 9·2; lat. 5·3; apert. 6×3·6; last whorl 8·4 mm.

There is no epidermis, the shell appearing to be a little beach-rolled.

Hab. Tasmania. Oyster Cove, near Hobart Town (Milligan); near Pirates Bay; Tasman's Arch (May).

Antipodes Islands (Bollons).

Type *ubi*?

Hedley and Suter selected this species as the Type of Swainson's genus *Cremnobates*, and published a few notes on its anatomy. This does not appear to differ to any considerable extent from that of *M. tristanensis*, as diagnosed by Robson in these pages, except that in *parva* "a central tooth could not be distinguished," while in *tristanensis* a central tooth is shown, but an infinitesimally small one. Without knowledge of the power of magnification employed, it is hardly safe for me to suggest that this feature may possibly exist and have been overlooked in the Tasmanian animal; but Mr. Robson informs me that it took a $\frac{1}{12}$ Homog. imm. objective to enable him to trace it in *tristanensis*.

The shell of *parva* is certainly that of a true *Marinula*, and, on the whole, there seems hardly sufficient cause for regarding *Cremnobates* as other than synonymous with King's genus, although, on the other hand, Hedley and Suter's description of the anatomy gives us no definite clue for uniting the two genera.

Marinula filholi, Hutton.

1878 *Marinula filholi*, Hutton, J. de C. xxvi. p. 42. *D.*
1880 ,, ,, ,, Man. N.Z. Moll. p. 34. *D.*
1913 ,, ,, ,, Suter, Man. N.Z. Moll. p. 591. *D.*

Shell small, prolonged ovate-acuminate, imperforate, pale corneous. Spire somewhat produced, nearly as long as aperture, sides convex, apex mamillate. Whorls $3\frac{1}{2}$, convex, rapidly increasing, finely microscopically striate parallel to the lines of growth. Aperture ovate, outer margin thin, simple; inner bearing three prominent white dental processes;—a long, thin tooth about equidistant between the outer lip and the next process, a smaller, conical tooth, which is situate a little more than half-way down from the apex of the aperture to the base; below the second, and parallel to it, is a still smaller tooth or fold, half the size of the central one.

Dimensions of a specimen from Chatham Island: Long. 7·4; lat. 4·5; apert. 4·5×2·8; last whorl 6·3 mm.

unknown.

Hab. New Zealand. Massacre Bay (Filhol); Auckland (Cheeseman); Banks Peninsula; Lyall Bay; Otago, alive on coast above high water (Iredale); Chatham Island (in coll. Connolly).

Marinula xanthostoma, H. & A. Adams.

1821 ?? *Pedipes ovulus*, Fér., Tabl. Syst. iii. p. 109 (*or* 113). *D.*
1832 ?? *Melampus patulus*, Lowe, Zool. Journ. v. 19. p. 289. *D.*
1854 *Marinula xanthostoma*, Ads., P.Z.S. p. 35. *D.*
,, ,, *cymbaeformis*, Récl., Ads., P.Z.S. p. 35 (*without characters*).
1855 *Cremnobates solida*, Swainson, Pap. & Proc. Roy. Soc. V.D. Land, iii. 1. p. 44. Pl. VII, f. 2. *D.F.*
1856 *Marinula patula*, Lowe (= *ovulus*? and *xanthostoma*), Pfr. Mon. Auric. p. 62. *D.*
,, ,, *cymbaeformis*, Récl., Pfr., Mon Auric. p. 63. *D.*
1857 ,, ,, ,, Cat. Auric. p. 47. *D.*
,, ,, *patula*, Lowe, Pfr., Cat. Auric. p. 46. *D.*
1867 ,, *xanthostoma*, Ads., Angas, P.Z.S. p. 231. *N.*
1901 ,, *patula*, Lowe (= *pellucida*, *xanthostoma*, and *solida*), Tate & May, Proc. Linn. Soc. N.S.W. xxvi. p. 419. *L.*
,, ,, ,, ,, (= *cymbaeformis*), Hedley, Proc. Linn. Soc. N.S.W. xxvi. p. 704. Pl. XXXIV, f. 18. *N.F.*

Before describing the shell, careful attention must be paid to the synonymy.

Férussac's diagnosis of *Pedipes ovulus* runs: "More elongated than *afra*, smooth and polished, and has not the internal rib on the external border of the aperture. Hab.?"

This might equally refer to a *Phytia* or *Marinula*, but it seems doubtful whence Férussac could have obtained an example of the latter genus. The Type of *ovulus* is not forthcoming, and in its absence the name is obviously worthless.

I do not think that *patula* can stand.

It has been impossible to trace the Type or a single authentic example of Lowe's species, which was unfigured and insufficiently described; but the following facts throw grave doubt on its being an Australian shell:—

When describing *Marinula pepita* in 1832, King mentioned that he had submitted his entire American collection to Sowerby, who had already obtained several of the species from other members of King's expedition.

Now *in the same year* Lowe described *Melampus patulus from a shell received from Sowerby*, and gave its measurements as $\frac{7}{16} \times \frac{4}{16}$ unc., *which are identical with those given by King for pepita.*

Errors of locality were frequent in those early days, and the translation of America into Australia would be a mere nothing, due to some one's misreading four letters of the name.

There is no proof that Pfeiffer was acquainted with originals of *patula*, and the fact of his connecting it with *xanthostoma* is easily accounted for by the locality.

Lowe's name of *patula* would take precedence of either *pepita* or *xanthostoma*, but, while the circumstantial evidence is strongly in favour of its application to the former rather than to the latter species, it may be advisable to retain the names which admit of no doubt, and to regard *patula* as a lost species pending the rediscovery of the missing type.

M. xanthostoma was founded by the brothers Adams on a set of well-preserved Queensland shells in the Cuming collection, while *C. solida* was described a year later by Swainson, from beach-rolled examples collected by Milligan on Flinders Island off the north coast of Tasmania.

The Type set of *xanthostoma* and good Co-types of *solida* are in the British Museum.

M. cymbaeformis was first mentioned in print by H. & A. Adams as having been described by Récluz in the Mag. de Zool. I can find no mention of any such name in Récluz' writings, and the species appears to have been first characterized by Pfeiffer from a shell in his own collection, purporting to come from the Island of Ticao, Philippines.

What this was I cannot say, but the Adams' set is probably still to be seen in the British Museum. It consists of 6 shells on one tablet labelled both "*patula*" and "*cymbeformis*" and assigned to Ticao (in Cuming's writing) and also to Tanhay, I. of Negros, in the Philippine Islands. These are simply beach-rolled examples of typical Australian *xanthostoma*, and failing further proof to the contrary, the Philippine locality may, I think, be accepted as erroneous.

Pfeiffer also mentions a var. *β, gracilior*, from Australia. This appears to be represented on another British Museum tablet, which

contains 4 smaller shells collected by Strange at Moreton Bay. They are a slender form of *xanthostoma*, and show that it is a variable species.

The following description is from one of the Adams' Type set.

Shell acuminate-ovate, imperforate, not very solid, apparently somewhat beach-rolled, pale brown. Spire rather short, with nearly straight sides; apex very sharp, slightly produced. Whorls 5, rapidly increasing, the apical smooth and glossy, remainder marked with occasional faint, almost invisible striation in the lines of growth. Suture very shallow. Aperture a little longer than spire, ovate, base rounded, apex acuminate, outer lip sharp, simple; columella thickened, furnished with three white plaits; the uppermost linguiform larger and further, in proportion, from the others; the second, straight and much shorter, about half-way between the foregoing and the base of the columella; while the third, close below the second, is merely a small projection.

Long. 9·8; lat. 6·0; apert. 6·1 × 2·5; last whorl 8·6 mm.

There is an appearance of a faint interior rib, parallel to and just inside the outer lip, but this is probably an accident, due to the thinness of the edge of the lip owing to the shell not being quite mature, rather than a characteristic feature.

Animal unknown.

Hab. East and South Coasts of Australia; Tasmania.

Type in British Museum.

The typical form of *xanthostoma* is, in itself, on the extreme borderland of *Marinula*, having flatter whorls and a more acuminate spire than any of the preceding species; but in almost any large series intermediates may be found, which link it insolubly to the more normal form described by Swainson under the name of *solida*.

The latter differs markedly from the Adams' Types in its more elongate and convex spire and rather more pronounced upper tooth. It may be regarded, on the whole, as representing the southern form of *xanthostoma*, which appears to undergo a gradual transition in shape between its extreme limits of geographical distribution; but as neither form is constant, even among specimens from the same locality, and as *solida* is by no means an appropriate name for a form which is in reality less solid than the Type, it appears inadvisable to perpetuate it.

So far as I have been enabled to examine specimens from different localities, the typical form, as well as Pfeiffer's slender var. β, hail from Moreton Bay, Queensland: the extreme form of Swainson's so-called *solida* is in the great majority in sets from Flinders Island

(Milligan); Portland, Victoria (Cox); North coast of Tasmania (Brazier) and Cossacks, West Australia (Woodward); while examples almost exactly intermediate between the type and the variety have been found in New South Wales at Freemantle (Kemp) and Coogee Bay (Brazier).

The species is further recorded from King Island (Tate & May), and Shoalhaven and Port Jackson (Angas); but I cannot tell which forms are to be referred to these localities.

There is also a typical set in the British Museum labelled "New Zealand" (Hancock, 1856), but, although the authority is said to be reliable, it is very doubtful indeed whether living specimens have ever reached the Dominion.

It is earnestly to be hoped that the whole question of the distribution and varieties of *M. xanthostoma* will be taken up by some of the great Australian conchologists, and the anatomy examined with a view to the determination of its true generic position.

Distribution of *Marinula*. It would hence appear that *Marinula* is a truly Antarctic genus, originating in the Australasian region, with a circumpolar range extending eastward through New Zealand to Chiloe, and westward through St. Paul's and Amsterdam Islands and South Africa to Gough Island and Tristan d'Acunha. In the sole case where it extends northward, *e.g. M. xanthostoma*, the shell tends to lose its distinctive shape and to merge into *Phytia;* while in Africa and America it is confined to the extreme south of the continent and retains its normal form.

Its habit seems to be entirely marine, and it is questionable whether the genus would not be better included among marine, rather than non-marine Mollusca.

It now only remains to deal with the mis-named Cumingian shells which have been the cause of so much confusion. I have already mentioned that these occupy three tablets in the British Museum; one contains three larger shells from Tumaco Island, Colombia, and each of the others two smaller specimens, from "Chile" and an unknown locality respectively, which appear to be inseparable from the Tumaco examples.

We know that the Tumaco shells constitute the Type set of *Auricula recluziana*, Petit; but Pfeiffer considered them to be identical with *Conovulus triplicatus*, Anton, which was described from the River Maule, Chile, in 1839. This appears to be correct,

in which case Anton's name has priority, and the synonymy is as under:—

PHYTIA TRIPLICATA (Anton).

1839 *Conovulus triplicatus*, Anton, Verzeichniss, p. 48. *D.*
1842 *Auricula recluziana*, Petit, P.Z.S. p. 201. *D.*
1844 „ *pepita*, "King," Küst., Conch. Cab. p. 35. Pl. V (1843), f. 3–5. *D.F.*
1855 *Marinula* „ „ H. & A. Adams, Gen. rec. Moll. iii. Pl. LXXXIII, f. 2*a*. *F.*
1856 „ „ „ Pfr., Mon. Auric. p. 59. *D.*
1857 „ „ „ „ Cat. Auric. p. 44. *D.*

Hab. CHILE. River Maule (*triplicata*, Anton).

COLOMBIA. Tumaco Island (*recluziana*, Petit).

An altogether coarser form than *P. acuta* (d'Orb.) described from Guayaquil in 1835, which much resembles this species.

The Types of *recluziana* and *acuta* are in the British Museum; that of *triplicata* was in coll. Anton.

III.—A MONOGRAPH OF THE *Dorcasiinae*.

Until recent years, comparatively few shells and only three or four live specimens of the desert snails of South Africa have been available for scientific examination. Inferences regarding the species were therefore often based on somewhat insufficient material, while, although the genera *Dorcasia* and *Trigonephrus* were established and the anatomy of *D. alexandri* and *T. globulus* published, considerable doubt existed as to which genus some of the allied species belonged.

Since 1908, however, thanks to the researches of Dr. A. W. Rogers and other able explorers, several comparatively large series of shells have been gathered, including a most gratifying number of live specimens.

The result is that, through the kindness of Drs. Péringuey and Thiele, Miss Wilman, and Messrs. Gude, Natermann, and Ponsonby, I have been privileged to examine the most extensive assemblage of these shells that has ever been got together; in addition to which Mr. Hugh Watson, of Cambridge, has dissected the spirit specimens, and his reports, embodied in the following pages, are of the utmost

value in confirming, or correcting, deductions drawn from conchological features alone. Even now, however, more than one of the species, of which animals have been obtained, is represented by only a single spirit specimen, and others are not in the best condition, so that the results of their examination are not quite as satisfactory as would have been the case had a more complete representation been available.

It will be seen that Watson states that *Dorcasia* and *Trigonephrus* are nearly allied to each other, but differ considerably from other genera whose anatomy is known. They are rightly placed by Pilsbry in the Family *Acavidae*, and a new Sub-family, *Dorcasiinae*, may conveniently be founded to contain them.

The *Dorcasiinae* are distributed in all shapes and sizes along the south-western seaboard of Africa, from Algoa Bay to Damaraland, and in some instances also to a considerable distance inland.

I must confess that when I first undertook this paper, it was with the idea that many existing species could be shown to be hardly varietally distinct, and that, owing to the presence of connecting links, their names would be scarcely worth preserving. Extended study, however, tends to prove that most of the named forms exhibit quite sufficient and constant difference to entitle them to specific rank; while, in other cases, shells from the same locality constitute a local race of some species, consistently well defined, and so widely divergent from the Type that a name is advisable in order to prevent confusion.

From an anatomical standpoint, Watson places the genus *Trigonephrus* first and *Dorcasia* after it, and as his arrangement of the species, based on their anatomy, is perhaps the most convenient for comparison of the shells, I follow it in the ensuing pages.

The history of the *Acavidae* and all subsequent references to anatomical details are in the exact words of Mr. Watson, who has also furnished the figures of the animals, and my warmest thanks are due to him for his kind co-operation.

I may here mention that I have made no attempt to make my measurements, taken from the actual shells, agree with the figures, all of which are the natural size. Hardly any two persons will be found to measure a globular helicoid in exactly the same fashion, and a very slight accidental difference in the angle from which the shell is viewed or measured will account for a proportionate difference in the dimensions recorded.

As full references to every species were given in my "Revised Reference List of South African Non-marine Mollusca," published

two years ago in these Annals, they are omitted in the present instance.

Family ACAVIDAE, Pilsbry, 1900.

Proc. Acad. Nat. Sci. Phila., p. 564.

It is generally believed that millions of years ago a great southern continent stretched westward from South Africa as far as the Andes, and eastward through Madagascar and Southern India to the Australian region. The climate of this continent was very cold towards the end of the Carboniferous period; but later it became warmer, and the snails that dwelt there flourished exceedingly, several new families being evolved. And one of these families seems to have been the *Acavidae*.

Now it is not difficult to form some idea as to what the first members of the *Acavidae* were like; for it is reasonable to suppose that they would possess any primitive characters that are still retained by some of their descendants, as well as such other features as are found in all the modern members of the family, or at least in all the more archaic genera. We may suppose, therefore, that the eggs of these snails would be larger than usual, and that the animals themselves would be above the average size. The shell would have a pointed spire and laterally compressed whorls; that is to say, both the shell and its aperture would be higher than broad. This is the form of shell found in the most primitive Euthyneura, such as the *Actaeonidae*, the *Chilinidae*, and the *Auriculidae*, as well as in many of the more ancient families of the Stylommatophora, and it is still retained by several members of the *Acavidae*. There would be the usual two pairs of tentacles, and the labial lobes would be well developed. The foot would have neither a definite peripodial groove nor longitudinal grooves on the sole. No caudal mucous pore would be developed. The lung would be rather short, and the pulmonary veins would branch over the whole of its roof, the first branch of the pericardial vein being nearly as large as the principal pulmonary vein. The excretory system would be unusually simple, the kidney being broad and probably without even a primary ureter. The nervous system would be of the type found in most of the more primitive snails and slugs, there being eleven separate ganglia. The cerebral ganglia would probably be rather near together, but the connectives uniting them with the remaining ganglia would be long. The jaw would be without ribs, but would probably have faint vertical striae and a

slight median projection. The radula would have nearly straight rows of "quadrate" teeth of the ordinary Helicid type, and the alimentary canal would pursue the usual course, though the difference in size between the two divisions of the liver would be less marked than is the case in most snails at the present day. The reproductive organs would be of a primitive type. A well-developed vesicula seminalis would be present, and there would be a swelling near the junction of the free oviduct and the duct of the spermatheca—a swelling which may have grown out into an appendiculum; but the spermathecal duct would have no diverticulum, and there would be no other accessory outgrowths of any kind. Though the penis and vagina would open together, a common vestibule would not have been developed. A considerable portion of the vas deferens, instead of lying freely in the body-cavity, would be still partially embedded in the invaginated portion of the skin which forms the wall of the penis. The retractor of the right upper tentacle would pass between the penis and the vagina.

Such we may suppose to have been the main characters of the earliest members of the *Acavidae*. It will be seen that they were more primitive than many modern snails, but probably at the beginning of the Mesozoic era they were both larger and more highly organized than most of the other families then living. And the family increased and multiplied, and spread far and wide through that ancient southern continent. Moreover, both their multiplication and their spreading led to the further evolution of these snails.

As the individuals increased in number under the favourable conditions, they would become more crowded, and the competition between them would become more severe. This would lead to the evolution of higher types: unfavourable varieties would be eliminated; progressive mutations would alone survive. Thus the eggs grew larger and larger, or, in an extreme case, the animal became viviparous, the embryo reaching a relatively enormous size. The adult also became larger and broader, the whorls very much wider, and the apex more and more obtuse, until the form of the shell became globular, and finally depressed. The lip also became more expanded. A closed primary ureter was developed, and eventually the beginning of a secondary ureter.* The fine striae on the jaw either developed into ribs, or, more frequently, disappeared altogether. Similarly, the comparatively useless small secondary cusps on the teeth of the radula were generally eliminated, the main cusps becoming larger and broader at their expense. The reproductive

* See Randles, Proc. Mal. Soc., 1900, iv. Pl. IX, fig. 1.

organs also became simplified by the disappearance of any appendiculum or swelling at the junction of the free oviduct and the duct of the spermatheca; and, at the same time, the vas deferens gradually emerged from the wall of the penis and came to lie freely in the body-cavity.

Now evolution of this kind would proceed most rapidly in the central area where the family first arose, which was probably nearer Ceylon than South Africa; for, unless the local conditions were unfavourable, the individuals would be most densely crowded towards the centre, and there the competition would consequently be most severe. Towards the periphery of distribution, on the other hand, the individuals would be more sparsely scattered, and the primitive forms would therefore survive, as Taylor has maintained in dealing with other groups.

There is, however, another kind of evolution, which proceeds more rapidly towards the limits of the distribution of a group than in the centre; for as the animals spread in different directions they encounter new conditions to which they have to adapt themselves. This may lead to a profound modification of some of the organs; and if there are great differences in the environment, the various peripheral genera may differ more from the ancestral form than do those which still inhabit the central area. But the conditions seem to have been fairly uniform throughout that ancient southern continent; and although the peripheral members of the *Acavidae* developed differences as they spread in various directions, they remained more primitive than those in the centre of evolution.

Until about the middle of the Mesozoic era the distribution of the family was probably continuous. And then there came the sea. First in one region and then in another, partly by denudation but chiefly by subsidence, that ancient continent gradually disappeared beneath the encroaching waves. The region extending from the south of India to Madagascar was cut off from Australia on the one hand and from South Africa on the other, and, later, Africa was separated from Brazil. Thus the old home of the *Acavidae* was divided into four large islands. Henceforth each of the divisions of the family would develop independently, their separation accentuating their differences, until the *Acavidae* were divided into four subfamilies, each inhabiting a different area.

The subfamily inhabiting the most westerly region, which included Brazil and the adjacent parts of South America, would be on the whole the most primitive, as it was furthest from the centre of evolution. So far as is known, none of the Heliciform members

of the family ever reached South America. Only the Bulimiform genera, *Strophocheilus* (including *Borus*) and *Gonyostomus*, are found in that region, and Plate has emphasized the very primitive character of these snails.* The researches of Semper,† von Ihering‡, Plate,§ and Pilsbry || have shown that, besides retaining an elongate shell, these South American genera have a very simple kidney with no ureter, a radula in which the ectocones are usually still present on the marginal teeth, and a free oviduct which is swollen or provided with an appendiculum at its junction with the duct of the spermatheca.

But although these snails retain many primitive characters, they have undergone a considerable development under the favourable climatic conditions of Brazil. In some species the jaw has developed stout ribs. Many of the forms attain a great size, and have very big eggs. A large number of species have arisen, and they have spread over the greater part of South America, though they are still most abundant to the east of the Andes. To this subfamily Pilsbry has given the name of *Strophocheilinae*.

The subfamily which inhabits Australia and some of the neighbouring islands contains far fewer species; but so diverse are these that they are assigned to at least twice as many genera as the South American forms. Probably the group was once much commoner in the Australian region than it is at the present day.

The south of Australia is nearly as far from the centre of evolution as is Brazil, and, with the exception of *Anoglypta launcestonensis*, all the species from this region are more or less Bulimiform. Further north, however, we find the greatly depressed genus *Pedinogyra* in Queensland and New South Wales; while in the most northerly species of *Hedleyella*, instead of the spire having been flattened, the entire shell has become reduced, so that it can no longer contain the animal. The teeth of the radula have almost entirely lost their secondary cusps in this group,¶ and a primary

* Sitz.-Ber. Ges. naturf. Freunde, Berlin, 1896, p. 149.

† Reis. im Archip. Philippin., 1874, iii. p. 150. Pl. XIV, f. 10, Pl. XVI, f. 25, Pl. XVII, f. 1, Pl. F (1894), f. 5.

‡ Zeitsch. f. Wissensch. Zoologie, 1884, xli. p. 270. Pl. XVII, f. 6, and Bull. Scientifique, 1891, ii. p. 213. Pl. V, f. 11.

§ Op. cit.

|| Man. Conch., 1895, x. p. 1, and 1902, xiv. pp. iv–viii. Pl. XLIX, f. 8, Pl. LI, f. 16, Pl. LII, f. 26, 27, Pl. LIII, f. 35, Pl. LIV, f. 37, Pl. LVII, f. 59, 65–68.

¶ The ectocones, however, can still be distinguished in the marginal teeth of some specimens of *Anoglypta launcestonensis*.

ureter seems to have been developed, though further information is needed about the pallial organs of these snails. On the other hand, the fine striae on the jaw are retained in *Pedinogyra* and *Anoglypta*, and the vas deferens is still partially embedded in the wall of the penis in the latter genus. Moreover, the lip of the shell is unusually simple in this subfamily, the appendiculum is well developed, and the egg, though large, does not attain the enormous size found in some of the more highly specialized members of *Acavidae*. The penial retractor arises from the columellar muscle, or from far back on the floor of the lung, instead of near the front.

Hedley, to whom we owe so much of our knowledge of these snails, was the first to demonstrate that the Australian genera *Hedleyella*,* *Caryodes*, *Anoglypta*, and *Pedinogyra*, were related to one another, notwithstanding their striking external differences.† Semper had already remarked on the resemblance of *Hedleyella* to *Acavus* and *Helicophanta* from Ceylon and Madagascar,‡ but after comparing the anatomy of *Hedleyella* and *Caryodes* with that of *Acavus*, *Helicophanta*, and *Ampelita*, Pilsbry states that the relationship between the Australian and Indo-Madecassine genera is by no means intimate §. The Australian region has long been cut off from the other three areas in which the *Acavidae* are found, and contains a separate branch of the family, less primitive in some respects than the *Strophocheilinae*, but not so highly organized as *Acavus* and its allies. This subfamily may be named the *Caryodinae*.

The region extending from the south of Madagascar to the south-western part of the peninsula of India remained a single large island, or a closely connected chain of islands, long after it was separated from the Australian region on the east and South Africa on the west; and it was probably not until Tertiary times that a series of faults, accompanied by subsidence, sent the greater part of that land beneath the Indian Ocean. The genera *Acavus* found in Ceylon, *Stylodonta* in the Seychelles, and *Helicophanta* and *Ampelita* in Madagascar, must therefore be regarded as the surviving remnants of a group which formerly also inhabited the intervening areas.

This group is that which lies nearest to the original centre of evolution of the family, and accordingly it includes the most highly

* *Hedleyella*, Iredale, 1914 (Proc. Mal. Soc., xi. p. 174) = *Panda*, Albers, 1860, *nec* van Heyden, 1826.

† Rec. Australian Mus., 1892, ii. p. 29.

‡ Reis. im Archip. Philippin., 1873, iii. p. 104.

§ Man. Conch., 1895, ix. p. 164.

organized members of the *Acavidae*. As in the *Caryodinae*, the most primitive forms are found in the south of the region, that is to say among the Madagascan species. Some of these have Bulimiform shells, while in the genus *Ampelita* the egg is only moderately large; but in all the genera of this subfamily, excepting *Ampelita*, the embryo attains a relatively enormous size before it is hatched or born (for *Stylodonta* is viviparous), and most of the Madagascan species, and all those from Ceylon and the Seychelles, have Helici-form or depressed shells. It is true that in some of the species of *Acavus* the spire is rather high, but this is almost certainly a case of reversion due to their having acquired arboreal habits. There is always a tendency among snails that live on trees or cliffs to become elongated, and the broad aperture of the shell in *Acavus* suggests that it was originally depressed. Moreover, in the two species of *Acavus* that are not arboreal, the spire is nearly flat. The shell is often highly coloured, and the lip, unlike that in the *Caryodinae*, is usually broadly expanded. Excepting in *Stylodonta*, all the teeth of the radula are without secondary cusps, and the jaw is without striae. An ureter is present. The reproductive system differs from that of the *Caryodinae* in being without an appendiculum; but in the Malagassy genus *Ampelita* Pilsbry has found that the vas deferens is still closely bound to the penis, as in *Anoglypta*.

This subfamily may be named the *Acavinae*, although Pilsbry originally included under this title the Australian genera also.* For our knowledge of the anatomy of this group we are indebted to the researches of Semper,† Viguier,‡ Sarasin,§ Pilsbry,‖ Wiegmann,¶ Randles,** and others; but we still know very little about most of the forms living in Madagascar.

As the land on which this subfamily arose extended as far as Southern India, one might perhaps have expected to find some members of the group in the peninsula. Possibly they may have once existed there; but, if so, they were probably unable to survive the competition of the more highly organized snails, belonging to the *Helicidae*, *Zonitidae*, and other families, which abound on the

* Man. Conch., 1895, ix. p. xxxii.

† Reis. im Archip. Philippin., 1873, iii. pp. 93–100. Pl. XII, f. 7–10, Pl. XVI, f. 5; and Nachrichtsbl. d. D. Mal. Ges, 1880, p. 60.

‡ Arch. Zool. Expér., 1880, viii. pp. 529–536. Pl. XL.

§ Ergeb. Naturwissensch. Forsch. auf Ceylon, 1888, i. pp. 35–69. Pls. VI–VIII.

‖ Man. Conch., 1894, ix. pp. 149–156. Pl. XLVIII, f. 9, 12–14, Pl. XLIX, f. 19–23, 25, Pl. LI *a*, f. 1–6.

¶ Mitteil. Zoolog. Samml., Berlin, 1898, i. pp. 77–81. Pl. III, f. 3.

** Proc. Mal. Soc., 1900, iv. pp. 103–113. Pl. IX.

continent of Asia. Indeed it is somewhat remarkable that the family has survived even in Ceylon, for several of the more highly developed forms have invaded that island. Probably the *Acavinae* owe their survival to the protection and nourishment which they give to their young until the latter have reached a large size. A parallel may be drawn between the *Acavinae* and the Elasmobranch fishes. The Elasmobranchs form a very ancient group, which is far more primitive in most of its characters than the great majority of modern fish; yet they have survived to the present day and have attained an unusually large size. This is probably due to the care which they bestow upon their young: some have very big eggs like *Acavus*, others are viviparous like *Stylodonta*, but, in both cases, the young grow to a very large size before they make their appearance in the world.

We have now seen what happened to three of the four subfamilies into which the *Acavidae* became divided, when their original home broke up into four large islands. Only the African division remains to be dealt with.

The descendants of this branch of the family are now living in the west of the Cape Province and in the neighbouring part of German South-West Africa. As might have been expected, these snails are much more primitive than the *Acavinae*, being further from the centre of evolution. The eggs are not so large; the kidney is without an ureter; the jaw is striated, and secondary cusps are always present at least on the outer teeth of the radula. The reproductive system is without an appendiculum, but the free oviduct is usually much swollen, and the vas deferens is often closely bound to the penis.

Nor is it surprising to find that this subfamily has greater affinities with the *Strophocheilinae* than with the *Acavinae*, for recent researches have shown that the connection between Africa and Brazil probably remained long after the formation of the Mozambique Channel, although it is possible that Madagascar was reunited with Africa for a short period during Tertiary times, after the transatlantic connection had broken down. The resemblance between Pilsbry's figure of the pallial organs of *Gonyostomus multicolor*, from Southern Brazil, and the corresponding organs of *Trigonephrus* is undeniable; * and the irregular longitudinal folds which he shows inside the swollen free oviduct of the same South American species occur also in the South African forms. Moreover, the radula of this

* Cf. Man. Conch., 1902, xiv. Pl. XLIX, f. 8, with Pl. III, f. 1–4 in the present work.

species is very like that of *Dorcasia*, while in *Strophocheilus rosaceus* from Chili it is almost exactly intermediate between the types found in *Dorcasia* and *Trigonephrus*, and the jaw in the latter species is striate, as in the South African subfamily. Plate states that in *Strophocheilus ovatus* and *S. proximus* the duct from the posterior division of the liver opens into the muscular part of the stomach, while that from the anterior division opens into the thin-walled part in front of the muscular portion.* This is also the case in the South African snails, but in *Acavus* Randles states that both hepatic ducts open into the thicker-walled portion of the stomach.† Even the shell of *Borus* shows some resemblance to that of *Trigonephrus* in its colouring and the character of the lip; and in the form of the shell the most elongate species of *Trigonephrus* are not very unlike some of the South American species, such as *Strophocheilus* (*Borus*) *lutescens*.

As a whole, however, the South African subfamily is probably not quite so primitive as the *Strophocheilinae;* though here again we find that the southern genus *Trigonephrus* retains more primitive characters than *Dorcasia*, which is found further north. This is shown by the central tooth of the radula (which in *Trigonephrus* is of a more primitive type than in almost any other member of the *Acavidae*), by the shape of the kidney, and perhaps most strikingly by the shell; for in *Dorcasia* the shell is depressed, with a widely expanded lip, and has quite lost that resemblance to the Bulimiform members of the family which can still be traced in many of the species of *Trigonephrus*. There is, however, a small section of the latter genus in which the shell has also become depressed, and in which the reproductive organs have in some respects become more highly specialized than in the other southern species. Perhaps this may be due to a small secondary centre of evolution having arisen in the southern part of the area, where the conditions are more favourable than in the arid regions further north, and where the proximity of the coast may have led to some crowding of individuals. And possibly the evolution of *Anoglypta* in Tasmania might be attributed to a similar cause.

The climate of the Cape is much more like that of Europe than that of Brazil, and the South African *Acavidae* differ from the *Strophocheilinae* in that they have a strong resemblance in their external features to the true Helices of Europe. Indeed *Trigonephrus globulus* was once regarded as a variety of *Helix pomatia*,‡

* Sitz-Ber. Ges. naturf. Freunde, Berlin, 1896, p. 149.

† Proc. Mal. Soc., 1900, iv. p. 105.

‡ Chemnitz, Conch. Cab., 1786, ix. 2. Pl. CXXVIII, f. 1138*c*.

and until recently nearly all conchologists placed the species of both *Trigonephrus* and *Dorcasia* in the genus *Helix*. Not until 1905 was it discovered that these South African snails belonged to the *Acavidae*, and this is one of the many important discoveries which we owe to the wide researches of Dr. Pilsbry.* The resemblance between the South African and European forms is purely superficial: in their internal anatomy both *Trigonephrus* and *Dorcasia* are far more primitive than any of the dart-bearing Helices. This South African subfamily of the *Acavidae* may be named the *Dorcasiinae*.

But why are these snails only found in the extreme south-west corner of Africa? Since they occur in Madagascar and the Seychelles on the one hand, and in Brazil on the other, we might have expected that the *Acavidae* would have a much wider distribution in Africa, and there can be little doubt that they once did inhabit nearly half the continent. It is therefore necessary to explain why their African distribution is now so limited. The reason is probably this.

Long after the advent of the *Acavidae*, perhaps not until the Cretaceous period, there arose in the tropics of Africa a new group of snails, the *Achatininae*. The earliest members of this group were small and slender, being scarcely distinguishable from the living *Stenogyrinae*; but soon they grew amazingly, and adorned their shells with flaming streaks of colour. Larger and larger and very much broader became these snails until they resembled the *Acavidae*, especially the Bulimiform members of the family. The *Acavidae* were probably the only other large herbivorous snails in Africa, and with this family the *Achatininae* would inevitably come into competition. Now the *Achatininae* were a newer and more highly organized group than the *Acavidae*, and some of them became larger than any other snails on the face of the earth; it is therefore not surprising that the *Acavidae* gave way before them. The *Achatininae* multiplied and spread in all directions, and wherever they became abundant the *Acavidae* disappeared. They were too late to get all the way across to South America before the land-connection was broken by the sea; but they spread as far as St. Helena, and no members of the *Acavidae* are known to occur in that island. In the east the Mozambique Channel prevented them from invading Madagascar and the Seychelles, and the very few species of *Achatina* which are now found in those islands have probably made their way there comparatively recently. But there

* Proc. Mal. Soc., 1905, vi. p. 287.

was no barrier to prevent these large and vigorous snails from spreading southward; and southward they spread, exterminating the *Acavidae* as they went. When, however, they reached the south-west corner of Africa they found themselves on the horns of a dilemma: while the winter in this region was too cold to be agreeable to these snails of tropical origin, the summer was much too dry. Consequently their distribution received a check, and even to the present day very few members of the *Achatininae* have been able to penetrate into the area which lies west of the twenty-second degree of east longitude and south of the Tropic of Capricorn. In this region, therefore, the *Acavidae* have been able to survive; for the *Acavidae* is such an old family that it has had time to become acclimatized to all sorts of conditions, from the arid wastes of Namaland to the forests of Brazil.

Perhaps, in time, the *Achatininae* will evolve forms which are able to flourish in this region also, and then the *Acavidae* will be found no more on the African continent. But it seems more likely that the Helices which man has introduced into South Africa from Europe will constitute the most formidable competitors of *Trigonephrus* and *Dorcasia*. Civilization has upset the normal course of the evolution and distribution of animals; and, if the world lasts long enough, we might almost look forward to a time when all the larger snails and slugs in the temperate regions of the Southern Hemisphere will be of European origin.

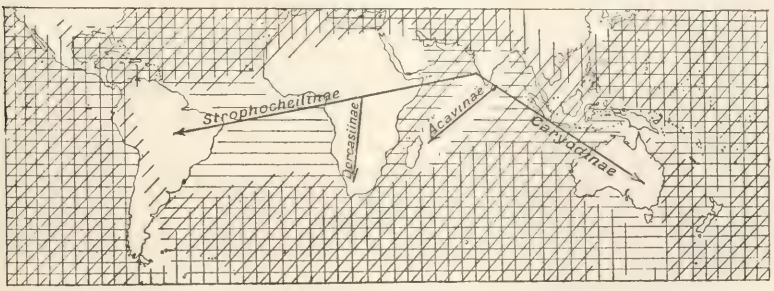


Diagram showing the possible spreading of the *Acavidae*.

Approximate area supposed to have been submerged in early mesozoic times.

Ditto ditto late mesozoic times.

Ditto ditto early tertiary times.

If this history of the *Acavidae* is correct, the general course of the evolution of the family might be summarized as follows. The *Aca-*

vidae arose at the beginning of the Mesozoic era somewhere near the middle of Gondwanaland; and the members of the family spread east and west and south, and underwent upward evolution in the centre. Then that ancient southern continent gradually broke up into four large islands (one of which became subdivided later), and the *Acavidae* became divided into four subfamilies, one in each region. Lastly, some of these subfamilies began to be exterminated by newer and more highly organized groups of snails.

But this story of the evolution and distribution of the *Acavidae* may not be true. Hedley has suggested that the family arose on the Antarctic continent.* Now it must be admitted that the climate near the South Pole was once much more suitable for the evolution of snails than it is at present, and it is very probable that the Antarctic continent was at one time united to both Australia and South America. Possibly it may have been united to South Africa also, but it is not necessary to invoke the aid of this highly problematical land-connection before we can accept Hedley's theory. Since the *Dorcasiinae* are so nearly allied to the *Strophocheilinae*, we might suppose that their ancestors had spread from the Antarctic to Africa by way of South America, having made use of the old connection between Africa and Brazil. Similarly the *Acavinae* might have reached their present home from the Australian region. But Hedley's hypothesis does not seem to explain the relative stages of development which have been attained by the different members of the family in so satisfactory a manner as the theory given above; and it certainly involves far greater assumptions; for we have no evidence at all that the *Acavidae* ever inhabited any part of the region which Hedley assumes was their original home. Moreover, Hedley's theory has been rejected by Pilsbry,† than whom there is no greater authority on the geographical distribution of snails. In writing about the *Acavidae*, Pilsbry goes so far as to state that "the radiation of this scattered group from the Palaeozoic Gondwana continent of Neumayr seems a reasonable, in fact the only tenable, hypothesis." ‡

Far more information, however, is needed about the comparative anatomy of snails before we can attach any great value to theories concerning the origin and evolution of the various families. Possibly further researches may show a more intimate relationship between some of the subfamilies of the *Acavidae* than at present

* Proc. Linn. Soc., N.S.W., 1899, xxiv. p. 396.

† Rep. Princeton Univ. Exped. Patagonia, 1896–99, iii. (1911), p. 631.

‡ Rep. Princeton Univ. Exped. Patagonia, 1896–99, iii. (1911), p. 614.

seems probable. Or perhaps connecting links may be found between one or two of these groups and snails now placed in other families. The line drawn between the *Acavidae* and the *Helicidae* is still somewhat vague; and perhaps the gap which separates the *Acavidae* from the *Corillinae*, *Camaeninae*, and *Polygyrinae* may be no greater than that which separates these subfamilies from the more highly organized *Helicinae*. If this is the case it is possible that just as the dart-bearing Helices have probably arisen from the more primitive *Helicidae*, so these may have in turn been evolved from the *Acavidae*. On the other hand, those genera of the *Helicidae* in which the reproductive system is most like that of the *Acavidae* have generally been found to possess very different pallial organs; and there is some ground for believing that the *Helicidae* may have arisen further north than the *Acavidae*, and that the resemblance between some members of the two families may be entirely due to convergent evolution. Perhaps a comparative study of the structure of the pedal gland in the two families might throw some light on this question.

The affinities between the *Bulimulidae* and the *Acavidae* are a little less doubtful, for the more primitive members of these two families show a decided resemblance to each other. Pilsbry has demonstrated that it is almost impossible to distinguish the Bulimiform *Acavidae* from the *Bulimulidae* by their shells *; and in their internal anatomy some genera of the latter family show an undoubted similarity to the *Acavidae*. Thus, according to Pilsbry's description and figures,† the genus *Macrodontes* is remarkably like the *Acavidae* in its pallial organs, its jaw, its radula, its retractor muscles, and in the general features of its reproductive system; and yet *Macrodontes* is placed in the *Bulimulidae* near *Odontostomus*, a genus which it closely resembles in its conchological characters. The theory that the *Acavidae* have arisen from the same stock as the *Bulimulidae* is also supported by a comparison of the distribution of the two families; for we find that the *Bulimulidae* are widely distributed in those regions of the world to which the primitive Bulimiform *Acavidae* have also become restricted, but that they occur nowhere else.‡ While, therefore, the two families have evolved along widely divergent lines, it seems not unlikely that the Palaeozoic group of snails from which the *Bulimulidae* have descended gave rise to the *Acavidae* also.

* Man. Conch., 1902, Index to vols x.–xiv. p. vii.

† Man. Conch., 1901, xiv. p. 29. Pl. V, f. 37, 38, Pl. XV, f. 28, 29.

‡ See Rep. Princeton Univ. Exped. Patagonia, 1896–99, iii. (1911), p. 630, f. 37.

And now, having taken as it were a bird's-eye view of the *Acavidae* as a whole, let us examine more closely those members of the family that live in South Africa.

Sub-Family DORCASIINAE, nov., 1915.

Shell rather large, perforate, elongate-globose to depressed-orbicular; fairly solid; usually almost unicoloured, with little ornamentation, transversely striate or costate, frequently showing malleation, but little or no spiral sculpture. Aperture large and toothless (except in *Tulbaghinia*), margin invariably thickened or reflexed.

External features of Animal.—Foot broad and rather short, more or less rounded at the hind end. Sole rather obscurely tripartite in *Dorcasia*, but undivided in *Trigonephrus;* covered by a ciliated columnar epithelium, and apparently without unicellular glands. Rest of skin divided into polygonal rugae. There are no well-marked peripodial, dorsal, or median posterior grooves, but a lateral groove runs down on each side from the mantle-edge to the head. The right lateral groove ends in the genital opening, which is almost as far forward as the upper tentacles, but lies nearer the foot. Beneath the lower tentacles there is a pair of broad and conspicuous labial lobes. No caudal mucous pore is present.

Mantle-edge thick, usually with right and left body-lobes. The left lobe is often divided into two widely separated portions, one near the respiratory opening, the other on the left side of the animal; but in most cases the two portions are united by a fold (see text-fig. 2, A, and Pl. IV., figs. 3–6). There are no shell-lobes.

Respiratory system.—Mantle-cavity or lung rather short. Pulmonary veins branching over the whole of its roof; usually rather more numerous between the respiratory opening and the pericardium and kidney than elsewhere, but never forming a very dense network. The first branch of the pericardial vein is almost as large as the main pulmonary vein, and runs forward nearly parallel to it, a large afferent vein lying between them. Beyond the first branch, the pericardial vein gives off one or two smaller branches, which alternate with afferent veins coming from the mantle-edge. Small efferent and afferent veins also cross the space between the rectum and the kidney and the main pulmonary vein (see text-fig. 2, A, and Pl. IV., figs. 1–6).

Heart and pericardium very oblique, the auricle lying nearer to the

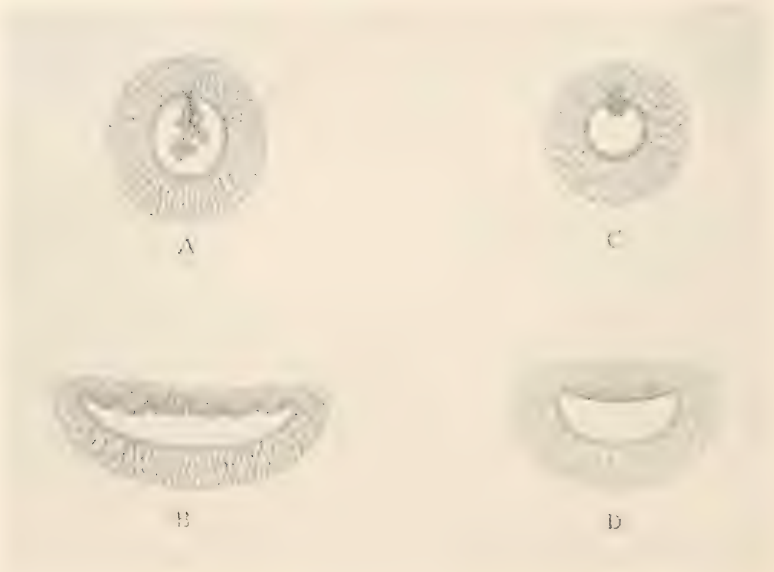
rectum than does the ventricle. A single aorta arises from the hind end of the ventricle and then divides into two vessels, one passing backwards to the liver and adjacent organs, the other bending round the anterior loop of the intestine and running forwards to supply the cephalic region with oxygenated blood.

Excretory system.—Kidney somewhat triangular, very broad in the middle, but tapering in front and behind; its walls much folded internally. Anterior end scarcely projecting beyond the front of the pericardium, but abruptly curved round towards the rectum, thus forming a kind of hook. There is no ureter, but the kidney seems to open on the posterior side of this hook. From this point a band of modified epithelium extends along the edge of the mantle-cavity as far as the respiratory opening, running back along the side of the kidney, and then curving round the hind end of the cavity and passing forward next to the rectum. It thus occupies the position usually held by the ureter in the more highly organized Sigmurethra. In *Dorcasia* a slight ledge or fold runs along the side of the kidney and rectum, overhanging this band; and in *Trigonephrus*, though this fold is not found on the side of the kidney, it is sometimes present on the rectum, being especially developed in *T. lucanus* (Pl. IV., fig. 4).

Pedal gland opening below the mouth, and extending backwards for two-thirds of the length of the foot; usually embedded in the pedal muscles, but emerging into the body-cavity for the greater part of its length in some species of *Dorcasia*. Towards the hind end, the gland is approximately circular in transverse section, with a central duct. An irregular longitudinal fold projects from the roof of the duct into the lumen (text-fig. 1, A, C). The wall of the gland is composed of a very thick layer of radially disposed gland-cells, within which is a thin layer of circular muscles immediately surrounding the epithelium of the duct. This epithelium is peculiar, consisting of small, very narrow cells, which project into the duct like cilia. The fold, however, has a more ordinary columnar epithelium, composed of broader cells with granular contents. The centre of the fold is pigmented in *Trigonephrus porphyrostoma*. Further forward the gland becomes flatter and much wider, the internal fold being broadened out to form the roof of the widened duct (see text-fig. 1, B, D). The gland cells do not converge to open in a median groove in the floor of the duct with a longitudinal ridge on each side of it, and the structure of the gland differs widely from that of the European forms described by André.*

* Revue Suisse de Zool., 1894, ii. pp. 291–348. Pls. XII, XIII.

Central nervous system.—Nerve-ring surrounding the buccal mass, the cerebral ganglia often lying in front of the opening of the oesophagus, and the rather long cerebro-buccal connectives being therefore frequently directed backwards. Cerebral ganglia rather close together, the cerebral commissure being short. In *Trigonephrus* the cerebral ganglia and the nerves arising from them are more or less surrounded by darkly pigmented connective tissue.



Text-Figure 1.

Transverse Sections through the Pedal Gland in the *Dorcasiinae* (somewhat diagrammatic).

A. *Trigonephrus porphyrostoma* (M. & P.); section near hind end of gland, × 9.
B. ,, ,, ,, ,, front end of gland, × 9.
C. *Dorcasia rogersi*, n. sp.; section near hind end of gland, × 15.
D. ,, ,, ,, ,, front end of gland, × 15.

The buccal retractor is innervated by a pair of nerves arising near the junction of the cerebral ganglia and the lateral connectives. Buccal ganglia widely separate, joined by a rather long commissure behind the opening of the oesophagus. Cerebro-pedal and cerebro-pleural connectives rather long. Pedal, pleural, parietal, and abdominal ganglia forming a compact ventral group, but none of them actually united, the abdominal ganglion tending to fuse

neither with the right parietal ganglion, as in the *Zonitidae*, nor with the left, as in the *Helicidae*. Left parietal ganglion much smaller than the other two visceral ganglia.

Digestive system.—Jaw of the usual crescentic form, with a slight median projection on the lower edge (except in *Trigonephrus globulus*); always without ribs, but covered with fine vertical striae (see Pl. IV., figs. 17–24). In *Trigonephrus* even fainter, though broader, oblique striae can also often be distinguished near the lower edge, diverging from the central projection.

Radula varying in size from $3{\cdot}9 \times 1{\cdot}3$ mm. in *Dorcasia rogersi* to $7\frac{3}{4} \times 4\frac{1}{4}$ mm. in *Trigonephrus rosaceus*, and possessing from 8,300 to more than 15,000 teeth (the number of teeth in each transverse row being a little less than the number of rows). Transverse rows straight or trending very slightly forward on each side. Bases of teeth quadrate, usually with a short flange projecting in front. Marginal teeth generally bicuspid; lateral and central teeth tricuspid in *Trigonephrus*, unicuspid in *Dorcasia;* but the transition from marginal to lateral teeth is very gradual. Central teeth not very much smaller than the laterals. (See text-fig. 2, B, and Pl. IV., figs. 9–16).*

Buccal mass muscular and rather large, the odontophoral muscles reaching back on each side as far as the end of the radula-sac in adult specimens of *Trigonephrus porphyrostoma* and *T. namaquensis*, so that in these species the end of the sac no longer projects as a papilla (compare Pl. IV., figs. 7, 8). Oesophagus and salivary ducts short (see Pl. IV., figs. 25, 26). Salivary glands generally meeting both above and below the alimentary canal, but only loosely united with each other. Crop narrow in the majority of specimens, but sometimes much distended, as in the example figured by Pilsbry.† In *Dorcasia coagulum* and *D. rogersi* the connective tissue surrounding the crop and salivary glands is darkly pigmented. Stomach sac-shaped, consisting of an anterior thin-walled portion in continuation with the crop, and a posterior portion with thicker muscular walls, from which the intestine passes

* The radula in this sub-family seems especially liable to malformation. In a specimen of *Trigonephrus globulus* belonging to Professor Gwatkin, as well as in one of the examples of *Dorcasia alexandri* var. *rotundata* dissected by the writer, the teeth in ten or fifteen adjacent transverse rows were all greatly shortened, and some of the outer marginals were suppressed altogether. In another specimen of *T. globulus* five of the teeth in each transverse row were abnormally large, being formed, in at least some cases, by the union of two adjacent teeth; and there were thus five separate longitudinal rows of abnormal teeth in the radula.

† Proc. Mal. Soc., 1905, vi. Pl. XIII, fig. 8.

forward ventrally. The intestine then bends upward and backward, and follows an S-shaped curve to the left of and above the crop and stomach, finally passing forward again into the rectum, which continues to the respiratory opening.

Liver consisting of two separate divisions of nearly equal size, the stomach lying between them. The anterior division is somewhat flattened, and is divided into three main lobes by the intestinal loops among which it lies. The ducts of these lobes unite to discharge by a single opening into the thin-walled portion of the stomach. The posterior division occupies (with the hermaphrodite gland) the upper whorls of the shell, and discharges by a duct opening into the posterior muscular portion of the stomach.

Free retractor muscles.—Right and left tentacular retractors separate from each other and from the "tail muscle" nearly to their origin on the columella. Each divides rather far forward into the retractors of the upper and lower tentacles, having first given off branches on its inner side to the anterior part of the foot. Right upper tentacular retractor passing between the penis and the vagina. Retractors of lower tentacles (and lips) thicker than usual. Buccal retractor generally united at its origin with the left tentacular retractor, but only for a very short distance excepting in *Dorcasia alexandri* var. *rotundata;* not bifurcating in front, but having a semicircular insertion around the under side of the buccal mass. Buccal protractors consisting of numerous small strands. Penial retractor arising dorsally from the front end of the floor of the lung.

Reproductive system (text-fig. 2, C, and Pl. V., figs. 1–8).—Hermaphrodite gland composed of numerous very narrow follicles embedded in the inner side of the posterior division of the liver. Hermaphrodite duct densely convoluted, but usually very slender, though somewhat swollen in *Trigonephrus gypsinus* and *T. lucanus*. Vesicula seminalis long and conspicuous. Albumen gland often very large. Common duct not convoluted or twisted. Free oviduct rather short, much swollen in *Trigonephrus*, and having irregular longitudinal folds projecting into its cavity. Receptaculum seminis, or spermatheca, oval, lying against the left side of the common duct. Receptacular duct usually moderately long, always without a diverticulum. Vagina long, excepting in *Trigonephrus globulus*, *T. gypsinus*, and *T. namaquensis*, in which it is rather short and slightly swollen. Genital atrium, or vestibule, extremely short, being scarcely developed at all.

Penis long and muscular, with internal longitudinal folds. In *Trigonephrus* these folds are corrugated (Pl. IV., figs. 27–29); in

Dorcasia both the folds and the intervening furrows are covered with diagonal rows of very minute papillae (Pl. IV., fig. 30). Penis-papilla absent or quite vestigial. Penial retractor attached to the posterior end of the penis, which is usually curved. A short epiphallus, lined by longitudinal rows of small papillae, is developed in *Trigonephrus* (excepting in *T. lucanus*), but it is not clearly marked off from the narrower vas deferens. The posterior part of the vas deferens next to the penis is slightly convoluted in *Trigonephrus*, and more strongly so in *Dorcasia alexandri* var. *rotundata*. In *Dorcasia* the vas deferens is usually only loosely united to the side of the penis, being nearly detached in *D. alexandri*, and in *Trigonephrus lucanus* it is quite free; but in the more globular species of *Trigonephrus* the vas deferens and epiphallus are very closely attached to the wall of the penis, the vas deferens being practically embedded in it towards the genital atrium in some forms, such as *T. namaquensis*. Followed backwards, the vas deferens bends under the female duct and curves up the right side of the swollen free oviduct in most of the species of *Trigonephrus;* and in these forms the receptacular duct arises on the left side. But in *Dorcasia* and in *Trigonephrus lucanus*, the vas deferens keeps to the left of the female duct, and the receptacular duct arises on the right side, and crosses over the junction of the free oviduct and the common duct.

Much connective tissue unites the vagina, free oviduct, and common duct to the adjacent body-wall; and at the junction of the two latter ducts this tissue is so abundant that it seems to form a partial septum across the body-cavity.

Spermatozoa (Pl. V., figs. 9–11).—Head varying in length from ·005 to ·006 mm.; tapering in front, and curving alternately to the right and left; broader behind, especially in *Trigonephrus*. Tail extremely long; proximal portion, or middle-piece, surrounded by very delicate spiral filaments or flanges, of which there usually appear to be three. An irregular, oval, flexible spermatophore is formed.

Eggs.—According to Binney, Gibbons stated that the eggs of *Trigonephrus globulus* were of a very large size.* It is probable, however, that in this sub-family they do not attain such large dimensions as in some genera of the *Acavidae;* for although the embryonic shell is not clearly differentiated from the succeeding whorls, it evidently does not reach the enormous size found in some members of the family.

* Ann. N.Y. Acad. Sci., 1880, i. p. 361.

Such are the chief characters found in those species of *Trigonephrus* and *Dorcasia*, of which it has been possible to examine the anatomy. Whether these features are possessed by *Tulbaghinia* also, it is at present impossible to say, for no specimens of this genus have been available for dissection.

Distribution.—South-West Africa, chiefly near the coast and in the neighbourhood of rivers, from Algoa Bay and Montagu in the Cape Province to the Northern borders of Damaraland.

Genus TRIGONEPHRUS, Pilsbry, 1905.

Proc. Mal. Soc., vi. p. 286.

Shell rather large, elongate- to compressed-globose, perforate, fairly solid, almost unicoloured. Whorls 4–5, rapidly increasing, all but the earliest covered with close faint transverse striae following the lines of growth, usually combined with a considerable amount of malleation, and, in some species, inconstant tracts of close, microscopic, spiral sculpture. Aperture large; peristome interrupted, margins externally thickened, sometimes to a considerable extent backward from the lip, and narrowly reflexed.

Animal differing from *Dorcasia* in the following respects. Foot-sole entire, without any longitudinal grooves. Kidney broader at the anterior end than in *Dorcasia*, with no fold along its right side. Pedal gland more or less embedded in the muscles of the foot. Cerebral ganglia pigmented. Jaw rather broad, and more than 2 mm. long. Radula about twice as long as it is broad; teeth larger than in *Dorcasia;* central and lateral teeth tricuspid; in the marginals the endocone gradually unites with the mesocone, and in the outer teeth the ectocone often disappears, though most of the marginals are bicuspid; bases of central teeth usually a little shorter than the mesocones.

Reproductive system: free oviduct greatly swollen; receptacular duct less than twice the length of the free oviduct; excepting in *T. lucanus*, the receptacular duct does not cross the common duct, and the vas deferens curves round the right side of the free oviduct, is closely bound to the penis, and terminates in a short epiphallus; penis containing rows of prominent rugae, or short papillae, which fuse with one another to form corrugated longitudinal ridges.

Distribution.—South-West Africa, for the most part in sandy

scrub near the coast, from Algoa Bay and Montagu, in the Cape Province, to the Southern districts of Damaraland.

Genotype. *T. globulus* (Müller).

In their general anatomy the species of this genus that have been dissected agree very closely with one another. Only in the reproductive organs of *T. lucanus* do we find any marked divergence from the common type. The radula is very constant throughout the genus, the specific differences being slight; and the tricuspid condition of the central and lateral teeth forms, perhaps, the most striking character of *Trigonephrus*. So far as is known, this feature is found in no other genus of the *Acavidae;* and Pilsbry has pointed out that the presence of side-cusps in *Trigonephrus* indicates that it is a relatively primitive member of the family.*

There can be little doubt that in its tricuspid central teeth *Trigonephrus* retains a feature which was possessed by the ancestors of the group, but has been lost by nearly all the other members of the *Acavidae*. It is not so certain, however, that these ancestral forms possessed tricuspid lateral teeth. Pilsbry has justly stated that as a rule "all modifications in the teeth proceed from the median line of the radula outwards towards the edges, the outer marginal teeth being the last to be modified"; and that "a study of the marginal teeth, therefore, gives a clue in many cases to the ancestral condition of a much modified radula."† Now if we examine the marginal teeth of *Trigonephrus*, we find that while the ectocone is, from its first appearance on the outer teeth, a separate cusp, the endocone arises by the bifurcation of the mesocone, with which it is united in the marginal teeth (see especially Pl. IV., fig. 11). It therefore seems not unreasonable to suppose that the endocones on the lateral teeth of *Trigonephrus* may have thus arisen from the mesocones in evolution, and that the ancestral *Acavidae* may have had bicuspid lateral teeth. According to the principles explained when discussing the distribution of the *Acavidae*, the most primitive members of the family should be found, not in South Africa, but in the more remote regions of South America, which are furthest from the centre of evolution. It is therefore specially significant that in the radula of *Strophocheilus rosaceus*, King, from Chili (judging from a specimen, found at Coquimbo, in Professor Gwatkin's magnificent collection), while the central teeth are tricuspid, as in *Trigonephrus*, both the lateral and the marginal teeth are bicuspid, without

* Proc. Mal. Soc., 1905, vi. p. 288.

† Man. of Conch., 1895, ix. p. xiii.

endocones. It seems possible, therefore, that in this form the ancestral type of radula has been retained, while in the other members of the family the lateral teeth have become modified to match the central teeth, beginning with those nearest the middle. In most forms the central teeth have lost their secondary cusps, and the ectocones on the lateral teeth have accordingly disappeared; but in *Trigonephrus* the central teeth have remained tricuspid, and the lateral teeth may have come to resemble them by the inner portions of their bifid mesocones becoming separated to form small endocones similar to the ectocones. When the teeth in the radula are numerous and arranged in nearly straight transverse rows, it is evident that all those towards the centre will have very similar functions, and that the right and left sides of any one of these teeth will have much the same work to do; and we might therefore be surprised if the central and lateral teeth did not tend to become like each other, the cusps of the laterals becoming more symmetrical.

A parallel case occurs among the true Helices of Europe. Nearly all of these have bicuspid lateral teeth, though the mesocones are frequently bifid. But in *Helix aperta*, Born, and *H. subaperta*, Ancey, the laterals are tricuspid, as in *Trigonephrus*, the inner portions of the mesocones having separated to form true endocones.

The internal structure of the penis in most of the species reminds one of Wiegmann's figure of the penis of *Papuina vitrea*.*

Some of the shells of *Trigonephrus* have long been a source of trouble to students.

Müller's originals of *T. globulus*, *rosaceus*, and *lucanus* are preserved in the Copenhagen Museum. Drs. Nordmann and Jensen of that Museum have kindly compared specimens, furnished by myself, of the shells which usually pass under the above names in British collections with the originals, and have reported that *globulus* and *lucanus*, as generally known, are quite correctly identified, and that the *rosaceus*, though not exactly agreeing with the Type, is undoubtedly conspecific.

This preliminary matter being determined, it is possible to prescribe means whereby the more puzzling forms may be distinguished.

The actual shape and size of the shell, and, to a less extent, the coloration and sculpture, may vary greatly in the same species; but, in a large array of material, I have failed, so far, to disprove the

* Abh. Senckenb. Naturf. Ges., Frankfurt, 1898, xxiv. Pl. XXXI, f. 8.

constancy of two features, namely, the colour of the peristome and the relative shape of the aperture.

As regards the former, though exceptions may of course exist, I have never seen *T. lucanus* or *namaquensis* with any but a white peristome, nor good specimens of the remaining species, *globulus*, *gypsinus*, *rosaceus*, *porphyrostoma* and *ambiguosus*, with other than a deeply coloured one.

With regard to the second point, we have what may be roughly divided into two forms of aperture, one drooping, the other outstanding. In *T. globulus* the upper end of the outer lip is comparatively further away from the columella than in *rosaceus*, so that it forms with the body whorl an obtuse external angle of about 125°, and imparts to the aperture a drooping appearance. In *rosaceus* the ends of the aperture appear to be comparatively nearer together, the outer lip consequently leaving the body whorl at a much sharper angle of about 105°, so that the aperture appears to be flatter and more outstanding.

T. namaquensis has the drooping *globulus* aperture, while *T. porphyrostoma* and *gypsinus* have, more nearly, that of *T. rosaceus*. *T. lucanus* and *ambiguosus* form, of course, a separate group.

Certain species of *Trigonephrus* exhibit, under a strong lens, irregular patches of granular, or of a kind of close, incised, spiral sculpture. These are usually present where there is least malleation, but are of very partial and uncertain occurrence, and cannot, in my opinion, be regarded as constant factors in determining the specific position of a shell.

Trigonephrus globulus (Müller).

(Pl. II, f. 1, 2. Pl. IV, f. 1, 7, 9, 17, 27. Pl. V, f. 1, 9.)

1774 *Helix globulus*, Müll., Verm. ii. p. 68. *D.*

Shell large, globose, umbilicate, solid, translucent, early whorls red-lilac above, later violet-blue, with occasional whitish mottling and small dark spots, and a narrow infra-sutural white band; underpart paler, almost white; peristome, callus, and interior reddish purple. Spire somewhat produced, apex rounded. Whorls 5, rounded, regularly and rapidly increasing, the apical smooth, remainder covered with very fine, close, transverse striae, with irregular malleation on the upper part of the later whorls and occasional traces of microscopic spiral sculpture. Suture well defined, subcrenulate. Aperture quadrate-ovate; peristome thick-

ened and somewhat reflexed, ends joined by a thin callus; outer lip making with the body whorl an angle of about 125°, and imparting a drooping appearance to the aperture. Columella erect, slightly concave, margin reflexed, partially concealing the narrow umbilicus.

Dimensions of a typical specimen from Hout Bay: Alt. max. 32·0; diam. 30·3; apert. 19·0 × 15·7 mm.; ends of peristome 15 mm. apart.

Animal of a single full-grown specimen from Milnerton, the shell of which measured about 32 mm. in altitude.—*

Colour drab, probably due to long immersion in alcohol; roof of mantle-cavity unpigmented. Body-lobes indistinguishable, owing to the bad preservation of the specimen. Principal pulmonary vein giving off more numerous transverse branches than usual (see Pl. IV., fig. 1, which also shows the form of the kidney, etc.).

Cerebral ganglia covered with grey connective tissue. Jaw 2·9 mm. long, more curved than usual, reddish brown and of moderate thickness, with scarcely a trace of a median projection (Pl. IV., fig. 17). Radula $6\frac{1}{2} \times 3\frac{1}{4}$ mm.; transverse rows of teeth almost straight; teeth relatively larger than in the allied species; centrals very similar to the laterals; outer marginals longer and narrower than usual, with single well-developed cusps (see Pl. IV., fig. 9); formula $(45 + 1 + 48) \times 115$. Radula-sac projecting beyond the buccal mass (Pl. IV., fig. 7).

Reproductive system (Pl. V., fig. 1): hermaphrodite duct slender, with broader convolutions than in the other species; vesicula seminalis club-shaped, rather thick; receptaculum seminis oval; anterior third of receptacular duct swollen; vagina short, somewhat swollen; vas deferens curving a little further round the free oviduct than usual; epiphallus longer than in the other species, being nearly one-third of the length of the penis; posterior part of penis curved; rugae on the longitudinal folds inside the penis diamond-shaped, being much narrower than in the remaining species (Pl. IV., fig. 27).

Hab. Cape Province. Generally distributed along the coast from Algoa Bay (*fide* Layard) to St. Helena Bay; Robben and Dassen Islands.

Type in Copenhagen Museum.

A large sinistral specimen, collected by Craven on Robben Island, is in the British Museum.

The late E. L. Layard, through whose hands passed most of the

* In order to avoid unnecessary repetition in describing the animals of the species, only those parts will be mentioned which have been found to differ in the various forms.

material sent home by the earlier collectors, left some valuable manuscript notes on the distribution of the Trigonephri, which, by Mr. Ponsonby's courtesy, I am enabled to publish. The record of *T. globulus* on Green Point Common is remarkable, as the species is now unknown there, having been completely ousted by the introduced *H. pisana*, Müll.

It will be noticed that Layard wrote in the days when only three species had been described, and he attributed every form to one or other of them, but this detracts but little from the interest of his notes, to which I shall have course to refer later.

"*Helix globulus*, Müll.—Various forms of this very variable shell are found on all sandy plains along the seaboard from Cape Agulhas to Walfisch Bay and Namaqualand. During the dry summer season they lie concealed, buried to a considerable depth in the sand, but on the fall of heavy rain they emerge from their retreats in thousands. I shall never forget my first sight of the living shells. I had found the sandy plain near Cape Town, known as Green Point, covered with the dead, bleached shells, but not a live one could I procure. Some friends even hinted at their being fossil and extinct, but I asserted they were too fresh-looking for that, and waited for the rains. They came, and I sallied out in the downpour, calling on an enthusiastic friend, C. A. F., to accompany me. On getting on to the Common, past the Battery, we found the surface of the ground literally heaving with the swarms coming up! They were everywhere! We gathered our handkerchiefs full, and as they emit a most copious, clear slime, we were soon covered with the sand which adhered to it and wet from head to foot with the pitiless downpour, and presented a draggle-tailed spectacle; but we agreed that the sight of tens of thousands, emerging from their long sleep, repaid us for all our dirt and discomfort.

"The specimens found near Cape Town, Kalk Bay and the Cape Flats may be taken as of fair medium size. They are about 31×29 mm. On Robben Island, a sandpatch in the mouth of Table Bay, there is a fine large variety, similar in colour, $38\frac{1}{2} \times 40$ mm. In Nord Hoek, not far from Kalk Bay, I took a small variety, fully formed shells varying from $25\frac{1}{2} \times 19\frac{1}{2}$ to 15×15 mm., shells purely white. In the George District there is a small variety, 19×19 mm., with a pale purple, or puce-coloured mouth. Another variety, probably from Algoa Bay, rather larger, $27\frac{1}{2} \times 25\frac{1}{2}$ mm., is much darker in the mouth, and the apex is also dark bluish purple.

"These seem to lead into the large solid shell, with the broadly recurved, heavy, purple lip, from Namaqualand, named *rosacea* by

Müller. The transition is through a shell resembling the Robben Island form, but with a rose-coloured lip and a general bluish-purple tint throughout, also found in Namaqualand. There are two forms of this, one globular, the other elongated, $44 \times 38\frac{1}{2}$ mm.

"There is yet another variety from Namaqualand, a small, stout, glossy form, $19{\cdot}5 \times 17$ mm., of a pinkish colour, of which I have only seen two examples.

"I am ignorant of the exact localities whence these varieties were severally procured; they were brought out by the late James Chapman, who also procured a solid white variety in Ovampoland.

"I suspect the coarse, solid shell of the variety called *rosacea* must be meant as a protection against the great heat and drought of the locality where found.

"The small purple-mouthed variety from George runs into one of the varieties of *Helix lucana*, Müll., from the same locality."

The shell selected for description is of average size, from Hout Bay, Cape Peninsula, and the animal is taken from a similar specimen, which was broken for anatomical purposes. This solid, bluish-purple form is that which is now found alive all over the extreme south-western corner of the Cape Province, the largest Peninsula example which I have measured being: alt. max. 37·6; diam. 33; apert. $23{\cdot}4 \times 17{\cdot}5$ mm.; and the smallest living one: alt. max. 25·7; diam. 25; apert. $15{\cdot}7 \times 12{\cdot}2$ mm.

Whether this form is of comparatively recent growth from a smaller one, I cannot say; but in an old shell mound at Milnerton are the subfossil remains of a smaller race, measuring about $22\frac{1}{2} \times 21\frac{1}{2}$ mm., and a somewhat similar variety is mentioned by Layard as existing, in bleached condition, at Nord Hoek. Almost the same is now found alive on Dassen Island (Pl. II., fig. 2), but the shell is thinner and apparently of a redder hue, with a browner peristome than the normal form.

This leads up to a very distinct local race, inhabiting the mainland at St. Helena Bay. In it, the shell nearly regains the size of typical *globulus*, which it also resembles in general shape and drooping aperture, but it is of thinner texture, rosy brown in colour, and the surface is more glossy and far more malleate. The four specimens known to me measure:—

Alt. max.	29·8;	diam.	28·5;	apert.	$17{\cdot}3 \times 14{\cdot}1$ mm.
,,	27·0;	,,	28·7;	,,	$16{\cdot}9 \times 13{\cdot}3$,,
,,	27·0;	,,	26·9;	,,	$15{\cdot}2 \times 12{\cdot}2$,,
,,	26·2;	,,	25·1;	,,	$13{\cdot}9 \times 11{\cdot}1$,,

This is the most northerly race of the true *globulus* which I have yet seen, for on reaching Namaland the drooping *globulus* aperture is transferred to the thin, white-lipped *T. namaquensis*, and the solid shells, which might otherwise be considered almost inseparable from *globulus*, have the projecting aperture of *T. rosaceus*.

The peristome is sometimes thickened a little squarely, but this feature is not usually nearly so marked as in *rosaceus* or *porphyrostoma*.

The anatomy of this species was described and figured by Pilsbry in 1905 *. Six years earlier Moss and Webb published a description and figure of the reproductive organs of a specimen from Robben Island † ; while so long ago as 1880 Binney described the jaw and radula and figured some of the teeth ‡. Pilsbry and Moss and Webb state that the jaw is smooth, which does not agree with the observations of the present writer: Binney merely says that it is without anterior ribs. Moss and Webb's figure does not show the swollen anterior end of the receptacular duct, but this is shown in Pilsbry's figures.

It will be seen by comparing fig. 9 with figs. 10 and 11 on Pl. IV. that, in the specimens examined, the teeth of the radula of this species are actually a little larger than those of *T. rosaceus* and *T. porphyrostoma*, notwithstanding that its shell, jaw, and reproductive organs are so much smaller. It is therefore not surprising to find that the number of teeth in each transverse row in *T. globulus* is usually less than in the other forms. Binney gives the number as about 81, Pilsbry as about 90, while in the specimen described above it is about 94.

Apart from the radula, perhaps the most distinctive anatomical characters of the present species are the jaw, the long epiphallus, and the internal structure of the penis. Further information is desirable about the external features of the animal.

Trigonephrus gypsinus (Melv. & Pons.).

(Text-fig. 2 and Pl. II, f. 3.)

1891 *Helix* (*Dorcasia*) *gypsina*, M. & P., A.M.N.H. viii. p. 238. *D.*

Shell elongate-globose, umbilicate, fairly solid, translucent, type bleached pale buff, peristome and callus apparently faded brown. Spire rather produced, apex rounded. Whorls 4, very

* Proc. Mal. Soc., vi. p. 286. Pl. XIII, f. 6–9, pl. XIV, f. 13, 15.

† Proc. Mal. Soc., iii. p. 264.

‡ Ann. N. Y. Acad. Sci., i. p. 361. Pl. XIV, f. K.

convex, rapidly increasing, sculpture very worn, apparently originally consisting of fine transverse striation, with faint malleation on the later whorls. Suture deep, simple. Aperture rather small, quadrately rounded; peristome thickened and slightly reflexed, the ends joined by a distinct callus, the outer lip making with the body whorl an angle of 105°; columella erect, margin strongly reflexed, partly concealing the narrow perforation.

Dimensions of Type: Alt. max. 24·5; diam. 20·2; apert. 13 × 10·9 mm.; ends of peristome 8·8 mm. apart.

Animal of two full-grown specimens from Wilde Paards Hoek.—

Colour (in alcohol): head and foot tinged with grey, the hind end of the foot being the darkest, mantle-edge grey to the left of the respiratory opening, but reddish and considerably swollen on the right side; roof of mantle-cavity unpigmented; upper whorls light yellow above the suture. Left body-lobe divided into two portions, which are connected by a fold or ridge; left division about as broad as the right, but lower. Pulmonary veins: a second large branch of the pericardial vein arises close to the origin of the first branch (text-fig. 2, A).

Cerebral ganglia covered with grey connective tissue. Jaw 2·9 mm. long, rather thin, light brown; resembling in form those of the three following species (cf. Pl. IV., figs. 18–20). Radula of the same specimen (the shell of which measured 24 × 24 mm.) $6\frac{1}{3} \times 3\frac{1}{4}$ mm.; transverse rows of teeth almost straight; centrals very similar to the laterals (text-fig. 2, B); formula, (53+1+53) × 133. Radula-sac projecting beyond the buccal mass.

Reproductive system (text-fig. 2, C): hermaphrodite duct long, swollen, and much convoluted; vesicula seminalis unusually long, rather broad distally but tapering proximally; receptaculum seminis oval and unusually large; receptacular duct somewhat swollen at its anterior end; vagina short, thicker behind than in front; epiphallus very short; penis curved at the hind end; rugae on the longitudinal folds inside the penis much broader than long, as in the three following species (cf. Pl. IV., fig. 28).

Hab. Little Namaland.

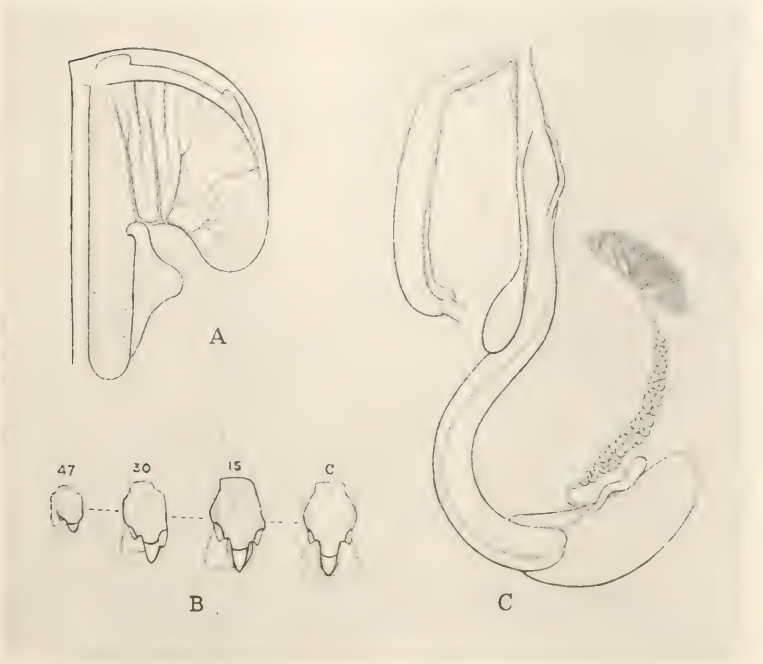
Type in British Museum.

This species having been founded on a bleached, subfossil shell, the original description is somewhat misleading. Some doubt, moreover, attaches to the correctness of the original locality, the fact that it was given as Springbok having led to a quite distinct form, *T. namaquensis*, var. *procerus*, being confounded with *gypsinus*.

A small series, collected by Dr. Rogers at Wilde Paards Hoek,

Little Namaland, has just come to hand, which appears to be quite conspecific with the subfossil Type, and as it includes two spirit-specimens, in excellent preservation, it has enabled me to present particulars of the animal.

In these shells the spire is comparatively less produced, their



Text-Figure 2.

Anatomy of *Trigonephrus gypsinus* (M. & P.).

A. Pallial organs.
B. Teeth from the radula, × 200.
C. Reproductive organs, × 3.

form being globose, rather than elongate-globose, but they agree with the Type in its two main characteristics, the very convex whorls and peculiarly small, rounded aperture. The colour is uniform pinkish drab, except the peristome and thin callus, which are pale rosy brown. The sculpture, on all but the $1\frac{1}{2}$ apical whorls, consists of extremely faint, close, transverse striation, and shows considerable malleation, especially on the upper portion of the last $1\frac{1}{2}$ whorls.

The dimensions vary from :—

Alt. max. 24·4 ; diam. 24·5 ; apert. 13·6 × 10·1 mm.

to ,, 22·3 ; ,, 20·2 ; ,, 11·5 × 9·2 mm.

I have also seen a very bleached example, apparently referable to this species, from Kaitop.

Probably *T. gypsinus* is a relatively primitive member of the genus. In its internal anatomy it possesses very few distinctive characters which are not shared by one or other of the remaining species, but in no other form do we find all these features combined. Perhaps it is most nearly related to *T. rosaceus*, but it differs from that species in its short vagina, swollen hermaphrodite duct, and a few other characters. From *T. globulus* it may be easily distinguished by its jaw, epiphallus, and penis ; while the coloration of the animal at once separates it from *T. namaquensis*, which it somewhat resembles in the lobes on its mantle-edge and in its internal anatomy. The number of transverse rows of teeth in the radula of this species is larger than in any other known member of the genus, and in this respect *T. gypsinus* resembles *Dorcasia*.

The animals were received too late for illustrations of their anatomy to be included in Plates IV. and V., but the accompanying text-figure shows some of their more important characters.

Trigonephrus rosaceus (Müller).

(Pl. II, f. 4, 5. Pl. IV, f. 10, 18. Pl. V, f. 2.)

1774 *Helix rosacea*, Müll., Verm. ii. p. 76. *D.*

Shell large, globose, umbilicate, fairly solid, translucent, shading from pinkish buff on the earlier, to bluish violet on the last whorl; interior nacreous blue, aperture and paries purple-brown. Spire but little produced; apex rounded. Whorls 5, very convex, rapidly increasing, all but the apical covered with close, straight, regular, transverse striae, and showing occasional traces of close, faint, spiral sculpture ; upper surface strongly malleate. Suture deep, subcrenulate. Aperture lunate ; peristome thickened and reflexed, ends joined by a very slight callus ; outer lip making with the body-whorl an angle of 105°. Columella obliquely concave, margin half concealing the deep umbilicus.

Dimensions of a fairly typical specimen from between the Holgat and Orange Rivers : Alt. max. 39·2 ; diam. 42·0 ; apert. 24·5 × 20·5 mm. ; ends of peristome 16·5 mm. apart.

Animal of the same specimen.—

Colour (in alcohol) light grey, darkest towards the hind end of

the foot; mantle-edge a darker shade of grey; roof of mantle-cavity unpigmented. Body-lobes very small, the two divisions of the left lobe being represented by a small low ridge near the respiratory opening, and a little triangular flap on the left side of the animal. Pulmonary veins similar to those of the next species, the first branch of the pericardial vein arising nearer to the main pulmonary vein than in *T. globulus* (cf. Pl. IV., fig. 2).

Cerebral ganglia covered with pale grey connective tissue. Jaw 3·65 mm. long, thick, dark brown (Pl. IV., fig. 18). Radula $7\frac{3}{4} \times 4\frac{1}{4}$ mm.; transverse rows of teeth nearly straight; centrals with rather broad bases and narrow median cusps (Pl. IV., fig. 10); formula, $(62 + 1 + 66) \times 124$. Radula-sac projecting beyond the buccal mass.

Reproductive system (Pl. V., fig. 2): hermaphrodite duct slender, closely convoluted; vesicula seminalis club-shaped, rather thick, as in *T. globulus;* receptaculum seminis somewhat elongate; receptacular duct only very slightly swollen at the anterior end; vagina long and rather narrow; vas deferens slightly convoluted for only a very short distance next to the epiphallus, instead of for nearly half the length of the penis, as in the other species; epiphallus very short; penis very abruptly curved near the hind end; rugae on the longitudinal folds inside the penis much broader than long, as in *T. gypsinus* and the two following species (cf. Pl. IV., fig. 28).

Hab. Little Namaland. Between the Holgat and Orange Rivers; Koingnaas (Rogers). Port Nolloth; Anenous (Day).

Type in Copenhagen Museum.

The shell figured is the only one known to have been taken in live condition. Though a good average example of the species, it does not quite equal Müller's Type in size or exactly resemble it in all detail. Dr. Jensen writes that the Type, an *unicum*, is an old, somewhat worn specimen, upon which the sculpture only appears locally, and the spire is a little obliquely deformed; it has a rather broader mouth and more pronounced wrinkled transverse sculpture than the figured shell, but there is no doubt that the latter is to be referred to *H. rosacea*, Müll.

This species appears to be very variable in size, while the comparative height of spire and strength of sculpture are by no means constant; in some examples the malleation is so pronounced as almost to efface the striation, while in others there is little malleation and the striation is far more clear. In all specimens which I have seen, however, the shell is globose in shape, as compared with the more elongate *T. porphyrostoma*, and the

sculpture is much finer, never approaching the coarse, rib-like striation of the last-named species.

The aperture, as before mentioned, projects more out to the side than that of *globulus*, and affords a ready means of distinction. The margins, moreover, are sometimes thickened backwards for as much as 3½ mm., and then squarely grooved, rather than reflexed; but this feature is quite inconstant, even among specimens from the same locality.

The large form of *T. rosaceus* seems to be pretty generally distributed in the neighbourhood of the Lower Orange River, though I have no definite localities for it except Port Nolloth. A smaller form, which from its sculpture and aperture probably represents a local race of the same species, is depicted on Pl. II., fig. 5. It has only come to hand so far in bleached condition, from Anenous and Koingnaas.

Judging from the single specimen dissected, the reproductive organs of *T. rosaceus* differ from those of both the preceding forms in the long vagina, and in the very small extent to which the vas deferens is convoluted. From *T. globulus* this species also appears to differ in its jaw, receptacular duct, epiphallus, and penis; and from *T. gypsinus* in its mantle-edge, hermaphrodite duct, and vesicula seminalis.

Trigonephrus porphyrostoma (Melv. & Pons.).

(Pl. II, f. 6. Pl. IV, f. 2, 11, 19, 25, 28. Pl. V, f. 3. Text-fig. 1, A, B.)

1891 *Helix (Dorcasia) porphyrostoma*, M. & P., A.M.N.H. viii. p. 238. *D.*

Shell large, slightly elongate-globose, deeply rimate, solid, just translucent, shading in colour from pale pink on the earlier, to bluish grey on the later whorls; peristome and interior purple-brown. Spire somewhat produced, very nearly as long as the aperture; apex rounded. Whorls 5½, convex, rapidly increasing, all but the first two faintly and irregularly malleate above, and covered with straight transverse striæ, which become coarse and more distant with the growth of the shell, and assume a rib-like appearance towards the aperture. Suture deep, subcrenulate. Aperture quadrate; peristome reflexed and much thickened, ends joined by a distinct callus; outer lip making with the body-whorl an angle of nearly 120°. Columella erect, margin broadly reflexed, almost concealing the narrow perforation.

Dimensions of a typical specimen from between the Holgat and

Orange Rivers: Alt. max. 41·5; diam. 39·7; apert. 23·5 × 20·4 mm.; ends of peristome 18·3 mm. apart.

Animal of full-grown specimens from the same locality, the shells of which measured about 45 mm. in altitude.—

Colour (in alcohol) grey, the hind end of the foot, the sole and the mantle-edge being the darkest; roof of mantle-cavity unpigmented. Left body-lobe irregularly swollen, its two divisions united by a fold. Pulmonary veins similar to those of the last species, the first branch of the pericardial vein arising nearer to the main pulmonary vein than in *T. globulus* (Pl. IV., fig. 2).

Cerebral ganglia covered with grey connective tissue. Jaw 3·7 mm. long, thick, dark brown (Pl. IV., fig. 19). Radula $7\frac{1}{2} \times 4\frac{1}{4}$ mm., transverse rows of teeth almost straight; centrals narrow, with rather inconspicuous side-cusps; outer marginals unusually broad; mesocones prominently bifid on a larger number of teeth than in the other species (Pl. IV., fig. 11); formula of one specimen $(61+1+62) \times 124$, of another $(63+1+62) \times 128$. Radula-sac not projecting beyond the hind end of the buccal mass.

Reproductive system (Pl. V., fig. 3): hermaphrodite duct slender, closely convoluted; vesicula seminalis rather small, swollen at the end but very narrow proximally; receptaculum seminis oval; receptacular duct not swollen; vagina long and rather narrow; epiphallus very short; penis abruptly curved at the hind end; rugae on the longitudinal folds inside the penis much broader than long (Pl. IV., fig. 28).

Hab. Little Namaland. Port Nolloth; T'Kaigas; between the Holgat and Orange Rivers; Koingnaas.

Great Namaland. Ghous; Angra Pequena.

Type in British Museum.

The shell is separable from that of *T. rosaceus* by its more elongate spire and coarser, rib-like striation on the last whorl. The peristome almost invariably shows the square external thickening, which is an irregular feature in the preceding species.

Both in the general appearance of the animal, however, and in most of the details of its internal anatomy, *T. porphyrostoma* closely resembles *T. rosaceus*, and it is evident that these two forms are very nearly allied; yet the radula of *porphyrostoma* differs considerably from that of *rosaceus*, especially in the form of the central teeth, and slight differences seem to be present in some of the soft parts, such as the vesicula seminalis. Moreover, as the specimens examined of both species were found in the same locality, these differences may be regarded as having a greater systematic importance than if the

specimens had been collected in different districts. The anatomical evidence seems, therefore, to support the view that *T. porphyrostoma* and *T. rosaceus* are distinct, though closely related, species.

Trigonephrus namaquensis (Melv. & Pons.).

(Pl. II, f. 7. Pl. IV, f. 3, 8, 12, 20. Pl. V, f. 4.)

1891 *Helix* (*Dorcasia*) *namaquensis*, M. & P., A.M.N.H. viii. p. 237. *D.*

Shell slightly elongate-globose, narrowly perforate, thin, smooth, semitransparent, uniform yellow-brown, interior nacreous, peristome white and glossy. Spire moderately produced, about three-fifths the length of the aperture; apex very blunt. Whorls $4\frac{1}{2}$, rounded, rapidly increasing, all but the apical covered with very faint, close, regular, straight, transverse striae, and rather faint, irregular malleation, with occasional traces of close, microscopic, spiral sculpture. Suture simple, well defined. Aperture ovate; peristome narrowly reflexed, outer lip making with body-whorl an angle of about 130°; callus faint. Columella erect, slightly concave, margin rather broadly reflexed, almost concealing the narrow perforation.

Dimensions of a specimen from "South Africa": Alt. max. 26·3; diam. 24·9; apert. 16·1 × 13·4 mm.; ends of peristome 11·7 mm. apart.

Animal of the above and another specimen from the same locality, one incomplete and the other immature.—

Colour (in alcohol): foot and mantle-edge pale yellowish buff; head tinged with grey on the top; roof of mantle-cavity conspicuously mottled with black, the mottling extending back over the pericardium, but being most concentrated just behind the mantle-edge and near the rectum; numerous irregular black patches occur on the outer surface of the roof of the cavity, while minute black specks are sparsely scattered over its inner surface. Left body-lobe divided into two portions connected by a very slight fold or ridge; left division much smaller than the right. Pulmonary veins: two chief efferent vessels bifurcating not very far from their origin (Pl. IV., fig. 3).

Cerebral ganglia covered with dark grey connective tissue. Jaw of the full-grown specimen 2·75 mm. long, thin, yellow-brown (Pl. IV., fig. 20). Radula 6 × 3 mm., transverse rows of teeth nearly straight; centrals with rather narrow median cusps (Pl. IV., fig. 12); formula (53 + 1 + 55) × 114. Radula-sac not projecting beyond the hind end of the buccal mass in the full-grown specimen.

Reproductive system (Pl. V., fig. 4): hermaphrodite duct and vesicula seminalis absent from the mature specimen, having been left in the shell with the posterior division of the liver when the animal was extracted; receptaculum seminis rather large, tapering posteriorly; receptacular duct scarcely thickened towards the anterior end; vagina short, swollen posteriorly; epiphallus very short; penis somewhat curved at the hind end, swollen near the genital opening, the vas deferens being more deeply embedded than usual in the wall of the swollen part; rugae on the longitudinal folds inside the penis much broader than long, as in the last three species (cf. Pl. IV., fig. 28).

Hab. Little Namaland. Quaggafontein; Ookiep; Wilde Paards Hoek; hills west of Groen Kloof (Rogers); Muishond; Meskiep; Kamaggas (Schultze).

Type in British Museum.

This uncommon but rather widely distributed species is easily recognizable by its thin brown shell and white peristome.

The colouring of the animal also distinguishes it from all the preceding species. Possibly the concentration of the dark pigment into black patches and spots on the roof of the mantle-cavity is connected with the thinness of the shell, which would allow more light to penetrate to the lung than in the case of forms with thicker shells. In its internal anatomy *T. namaquensis* closely resembles *T. gypsinus;* but it differs from that species, as well as from the other members of the genus, in the enlarged base of the penis.

Trigonephrus namaquensis (Melv. & Pons.), var. procerus, nov., 1915.

(Plate II, f. 8, 9.)

1912 *Trigonephrus gypsinus*, M. & P. (*pars*), Conn., Ann. S.A. Mus. xi. p. 155.

Shell comparatively small, ovate, perforate, thin, nearly transparent, uniform pale corneous except the umbilical region and peristome, which are white; interior nacreous. Spire produced, about two-thirds the length of the aperture; apex obtusely rounded. Whorls $4\frac{1}{2}$, inflated, rapidly increasing, covered, after the first two, with extremely faint, regular, close, transverse striae, and faint, irregular pitting or malleation, hardly visible without a lens, which imparts to the surface a slight appearance of spiral sculpture. Suture deep, simple. Aperture quadrate-ovate; peristome slightly reflexed; outer lip making with the body-whorl an obtuse angle of

120°, and giving to the aperture the drooping appearance of *T. globulus*; callus none. Columella erect, with conspicuous wrinkles of growth on the broad upper margin, which is strongly reflexed, almost concealing the deep, narrow perforation.

Alt. max. 22·8; diam. 19·0; apert. 12·7 × 9·0 mm.; ends of peristome 6·5 mm. apart.

Animal unknown.

Hab. Little Namaland. Ookiep (Lightfoot; Day; Rogers). Buffels River (Rogers).

Type in coll. Ponsonby.

The shell selected as Type is the only good specimen I have seen. Its finding-place is uncertain, but bleached shells, exactly agreeing with it in form and substance, have been brought on more than one occasion from the neighbourhood of Ookiep, whence the Type also was probably derived.

Another white-mouthed race, very similar in form to the above, but of thicker substance, is found further south at Clanwilliam and apparently also at Kangnas and Areb, which may bear, for the present, the same varietal name, although I think that when live specimens are discovered they may be found to constitute a distinct species. Intermediates between these unusually elongated races and the typical form of *namaquensis* also occur and establish a connection between them, which would hardly be apparent if the extremes alone were considered. A peculiarly small example from Clanwilliam is shown on Plate II., fig. 9.

Trigonephrus lucanus (Müller).

(Pl. II, f. 10. Pl. IV, f. 4, 13, 21, 29. Pl. V, f. 5, 10.)

1774 *Helix lucana*, Müll., Verm. ii. p. 75. *D.*

Shell rather large, subglobose, deeply umbilicate, rather thin, translucent, chestnut-brown, paler underneath, with a narrow infrasutural white line; peristome white; interior pale brown. Spire moderately elevated, apex blunt. Whorls 5, rounded, rapidly increasing, all except the first 1½ covered with very close, faint, regular transverse striae, extending more faintly into the umbilicus, and faint malleation, more pronounced towards the aperture. Suture rather shallow and crenulate. Aperture truncate-ovate; peristome slightly thickened and reflexed, ends joined by a faint callus. Umbilicus narrow but deep, extending to the apex.

Dimensions of a typical specimen from Cape Point, which agrees

with Müller's originals: Diam. maj. 29·2, min. 23·2; alt. max. 20·0; apert. 16·7 × 13·5 mm.; ends of peristome 7 mm. apart.

Animal of specimens from Montagu, the shells of which measured about 24 mm. in diameter, and a single, larger, but immature specimen from Kommetje, which had a white shell.—

Colour (in alcohol): foot and mantle-edge pale; top of head and neck tinged with grey; roof of mantle-cavity streaked and spotted with dark grey, the pigment extending back over the pericardium, but being most abundant along the three principal blood-vessels and near the rectum; the mottling is coarser in the Kommetje specimen than in those from Montagu. Left body-lobe consisting of two divisions connected by a fold or ridge, the left division being broad but very low, scarcely projecting further than the connecting fold. Pulmonary veins showing a simple generalized arrangement. The fold, which runs along the side of the rectum and projects into the mantle-cavity next to the band of modified epithelium, is well developed in this species and somewhat sinuous (Pl. IV., fig. 4).

Cerebral ganglia covered with pale grey connective tissue. Jaw (of the Kommetje specimen) 2·55 mm. long, rather thin, reddish brown along the lower edge; ends squarer and edges more nearly parallel than in the preceding species. In a Montagu specimen the jaw is similar, but smaller. Radula (of a Montagu specimen) $5 \times 2\frac{1}{2}$ mm.; transverse rows of teeth nearly straight; centrals similar to the laterals, but a little smaller (Pl. IV., fig. 13); formula $(43 + 1 + 43) \times 114$. In the Kommetje specimen the radula measures $6\frac{1}{2} \times 2\frac{1}{2}$ mm., the teeth are larger, and the formula is $(35 + 1 + 36) \times 113$ Radula-sac projecting beyond the buccal mass.

Reproductive system (Pl. V., fig. 5): hermaphrodite duct swollen and much convoluted; vesicula seminalis rather long, curved, somewhat swollen distally but tapering proximally; receptaculum seminis oval, rather large; receptacular duct crossing the anterior end of the common duct, shorter than usual, and rather thick; vagina long; vas deferens keeping to the left of the female duct, not attached to the side of the penis; epiphallus absent; penis very long, curved and contorted, the bends occupying different positions in different specimens; rugae on the longitudinal folds inside the penis larger but relatively flatter than in the other species, each crossed by a narrow white ridge (Pl. IV., fig. 29).

Hab. South-western districts of the Cape Province. Montagu; Bredasdorp; Avontuur; Hermanus; Rabiesberg, Worcester Div.; Cape Peninsula, from Kalk Bay and Hout Bay to Cape Point.

Type in Copenhagen Museum.

E. R. Sykes has chronicled the existence of a sinistral specimen.

Layard's note on this species runs :—

"*Helix lucana*, Müll.—Another variable and rather widely distributed species, but as yet I have not procured it beyond the limits of the Colony, and in it, chiefly along the Southern seaboard.

"The brown variety, with white band along the suture, is found pretty abundantly about Kalk Bay, in the sand under bushes. A smaller variety, with a brownish purple mouth, is found in the George District; a small variety (diam. 17, alt. 13 mm.) with a white mouth, is not uncommon at Bredasdorp, while a large white form (diam. 32; alt. 25½ mm.) exists at Mossel Bay."

The first of the above forms is, of course, the typical *lucanus*, and the last must be referable to bleached specimens of *ambiguosus*. The other two are more open to doubt, as I have been unable to trace an authentic example from either of the localities mentioned, but it is reasonable to infer that the form from the George District may be *T. ambiguosus*, var. *compactus*, described hereafter; and that from Bredasdorp, the doubtful species No. 3 on p. 176.

T. lucanus has possibly undergone a slight diminution in size during recent times, for in a subfossil set, collected by J. S. Gibbons at Kalk Bay, are solid, coarsely malleated examples attaining such dimensions as :—

Diam. maj. 38·6, min. 31·0 ; alt. max. 29·5 ; apert. 21·1 × 14·9 mm.
and ,, 32·4, ,, 25·5 ; ,, 22·0 ; ,, 15·5 × 13·7 ,,

but, in other respects, not varietally separable from Type. The smaller of these shells is remarkable, in that its thick, white callus helps to make a practically continuous peristome, it being almost impossible to mark where the latter ends and the callus begins.

I have collected at Kommetje a white-shelled mutation of *lucanus*, agreeing with the normal form in other respects; the shells found inland at Montagu are slightly smaller and thinner than the coastal race, but cannot be considered even varietally distinct.

While in its radula and in most of its other organs *T. lucanus* agrees closely with those species which have already been described, in its depressed shell and in some features of its reproductive system it departs considerably from the preceding forms, and bears a slight superficial resemblance to the genus *Dorcasia*. The complete detachment of the vas deferens from the side of the penis has doubtless been brought about by the extraordinary

increase in length of the latter organ. Perhaps *T. lucanus* might be regarded as one of the least primitive members of the genus.

Trigonephrus ambiguosus (Férussac).

(Pl. II, f. 11).

1821 *Helix* (*Helicella*) *ambiguosa*, Fér., Tabl. Syst. Moll. pt. 3. p. 47. *L.*

1848 *Helix lucana*, Müll., var. *β*, *peristomate aurantiaco*, Pfr., Mon. Hel. viv. i. p. 332.

1850 *Helix lucana*, Müll. (*ambiguosa*, Fér.), Desh., Hist. Nat. Moll. pl. X B, f. 3–5. *F.*

1910 *Dorcasia ponsonbyi*, Fulton, A.M.N.H. vi. p. 212. *D.*

Shell rather large, depressed-globose, umbilicate, of moderate thickness, translucent, bright corneous above, much paler, shading to grey, beneath; peristome and callus bright orange-brown. Spire but little raised, apex sub-mamillate, bluntly rounded. Whorls $4\frac{1}{2}$, rounded, rapidly increasing, the first $1\frac{1}{2}$ smooth, remainder covered with close, faint, curved striae, becoming rather fainter beneath, with little malleation, but with tracts of microscopic granular sculpture, which is most apparent on the upper portion of the last whorl. Suture simple, shallow. Aperture truncate-ovate; peristome narrowly reflexed and a little thickened, ends joined by a thin callus. Umbilicus deep, but narrow and a little strangulate.

Dimensions of a cotype of *ponsonbyi* from Mossel Bay, in my collection: Diam. maj. 28·3, min. 23·1; alt. max. 15·8; apert. 15·7 × 11·7 mm.; ends of peristome 7·7 mm. apart.

Animal unknown.

Hab. Cape of Good Hope. Le pays des Hottentots (Férussac); Mossel Bay (Gibbons); Vleesch Bay (Power).

Type of *ambiguosa*, *ubi*? that of *ponsonbyi* in British Museum.

Férussac first published the name *ambiguosa* among a number of other uncharacterized species, but gave an acceptable locality. Deshayes' conception of the species as *lucanus* is erroneous, but as he expressly states, in the explanation of his plate, that the shell thereon figured as *lucanus* is *ambiguosa*, Fér., the latter name is clearly established. The figure in question is a very good one of *Dorcasia ponsonbyi*, Fulton, and this name must, therefore, be relegated to synonomy.

The comparative breadth of the last whorl varies greatly in this species. In most examples it expands considerably towards

the aperture, but in some much more so than in others, and this expansion influences the shape of the umbilicus, which becomes more crooked and strangulated in proportion to the amount of expansion. This point, together with the more flattened shell and coloured peristome, serves to distinguish *ambiguosus* at a glance from *lucanus*, in which none of these characters appear. Fulton mentions the microscopic granular sculpture on the last whorl as being of specific value in his description of *ponsonbyi*. In the examples which I have seen, this feature, though usually present, does not appear to be quite constant, but, on the other hand, I have never seen a fairly recent specimen in which the peristome did not show traces of colour, and have no reason to doubt that this character affords one of the surest methods of identification.

I have examined two good series of *ambiguosus*, from Mossel Bay and Vleesch Bay. The latter shells are more solid, and show more variation than the former. The dimensions of a few specimens, taken at random, are :—

Diam. maj.	33·0 ;	min.	26·30 ;	alt. max.	19·0
,,	34·75 ;	,,	27·0 ;	,,	19·5
,,	25·8 ;	,,	22·2 ;	,,	15·8

It is to be hoped that animals of this species may be procured and dissected, in order to find out whether the reproductive system shares those peculiarities which occur in *T. lucanus*.

Trigonephrus ambiguosus (Fér.) var. compactus, nov., 1915.

(Pl. II, f. 12.)

Shell subglobose, umbilicate, rather thin, semitransparent, chestnut-brown above, shading to greyish white beneath ; peristome and callus yellow-brown. Spire moderately elevated, apex blunt. Whorls 5, moderately convex, rather gradually increasing, the apical smooth, remainder covered with close, faint, regular, transverse striae, with occasional faint malleation, especially on the upper surface of the last whorl, and a suggestion of microscopic granular sculpture, which is less apparent than in typical *ambiguosus*. Suture simple, rather shallow. Aperture rounded-ovate ; peristome narrowly reflexed, ends joined by a thin callus. Columella weak and concave, margin scarcely overhanging the deep, narrow umbilicus.

Diam. maj. 24·1; min. 20·8; alt. max. 19·2; apert. 13·5 × 10·8 mm.; ends of peristome 7·7 mm. apart.

Animal unknown.

Hab. "South Africa."

Type in my collection.

I have seen three specimens, all nearly alike; the locality is doubtful, but it seems reasonable to suppose that they represent the form mentioned by Layard on p. 158 as inhabiting the George District.

If this is truly a variety of *ambiguosus*, it is indeed a remarkably aberrant one; but there is nothing in its coloration and sculpture, as well as in the general formation of its base and aperture, which is not consonant with its belonging to a close-coiled, high-spired race of the Mossel Bay form, and therefore, so long as the animal is unknown and the locality doubtful, I prefer to give it varietal rank, which it certainly deserves, rather than specific, to which it may not be entitled.

Genus DORCASIA, Gray, 1838.

(Alexander's Expedition, ii. p. 268.)

Shell rather large, depressed or depressed-globose, perforate, usually rather thin and corneous with little or no ornamentation. Whorls 5–6, rather gradually increasing; sculpture consisting of fairly close, transverse, sometimes costate striae, which are more marked and regular than in *Trigonephrus*, where they pertain rather to the nature of growth-lines. Aperture rather small; peristome interrupted or continuous, seldom thickened, but more or less broadly reflexed. Umbilicus sometimes deep and perspective, but more frequently shallow and eccentric.

Animal differing from *Trigonephrus* in the following respects. Footsole rather indistinctly tripartite, having two shallow grooves, which diverge from a point about $1\frac{1}{2}$ mm. in front of the hind end, and can be traced forward nearly to the anterior end of the sole. Kidney narrower at the anterior end than in *Trigonephrus;* having a slight fold or ledge running along its right side, and overhanging the band of modified epithelium which takes the place of the ureter. Pedal gland tending to emerge into the body-cavity. Cerebral ganglia usually unpigmented. Jaw rather narrow, and less than 2 mm. long. Radula nearly three times as long as it is broad; teeth smaller than in *Trigonephrus;* central and lateral teeth unicuspid; marginals usually bicuspid, rarely tricuspid owing to

the doubling of the ectocone; bases of central teeth usually longer than their cusps. Reproductive system: free oviduct not much swollen; receptacular duct more than twice the length of the free oviduct, crossing the front end of the common duct; vas deferens keeping to the left of the free oviduct, usually loosely bound to the penis, not terminating in an epiphallus; penis longitudinally folded inside, and lined by diagonal rows of very minute papillae.

Distribution.—Usually in the vicinity of rivers in the sandy deserts of Great and Little Namaland, extending eastward into Bechuanaland and northward through Damaraland.

Genotype *Dorcasia alexandri*, Gray.

Dorcasia is undoubtedly very closely allied to *Trigonephrus*. The two genera, however, can be distinguished externally, both by the sculpture and lip of the shell, and by the footsole of the animal; while internally they differ in their digestive, reproductive, and excretory systems, the difference in the radula being the most striking (see Pl. IV., figs. 9–16).

On the whole *Dorcasia* seems to be a rather more highly specialized genus than *Trigonephrus*, and it is probably not quite so old. It has therefore been thought advisable to describe *Trigonephrus* first and *Dorcasia* afterwards.

Dorcasia coagulum (von Martens).

(Pl. III, f. 1. Pl. IV, f. 5, 14, 22, 26, 30. Pl. V, f. 6.)

1889 *Helix coagulum*, von Mts., Sitz.-Ber. Ges. Nat. Fr. Berlin p. 160. *D.*

1897 ,, von Mts., Archiv f. Naturg. lxiii. i. p. 37. Pl. VII, f. 11–14. *D.F.*

Shell rather large, subglobose, narrowly umbilicate, thin, translucent, pale corneous above and at sides, with irregular blotches and streaks of opaque cream; apex brown; base and peristome white; interior colourless, exhibiting the markings of the exterior. Spire somewhat produced, apex roundly obtuse. Whorls $5\frac{1}{2}$, rounded, rather gradually increasing, all but the $1\frac{1}{2}$ apical covered with close, faint, regular, transverse striae, becoming much fainter beneath. Suture simple, of moderate depth. Aperture truncate-ovate; peristome slightly reflexed, ends joined by an extremely faint callus. Umbilicus very deep and narrow, somewhat strangulate.

Dimensions of a specimen from Fielding's Chabeesies, nearly agreeing in shape with those of the Type set: Diam. maj. 22·8,

min. 18·5; alt. max. 17·2; apert. 13·2 × 11 mm.; ends of peristome 5·6 mm. apart.

Animal of specimens from Fielding's Chabeesies and Stinkfontein.—Colour (in alcohol): whitish, tinged with grey towards the hind end of the foot and on the head; mantle-edge pale, but roof of mantle-cavity greyish near the edge, and along the rectum and one or two of the chief veins. Left body-lobe consisting of two portions connected by a fold, both divisions being prominent, though the left one is narrow (see Pl. IV., fig. 5, which also shows the arrangement of the pulmonary veins and the form of the kidney, in which features the present species does not differ much from the other members of the genus). Pedal gland partially embedded in the muscles of the foot.

Jaw 1·6 to 1·7 mm. long, rather narrow, thin, yellow-brown (Pl. IV., fig. 22). Radula of a Fielding's Chabeesies specimen, the shell of which measured 24 mm. in diameter, 4·6 × 1·8 mm.; transverse rows of teeth trending slightly forwards on each side of the middle line, where they form a very obtuse angle; cusps of inner marginals longer than in the other species (see Pl. IV., fig. 14, which shows the shapes and sizes of individual teeth); ectocones can be distinguished on about 70 per cent. of the teeth, though they are sometimes very small; formula (45 + 1 + 45) × 137. A specimen from Stinkfontein had a very similar radula measuring 4·6 × 1·9 mm., the teeth being almost identical in appearance with those figured, and the formula being (48 + 1 + 48) × 135. Crop and salivary glands surrounded with darkly pigmented connective tissue (Pl. IV., fig. 26).

Reproductive system (Pl. IV., fig. 30; Pl. V., fig. 6): hermaphrodite duct very slender and closely convoluted; vesicula seminalis rather small; free oviduct somewhat swollen; receptaculum seminis small, with a slender duct; vagina rather long; vas deferens rather closely bound to the penis for the greater part of its length; penis long, curved posteriorly.

Hab. Great Namaland. Between Aos and the Orange River. Little Namaland. Stinkfontein; Fielding's Chabeesies.

The Type set is in the Berlin Museum.

It consists of two shells, one so bleached that its ornamentation is unrecognizable; the other smaller and apparently some time deceased, but showing clearly the beautiful mottling, which is such a prominent characteristic of the species. With the Types is another bleached example, agreeing with them in form, from the Lower Orange River.

The height of spire varies greatly. Von Martens gave the measurements of his larger shell as: Diam. maj. 24, min. 19; alt. 20 mm.; and his smaller one, as measured by myself, is: Diam. maj. 20, min. 15·4; alt. max. 14 mm. Most of the examples brought by Rogers from Little Namaland are comparatively lower in the spire, measuring 25·3 × 20·5 × 15·5; 22·8 × 19 × 15·6; 22·6 × 18·5 × 15·2; 22·5 × 18·2 × 13·8; and 21·5 × 17·3 × 13·6 mm. In all of these the umbilicus is a little smaller and less overhung by the columellar margin than in the Type pair, but the discrepancy is not sufficient to necessitate varietal distinction. The callus is variable, being entirely absent in some fully formed shells and quite distinct in others.

This species might perhaps be regarded as one of the more primitive members of the genus, though the radula is of a somewhat specialized type. In the form of the shell and reproductive organs *D. coagulum* approaches *Trigonephrus* more nearly than do the other known species of *Dorcasia;* nevertheless the sculpture of the shell, the tripartite footsole, the form of the kidney, the internal structure of the penis, and especially the unicuspid central and lateral teeth of the radula, prove beyond doubt that this species belongs to the genus *Dorcasia.*

The shell is peculiar for South Africa, being far more reminiscent of the Mediterranean *H. vermiculata,* Müll., than of the neighbouring forms of its own genus.

Dorcasia rogersi, sp. nov., 1915.

(Pl. III, f. 2, 3. Pl. IV, f. 15, 23. Pl. V, f. 7. Text-fig. 1, C, D.)

Shell rather small, umbilicate, depressed orbicular, fairly solid, translucent, calcareous, creamy white, with slight, irregular, fawn blotches and spots, which are chiefly present on the third whorl; apex pale corneous; peristome white. Spire depressed, but each whorl, in profile, projects clearly above the next; apex rounded. Whorls 5, narrowly rounded, regularly increasing, the two apical smooth, remainder prettily sculptured with close, transverse striae, which become rather coarser and less regular towards the aperture and are hardly visible on the base. Suture deep, very little crenulate. Aperture almost circular; peristome reflexed, ends joined by a very slight callus. Columella very weak, margin slightly thickened and reflexed, but not approaching the umbilicus, which is perspective and very deep, but not wide.

Diam. maj. 21·1, min. 17·5; alt. max. 11·7; apert. 9·7 × 8·9 mm.; ends of peristome 4·3 mm. apart.

Animal of specimens from T'Kaigas :—

Colour (in alcohol) whitish, roof of mantle-cavity tinged with grey near the edge and along the rectum. Pallial organs very similar to those of *D. coagulum* (cf. Pl. IV., fig. 5). Pedal gland partially embedded in the muscles of the foot, especially at the hind end (Text-fig. 1, C, D).

Jaw 1·3 mm. long, rather narrow, thin, yellow-brown (Pl. IV., fig. 23). Radula of specimens, the shells of which measured about 21 mm. in diameter, 3·9 × 1·3 mm. ; transverse rows of teeth trending slightly forwards on each side of the middle line, where they form a very obtuse angle ; teeth broad and short (Pl. IV., fig. 15) ; ectocones are present on about two-thirds of the teeth ; formula of one specimen (35 + 1 + 37) × 128, of another (30 + 1 + 30) × 137. Crop and salivary glands surrounded with darkly pigmented connective tissue.

Reproductive system (Pl. V., fig. 7) : hermaphrodite duct long, very slender, and closely convoluted ; vesicula seminalis rather small ; free oviduct scarcely swollen ; receptaculum seminis small, with a slender duct ; vagina long ; vas deferens rather closely bound to the anterior half of the penis, but only loosely attached further back ; penis rather small and slender, curved at the hind end.

Hab. Little Namaland. T'Kaigas (Rogers).

Type in South African Museum.

Eight examples, the smallest measuring : Diam. maj. 18·3, min. 14·8 ; alt. max. 8 ; apert. 8·5 × 7·4 mm.

I have founded this new species on a series of small shells in perfect condition, of which some of the animals have been available for dissection. It is possible, however, that the Type represents the smallest race of a species which usually attains much greater dimensions, for I have seen examples from Henkries District, Little Namaland, apparently conspecific with those from T'Kaigas, but attaining such dimensions as :—

Diam. maj. 27·9, min. 21·7 ; alt. max. 12·2 ; apert. 14·0 × 11·4 mm.
and „ 33·9, „ 26·8 ; „ 18·0 ; „ 18·5 × 14·2 „

The last of these is illustrated on Pl. III., fig. 3. They are too long dead to be classified with any certainty, but they agree in form with the smaller shells, and show calcined traces of a mottling, which would probably correspond, in life, to that which appears on the early whorls of the Type set.

Although connecting links may doubtless be found, all these shells, large and small, can at present be clearly distinguished from other

known species of *Dorcasia*. They have neither the continuous peristome of *alexandri* nor the open umbilicus and comparatively small aperture of *cernua*, while *coagulum* is a more globose form, with more rapidly increasing whorls.

In many features of its internal anatomy *D. rogersi* bears a close resemblance to *D. coagulum*. The radula, however, is very distinct; for not only are there fewer teeth in each transverse row, but the shape of the teeth is different, the inner marginals being quite unlike those of *D. coagulum*, as will be seen from the figures. The reproductive organs are very simple, the relatively small size of the penis being, perhaps, the most characteristic feature.

I should not be surprised to find that the new species is more nearly allied to *D. cernua*, when live examples of the last-named are available for examination; the difference in the umbilicus and aperture, however, should always afford means of distinction.

Dorcasia cernua (von Martens).

(Pl. III, f. 4.)

1889 *Helix cernua*, von Mts., Sitz.-Ber. Ges. Nat. Fr. Berlin, p. 161. *D.*

Shell large, flat, deeply umbilicate, rather thick and solid, but translucent, type bleached white, but exhibiting faint traces of mottling, which would probably represent patches of colour in a live specimen. Spire hardly raised. Whorls $5\frac{1}{2}$, rounded, gradually increasing, the last descending so abruptly and steeply in front that when the empty shell rests in its natural position the interior can hardly be seen; surface almost smooth, the fine, close, regular transverse striation, which is present on all but the first $1\frac{1}{2}$ whorls, being only just visible without a lens. Suture shallow. Aperture comparatively small, ovate; peristome thickened and reflexed, ends joined by a thick callus. Umbilicus wide and deep, extending to the apex.

Dimensions of Type: Diam. maj. 30·5, min. 24·5; alt. max. 12·5; apert. 14·3 × 10·7 mm.; ends of peristome 5·5 mm. apart.

Animal unknown.

Hab. Great Namaland. Angamthal; Kuibis; Rooiberg (subfossil).

Type in Berlin Museum.

With this is another subfossil shell from Rooiberg, near Bethany. It is much smaller than the Type, spire more raised, sculpture slightly more pronounced, whorls 5, the last not descending so far nor so

abruptly. Aperture almost circular, the ends joined by so thick a callus as to make the peristome practically continuous. Umbilicus wide and deep, as in the Type, and it is owing to this feature, in particular, that I agree with von Martens in considering the two shells conspecific.

The measurements of this smaller form are : Diam. maj. 19·3, min. 15·6 ; alt. 9·4 mm.

The abrupt final descent of the last whorl, which causes the entire peristome to lie flat on the ground and conceal the aperture when the shell is in its normal position, is not of such specific value as it was considered by von Martens. In large series, both of *D. alexandri* and its var. *rotundata*, I have seen some examples in which this feature is very marked, while, in the generality of specimens, the descent is either less abrupt or less extensive, so that the interior of the empty shell is plainly visible from the front, when the shell is laid in its normal position.

As will be seen from the figures, the Type, with its extraordinarily flattened spire and small aperture, looks almost like an abnormal example ; but Dr. Thiele informs me that there are two more subfossil shells, from Kuibis, in the Berlin Museum, both very similar to the Type, so that the form is probably well established and distributed, and should be easily distinguishable from others of the genus.

Dorcasia alexandri, Gray.

(Pl. III, f. 5.)

1838 *Dorcasia alexandri*, Gray, Alexander's Expedition, ii. p. 268. *D.*

Shell large, depressed-globose, rimate-perforate, rather thin, translucent, type bleached white, but normally corneous ; peristome white. Spire but little raised ; apex obtuse. Whorls 5, the later rapidly increasing, all but the $1\frac{1}{2}$ apical covered with very fine and close, regular, curved transverse striae, almost disappearing on the base ; last whorl swollen, so that it is nearly as high as the spire, ascending slightly at the suture and descending very abruptly, nearly perpendicularly, in front, almost concealing the aperture. Suture well defined, simple. Aperture rounded ovate ; peristome continuous, free, margins not thickened but widely and strongly reflexed, though not overhanging the perforation, which is narrow, strangulate, and so eccentric that a portion of the penultimate whorl is fully disclosed.

The measurements agreeing most nearly with those given in Gray's description, of a specimen in his Type set, are: Diam. maj. 32·6, min. 24·8; alt. max. 15·5; apert. 13·7 × 11·7 mm.

Animal only known from a single, slightly immature specimen, from "Herero and Namaland"!? examined by Simroth and Pilsbry. According to their descriptions and figures, the possession of the following characters distinguishes the typical form of *D. alexandri* from the other members of the genus.

Pedal gland lying free in the body-cavity. Jaw* "entirely smooth," with little or no median projection. Radula† with teeth resembling those of the var. *rotundata*, but broader in front, and the centrals and laterals with longer basal plates. Reproductive system‡: free oviduct not swollen, vagina long, vas deferens not attached to the side of the penis, but free throughout; penis rather long, becoming thicker and bending abruptly towards the hind end, extending 1½ mm. beyond its junction with the vas deferens, to form a short terminal caecum or flagellum, on the apex of which the penial retractor is inserted.

Hab. Great Namaland. Neighbourhood of the Great Fish River. Little Namaland. Neighbourhood of the Orange River.

Type set in British Museum.

Judging from the descriptions of Simroth and Pilsbry the typical form of *D. alexandri* differs widely from the other known members of the genus in possessing a smooth jaw and a terminal caecum on the penis; for in all the remaining forms that have been examined the jaw is transversely striated, and the penis scarcely extends at all beyond its union with the vas deferens, as will be seen from the figures. It must be remembered, however, that the observations of both these authors were made on the same specimen, which was stated to be badly preserved and slightly immature; and it is therefore to be hoped that further material will be collected in order that a new examination of the anatomy may be made.

Many varieties have been attributed to this species. The typical form is chiefly known from the neighbourhood of the Lower Orange River; I have seen one beautiful example of dark reddish-corneous hue, and it is possible that when further good species have been collected this coloration will be found to prevail in the comparatively smooth typical form, and to supply additional ground for its specific separation from varieties such as *rotundata*.

* Man. of Conch., 1895, ix. Pl. LX, f. 3.

† Ibid. Pl. LX, f. 6.

‡ Ibid., frontispiece, f. 3, and Ber. Senckenb. Naturf. Ges. Frankfurt, 1894, p. 94, text-figs.

Dorcasia alexandri, Gray, var. minor, O. Boettger.

(Pl. III, f. 6.)

1886 *Helix* (*Dorcasia*) *alexandri*, Gray, var. *minor*, Bttg., Ber. Senckenb. Naturf. Ges. Frankfurt, p. 22. Pl. II, f. 1.

Shell differing from typical *D. alexandri* in being smaller, and in having a comparatively higher spire, very slightly more pronounced sculpture above, and a deeper, less eccentric umbilicus.

Animal unknown.

Hab. Bechuanaland. Ghous.

Great Namaland. Geitsi Gubib.

Type in Senckenberg Museum, Frankfurt am Main.

The example figured, S.A.M. No. A 2818, from Geitsi Gubib, measures: Diam. maj. 22·6, min. 18·8; alt. max. 13·5; apert. 11·0 × 9·9 mm.

Böttger founded the variety on five specimens from Ghous, north of Smalvisch Kop, Gordonia, and gives the measurements as: Diam. 21–24; alt. 10–11½; apert. 10–10½ × 11–12 mm.

Almost every intermediate size between the typical form and the smaller variety can be found, the sculpture, height of spire, and consequent form of the umbilicus being by no means constant.

Dorcasia alexandri, Gray, var. rotundata, Mousson.

(Pl. III, f. 7. Pl. IV, f. 6, 16, 24. Pl. V, f. 8, 11.)

1887 *Helix alexandri*, Gray, var. *rotundata*, Mouss., J. de C. xxxv. p. 292. Pl. XII, f. 1. *D.F.*

1914 *Dorcasia alexandri*, Gray, var. *siegmanni*, Honigmann, Nachrichtsbl. d. D. Mal. Ges. lxiv. p. 29. *D.F.*

Shell depressed-globose, umbilicate, thin, semitransparent, pale corneous, peristome white and glossy. Spire depressed, each whorl, in profile, just projecting above the next; apex obtuse. Whorls 4¼, narrowly rounded, rapidly increasing, all but the apical sculptured with close, regular, transverse costae, which become closer and finer, but show very clearly, on the base and extend into the umbilicus; last whorl descending very abruptly in front. Suture deep, simple. Aperture rounded-ovate; peristome quite free, continuous, widely reflexed, but in no way overhanging the umbilicus, which is deep, but strangulate and very narrow.

Dimensions of a specimen from Rehoboth: Diam. maj. 21·1, min. 16·8; alt. max. 12·3; apert. 10·8 × 9·2 mm.

Animal of full-grown specimens from the same locality.—

Colour drab, possibly due to immersion in strong spirit; roof of mantle-cavity apparently unpigmented. Left body-lobe divided into two separate portions, the left being rather small and not connected with the right by any fold or ridge (see Pl. IV., fig. 6, which also shows the arrangement of the pulmonary veins and the form of the kidney). Pedal gland embedded in the muscles of the foot at its hind end, but emerging into the body-cavity further forward.

Jaw 1·9 mm. long, rather thin, golden-brown; broader towards the middle, more pointed at the ends, and rather more curved than in *D. coagulum* and *D. rogersi* (Pl. IV., fig. 24). Radula of a specimen, the shell of which measured about 21½ mm. in diameter, 5 × 1·8 mm.; transverse rows of teeth almost straight; teeth less diverse in shape than in *D. coagulum* and *D. rogersi;* outer marginals with squarer bases (Pl. IV., fig. 16); ectocones are present on about five-eighths of the teeth; formula (39 + 1 + 40) × 139. In another specimen several of the rows of teeth are abnormally shortened and crowded, the formula being (41 + 1 + 41) × 166, and the radula measures 5·2 × 1·8 mm. Crop and salivary glands apparently unpigmented. Buccal retractor united with the left tentacular retractor for a longer distance than in the other species.

Reproductive system (Pl. V., fig. 8): hermaphrodite duct very slender and closely convoluted; vesicula seminalis long; common duct abruptly curved at its anterior end; free oviduct scarcely swollen, receptaculum seminis larger than in *D. coagulum* and *D. rogersi*; vagina long; vas deferens very loosely attached to the side of the penis; the part next to the posterior half of the penis is closely convoluted, the convolutions being bound together by a sheath of connective tissue; penis long, curved and contorted, especially towards the posterior end, though the bends occupy different positions in different individuals.

Hab. Damaraland. Rehoboth District.

Type of *rotundata* in Zurich Museum; *siegmanni* in coll. Natermann.

The published figures of *rotundata* hardly convey a proper idea of the actual shell, as they entirely fail to show the well-marked basal sculpture, which is its most prominent characteristic. This unfortunate omission was the cause of its being re-described by Honigmann under the varietal name of *siegmanni*. However, at the instance of Herr Carl Natermann, cotypes of the last-named form have been compared by Dr. O. Stoll, of Zurich, with the type set of *rotundata*, and pronounced inseparable. Both were

described from the Rehoboth District, and are known, as yet, from no other locality.

In a large series, the shape of the peristome and the relative position of the umbilicus differ considerably. The peristome may be either acuminate-ovate or nearly circular; the last whorl, also, may descend very abruptly in front and cause the peristome to be entirely solute, or less abruptly, when the peristome may be almost adnate. The striation is not quite constant, being perceptibly closer in some specimens, both above and beneath, than in others.

The dimensions vary considerably, a few specimens, taken at random, measuring:—

Diam. maj.	25·2,	min.	20·0;	alt. max.	13·5;	apert.	12·2×11	mm.
,,	25·1,	,,	20·0;	,,	13·2;	,,	12·3×9·8	,,
,,	22·0,	,,	17·0;	,,	13·0;	,,	10·7×9·5	,,
,,	21·8,	,,	17·1;	,,	13·0;	,,	11·2×9·5	,,

This form differs anatomically from the other members of the genus that have been examined in several minor features, one of the most striking being the close convolution of the posterior part of the vas deferens. Although the vas deferens is not wholly detached from the side of the penis, as is said to be the case in the typical form of *D. alexandri*, it is much more loosely joined to it than in *D. coagulum* and *D. rogersi;* and it is interesting to note that this gradual separation of the vas deferens from the wall of the penis is correlated with the lengthening and contortion of the latter organ, just as in *Trigonephrus lucanus*. The jaw is striated, and the caecal prolongation of the penis, described as occurring in the typical form of *D. alexandri*, is absent from this variety.

Dorcasia alexandri, Gray, var. trivia, O. Boettger.

1910 *D. alexanderi*, Gray, var. *trivia*, Bttg., Abh. Senckenb. Naturf. Ges. Frankfurt, xxxii. p. 439. Pl. XXVIII, f. 3. *D.F.*

I have not seen this variety, the following notes on the Type being compiled from information kindly rendered by Dr. Haas.

Shell intermediate in size between the typical form and var. *minor*, but of thinner texture. The elevation of the whorls and general form of the aperture and umbilicus are similar to typical *alexandri*, but the sculpture consists of raised, rather distant costae, from $\frac{1}{2}$ to 1 mm. apart, whereas the fine striae of *alexandri* are far closer together, 3 to the mm. on the last whorl.

Animal unknown.

Hab. Damaraland. Khoma's Plateau.

Type in Senckenberg Museum.

Boettger founded this variety on 13 specimens, and gives the measurements as : Diam. 24–30 ; alt. 14–15 mm.

Dorcasia alexandri, Gray, var. perspectiva, nov., 1915.

(Pl. III, f. 8.)

Shell depressed-globose, umbilicate, thin, semitransparent, type pale buff, peristome white and glossy. Spire flattened, each whorl, in profile, just projecting above the next; apex obtuse. Whorls $4\frac{1}{2}$, very rounded, fairly rapidly and regularly increasing, the apical smooth, remainder beautifully sculptured with curved transverse costae, at first close, fine and regular, gradually becoming coarser and, towards the aperture, irregularly waved or broken and wider apart. The last whorl descends abruptly in front, but not so as to conceal the aperture entirely. Aperture roundly ovate; peristome continuous, broadly reflexed, quite free and clearly projecting from the last whorl, but in no part overhanging the umbilicus, which is broad and very deep, so that the apex is fully disclosed and quite transparent.

Diam. maj. 29·0, min. 22·0 : alt. max. 12·8; apert. 13·8 × 11·5 mm.

Animal unknown.

Hab. Damaraland. Omaruru River (A. Wohlfahrt).

Type in Kimberley Museum.

This is the most northerly form of *alexandri* yet known. The Type set, being almost subfossil, are nearly colourless, but would doubtless be pale corneous were they in live condition.

The shell differs from that of var. *trivia*, Boettger, in having even coarser sculpture, and in its umbilicus being very broad and deep instead of more or less shallow and narrow, as in other described forms of *alexandri*. The dimensions vary considerably. I have selected the largest example as Type ; others measure respectively :—

Diam. maj.	26·0,	min.	19·8;	alt. max.	11·0	mm.
,,	23·0,	,,	18·5;	,,	10·5	,,
,,	22·6,	,,	18·2;	,,	10·7	,,
,,	22·0,	,,	17·4;	,,	10·1	,,

A glance at *D. alexandri* and its varieties will show that, if they all belong to the same widely distributed species, it is an extremely

variable one. Little reliance can be placed on the comparative size of the shell, height of the spire, or shape of the aperture, but the perforation varies from a slit to a well, and the sculpture from fine and regular to irregular and costate. Moreover, the difference in anatomy between the only two forms which have yet been examined may well be more than merely varietal. It is quite possible, therefore, that, when we have a better knowledge of their anatomy and exact distribution, more than one of the so-called varieties of *alexandri* will be proved worthy of specific rank. On the other hand, it will be seen that the gradual, constant divergence from Type increases quite regularly in a northerly direction, from the rimate typical form with hardly visible sculpture in the south, through *rotundata* and *trivia*, to the widely umbilicate *perspectiva* with costate sculpture in the north. This gradual divergence is less incompatible with all the forms belonging to one species than if they were scattered about indiscriminately, irrespective of geographical restrictions. I therefore prefer, for the present, not to disturb the varietal arrangement; it can easily be done later, if warranted by the occasion.

Genus TULBAGHINIA, Melv. & Pons., 1898.

A.M.N.H. i. p. 28.

Shell rather large, depressed-globose, umbilicate, usually corneous and ornamented with bands or mottling; peristome thickened or reflexed, sometimes showing weak dentition on the columella.

Animal unknown.

Distribution.—The South-western district of the Cape Province, chiefly in the more wooded areas between Tulbagh and Bredasdorp.

Genotype, *Tulbaghinia isomerioides* (M. & P.).

Founded as a sub-genus of *Dorcasia* for *T. isomerioides*, on account of its peculiar columellar formation. As it is extremely doubtful whether this species belongs to the *Dorcasiinae* at all, it is obviously advisable to raise *Tulbaghinia* to generic rank. I have no hesitation in including *schaerfiae*, Pfr., in the genus on account of its close conchological affinity with the genotype.

The general appearance of the shell, especially the white, thickened peristome, recalls certain members of the *Dorcasiinae*, and, until more is known of the animal, I am content to regard the genus as representing the sylvan races of the subfamily.

Tulbaghinia isomerioides (Melv. & Pons.).

1898 *Dorcasia* (*Tulbaghinia*) *isomerioides*, M. & P., A.M.N.H. i. p. 28. Pl. VIII, f. 10. *D.F.*

Shell rather large, depressed-globose, umbilicate, fairly thin, translucent, bright corneous, slightly paler beneath; peristome white and glossy; interior showing the colour of the exterior. Spire depressed, apex very obtuse. Whorls $5\frac{1}{2}$, rounded, rather gradually increasing, all but the apical covered with close, curved, well-defined transverse striae, the earlier whorls showing considerable faint malleation, and the last, clear microscopic granulation. Suture simple, rather shallow. Aperture truncate-ovate; peristome narrowly reflexed, ends joined by a thin callus. Columella furnished with three small protuberances on the inner edge; outer columellar margin forming a distinct angle of 130° 3·8 mm. from its junction with the paries.

Dimensions of Type: Diam. maj. 30·0, min. 24·6; alt. max. 15·8; apert. 16·2 × 12·4 mm.; ends of peristome 4·1 mm. apart.

Animal unknown.

Hab. Cape Province. Tulbagh.

Type in British Museum.

Only three specimens are known, and in these the peculiar columellar dentition is variable, there being three processes in the Type and only two in another example. The last mentioned, which I described in Vol. XI. p. 152 of these Annals, also differs widely from the Type in coloration, being dark olive-brown, beautifully mottled with yellow on the upper whorls. Whether this, or the uniform brown of the Type, is the normal colour scheme of the species, will be proved when further examples come to hand.

Although the little protuberances on the columella may prove to be of specific value in the case of *T. isomerioides*, something of a similar nature is of irregular, though infrequent occurrence in other *Dorcasiinae*. Possibly owing to its slime attracting minute particles of sand, the parietal region of *Trigonephrus globulus* is sometimes quite rough with brown, horny points, while even in the shell figured (Pl. II, f. 1) a somewhat similar excrescence is noticeable on the exterior of the outer lip. I have also seen an example of *T. gypsinus*, which showed a minute, perfectly formed denticle just inside the basal margin of the aperture.

Tulbaghinia schaerfiae (Pfeiffer).

1861 *Helix schaerfiae*, Pfr., Mal. Blätt., viii. p. 73. Pl. II, f. 1–3. *D.F.*

Shell depressed orbicular, umbilicate, thin, glossy, semitransparent, bright corneous, with several narrow, regular, spiral rufous

bands, more frequent above, but also present, though fewer and fainter, beneath; peristome white and glossy; interior nacreous blue. Spire flattened. Whorls 4, flattish, rapidly increasing and expanding, covered with close, regular, transverse striae which impart a satin-like appearance to the shell. Suture simple, rather shallow. Aperture quadrate-oval; peristome very slightly thickened. Columella extremely weak. Umbilicus deep and open.

Dimensions of a shell from Oudebosch, in my collection: Diam. maj. 29·9, min. 24·0; alt. max. 14·7; apert. 14·6 × 13·0 mm.; ends of peristome 8·2 mm. apart.

Animal unknown.

Hab. Cape Province. Bredas Bosch and Oudebosch.

Type in Stettin Museum, from Bredas Bosch.

Layard's notes on this species run: "Of this beautiful shell there are three very distinct varieties:—

(*a*) a pale, almost white var., marked with sparse, faint, brown lines;

(*b*) also pale, but covered with close-set, well-marked, dark brown longitudinal lines.

"These two varieties are from the open veldt at Bredasdorp, and are, except slightly on the underside, destitute of epidermis. This, I conceive, is burnt off by the sun, for at Oudebosch, in Caledon District, in the forest, my son and I took (*c*) a lovely variety, of a dark brown colour, covered with a beautiful transparent epidermis, quite polished and glistening on the underside, through which the dark brown bands of the shell show quite plainly. In this locality the shells are protected from the sun by the dense forest. I never saw this shell from any other localities than those named, and it is there not a common species."

The pale coloration of Layard's vars. (*a*) and (*b*) is not due to loss of epidermis, as I have seen similarly marked specimens in excellent condition. The ground colour is pale cream, and the narrow reddish bands may be either quite conspicuous or almost invisible.

APPENDIX.

Undetermined Varieties.

A few specimens which have come under examination are not referable to any of the preceding forms, but, owing either to insuffi-

cient material or poor condition, I have not ventured to found new species on them. When live examples come to hand, some of them will doubtless prove worthy of names.

I append rough diagnoses of the more remarkable.

1. Trigonephrus, spec. (S.A.M. No. A 2817).

Shell somewhat resembling in contour a small, blunt-apexed *T. porphyrostoma*, bleached and subfossil, but once, apparently, of brownish colour with reddish purple peristome. Whorls 5, sculpture resembling that of *rosaceus*. Aperture similar to that of *globulus;* peristome much thickened, columellar margin *completely overgrowing the umbilicus*, so that the shell appears to be imperforate.

Alt. max. 37·8; diam. 33·5; apert. 19·6×17·5 mm.; ends of peristome 12·75 mm. apart.

Animal unknown.

Hab. Great Namaland. Granite Berg, 27° 30′ S.; 15° 30′ E. (Rogers).

Possibly an aberrant form of *porphyrostoma*.

2. Trigonephrus, spec. (S.A.M. No. 8235*a*).

Shell slightly elongate-globose, thin, semitransparent, dark reddish brown; peristome brown. Spire a little produced, apex bluntly rounded. Whorls 4½, rapidly increasing, all but the apical covered with close, faint transverse, and microscopic spiral striae. Aperture quadrate-ovate, shaped like that of *T. globulus;* peristome moderately thickened and reflexed, half concealing the narrow umbilicus.

Alt. max. 25·8; diam. 21·1; apert. 13·5 × 10·1 mm.; ends of peristome 9·6 mm. apart.

Animal unknown.

Hab. Cape of Good Hope. St. Helena Bay (Gould).

A single specimen, possibly a sport from the local race of *globulus*, but differing in its darker colour and the absence of the infra-sutural white band, while in form resembling a squat *T. namaquensis*, var. *procerus*, rather than *globulus*. A longer series is necessary before its exact status can be determined.

3. Trigonephrus, spec.

A little brown shell, almost similar in shape to *T. ambiguosus*, var. *compactus*, but considerably smaller, with a white peristome. Its

dimensions are: Diam. maj. 21, min. 17·3; alt. max. 15·8; apert. 11·3 × 9·3 mm.

Two specimens, labelled "Namaqualand," in the Layard Collection. I am uncertain whether they can be the pair mentioned as from Namaqualand on p. 146, or whether they are not rather the small form of *lucanus* from Bredasdorp (p. 158). Under such circumstances, it seems inadvisable to name them.

4. Dorcasia alexandri, var. (S.A.M. No. A 2819).

Shell similar to the typical form in all respects except the sculpture, which, though much worn, appears to be slightly more pronounced, and the umbilicus, which is very wide and open, deep and perspective, extending to the transparent apex.

Diam. maj. 28·1, min. 22·8; alt. max. 14·2; apert. 15 × 11 mm.

Animal unknown.

Hab. Damaraland. Erongo Mountains (Rogers).

A connecting link between the var. *perspectiva*, which it resembles in its open umbilicus, and the typical form, which it nearly resembles in sculpture. The locality, however, being just north of the Omaruru, suggests that it is a smoothish sub-variety of *perspectiva*, rather than a widely umbilicate one of the true *alexandri*.

5. Helix bulbus, Menke.

1848 *Helix bulbus*, Mke., Pfr., Zeitschr. f. Malak. v. p. 116. *D.*
1853 ,, ,, ,, ,, Conch Cab., p. 268. Pl. CXXII (1852), f. 4–6. *D.F.*

Apparently founded on a single specimen, whose present whereabouts cannot be traced.

A translation of Pfeiffer's diagnosis runs: "Shell moderately umbilicate, globose-depressed, thin, irregularly rugose and sculptured with impressed concentric lines; white; spire flattish. Whorls $4\frac{1}{2}$, almost flat, the last rounded, scarcely descending in front. Aperture oblique, lunate-oval, interior white, shining; peristome simple, margins approximating, the right lip straight, curved forward; the basal very slightly reflexed; the columellar margin dilated. Shell 26 × $21\frac{1}{2}$; alt. 13 mm."

"*Hab.* Cape, in coll. Menke."

The description and figure should be quite sufficient for the identification of the species, should it ever be rediscovered. Not only, however, do the conspicuous spiral striae suggest little affinity

with the *Dorcasiinae*, but the shell appears to be quite unlike anything known to exist in South Africa, though, were it not for the spiral sculpture, it might be attributable to some bleached form of *Natalina*.

Failing the reappearance of the Type, therefore, I am inclined to believe that the locality quoted is erroneous, and, for this reason, to expunge *H. bulbus* altogether from the South African list and place it in the category of lost species.

PLATE II.

Fig. 1.—*Trigonephrus globulus* (Müll.); from a specimen in my collection.
,, 2.—*T. globulus*, forma *minor*; from a specimen in my collection.
,, 3.—*T. gypsinus* (Melv. & Pons.); from the Type in British Museum.
,, 4.—*T. rosaceus* (Müll.); from a specimen in the South African Museum.
,, 5.—*T. rosaceus*, forma *minor*; from a specimen in my collection.
,, 6.—*T. porphyrostoma* (Melv. & Pons.); from a specimen in the South African Museum.
,, 7.—*T. namaquensis* (Melv. & Pons.); from a specimen in the South African Museum.
,, 8.—*T. namaquensis*, var. *procerus*, nov.; from the Type in coll. Ponsonby.
,, 9.—*T. namaquensis*, var. *procerus*?; from a specimen in the South African Museum.
,, 10.—*T. lucanus* (Müll.); from a specimen in my collection.
,, 11.—*T. ambiguosus* (Fér); from a specimen in my collection.
,, 12.—*T. ambiguosus*, var. *compactus*, nov.; from the Type in my collection.

West, Newman del. et lith.

SPECIES OF TRIGONEPHRUS.

PLATE III.

Fig. 1.—*Dorcasia coagulum* (v. Mts.); from a specimen in the South African Museum.

,, 2.—*D. rogersi*, nov.; from the Type in the South African Museum.

,, 3.—*D. rogersi*, forma *maxima*; from a specimen in the South African Museum.

,, 4.—*D. cernua* (v. Mts.); from the Type in Berlin Museum.

,, 5.—*D. alexandri* (Gray); from the Type in British Museum.

,, 6.—*D. alexandri*, var. *minor*, Bttg.; from a specimen in the South African Museum.

,, 7.—*D. alexandri*, var. *rotundata*, Mouss.; from a specimen in the South African Museum.

,, 8.—*D. alexandri*, var. *perspectiva*, nov.; from the Type in Kimberley Museum.

West, Newman del. et lith

SPECIES OF DORCASIA.

PLATE IV.

Anatomy of the Dorcasiinae.

Figs. 1–6.—*Pallial organs* seen from below, showing the arrangement of the pulmonary veins, with the mantle-edge and left body-lobes above, the pericardium and kidney below, and the rectum on the left side. (Somewhat diagrammatic.)

Fig. 1.—*Trigonephrus globulus* (Müll.).
,, 2.—*T. porphyrostoma* (M. & P.).
,, 3.—*T. namaquensis* (M. & P.).
,, 4.—*T. lucanus* (Müll.).
,, 5.—*Dorcasia coagulum* (v. Mts.).
,, 6.—*D. alexandri*, var. *rotundata*, Mouss.

Figs. 7 & 8.—Dorsal views of *buccal mass*, showing the end of the radula-sac and the opening of the oesophagus. (Natural size.)

Fig. 7.—*Trigonephrus globulus* (Müll.).
,, 8.—*T. namaquensis* (M. & P.).

Figs. 9–16.—Representative teeth from the *radula* (seen from above).

Fig. 9.—*Trigonephrus globulus* (Müll.) × 150.
,, 10.—*T. rosaceus* (Müll.) × 150.
,, 11.—*T. porphyrostoma* (M. & P.) × 150.
,, 12.—*T. namaquensis* (M. & P.) × 150.
,, 13.—*T. lucanus* (Müll.) × 175.
,, 14.—*Dorcasia coagulum* (v. Mts.) × 250.
,, 15.—*D. rogersi*, nov. × 250.
,, 16.—*D. alexandri*, var. *rotundata*, Mouss. × 250.

Figs. 17–24.—Anterior views of *jaw*.

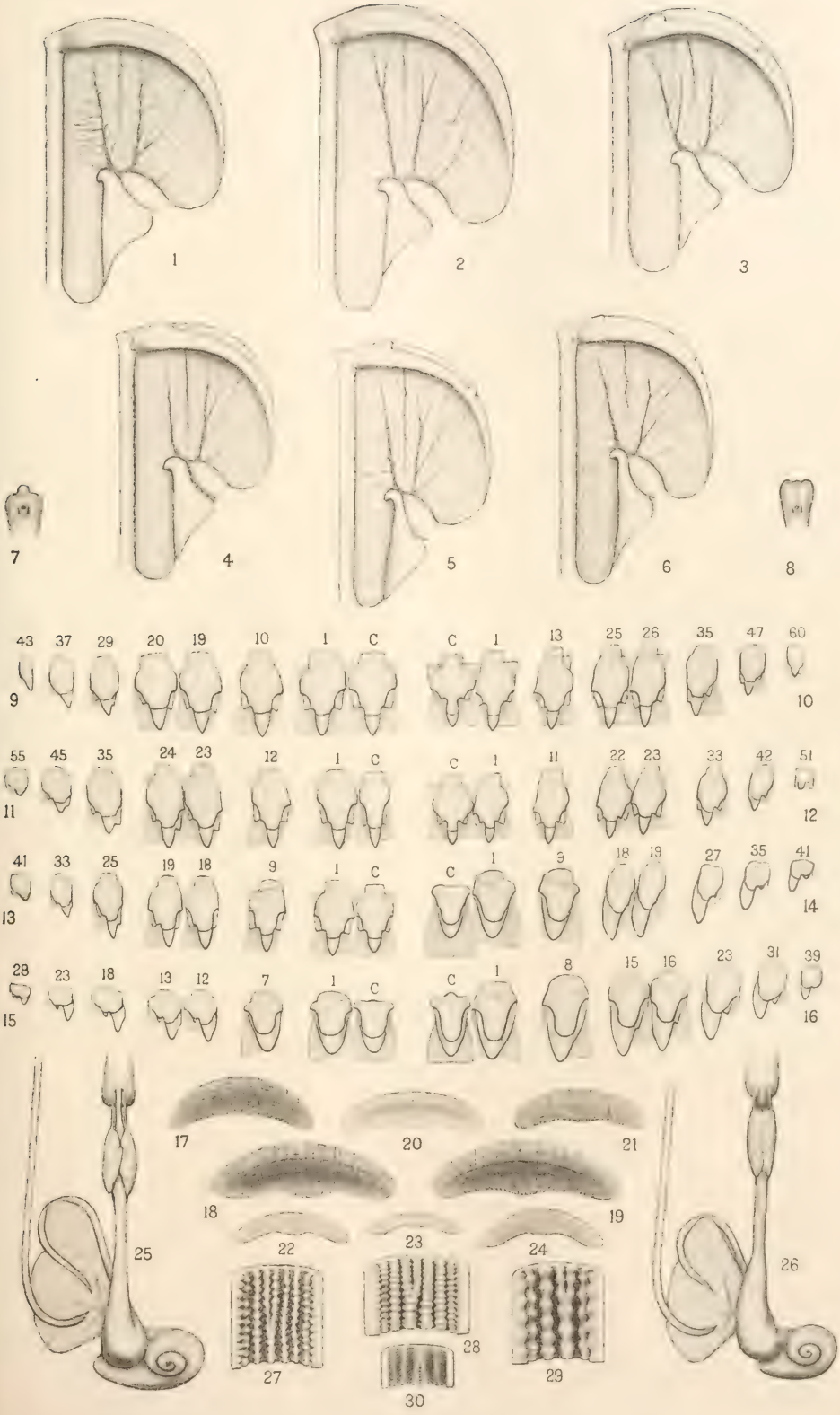
Fig. 17.—*Trigonephrus globulus* (Müll.) × 7·5.
,, 18.—*T. rosaceus* (Müll.) × 7·5.
,, 19.—*T. porphyrostoma* (M. & P.) × 7·5.
,, 20.—*T. namaquensis* (M. & P.) × 7·5.
,, 21.—*T. lucanus* (Müll.) white var. × 7·5.
,, 22.—*Dorcasia coagulum* (v. Mts.) × 10.
,, 23.—*D. rogersi*, nov. × 10.
,, 24.—*D. alexandri*, var. *rotundata*, Mouss. × 10.

Figs. 25 & 26.—*Digestive system*, seen from above, after the intestine and rectum, with the anterior division of the liver, have been turned over to the left.

Fig. 25.—*Trigonephrus porphyrostoma* (M. & P.) × 1.
,, 26.—*Dorcasia coagulum* (v. Mts.) × 2.

Figs. 27–30.—Part of the wall of the *penis*, seen from within.

Fig. 27.—*Trigonephras globulus* (Müll.) × 6.
,, 28.—*T. porphyrostoma* (M. & P.) × 5.
,, 29.—*T. lucanus* (Müll.) × 6.
,, 30.—*Dorcasia coagulum* (v. Mts.) × 6.



West Newman, ad nat. tum.

PLATE V.

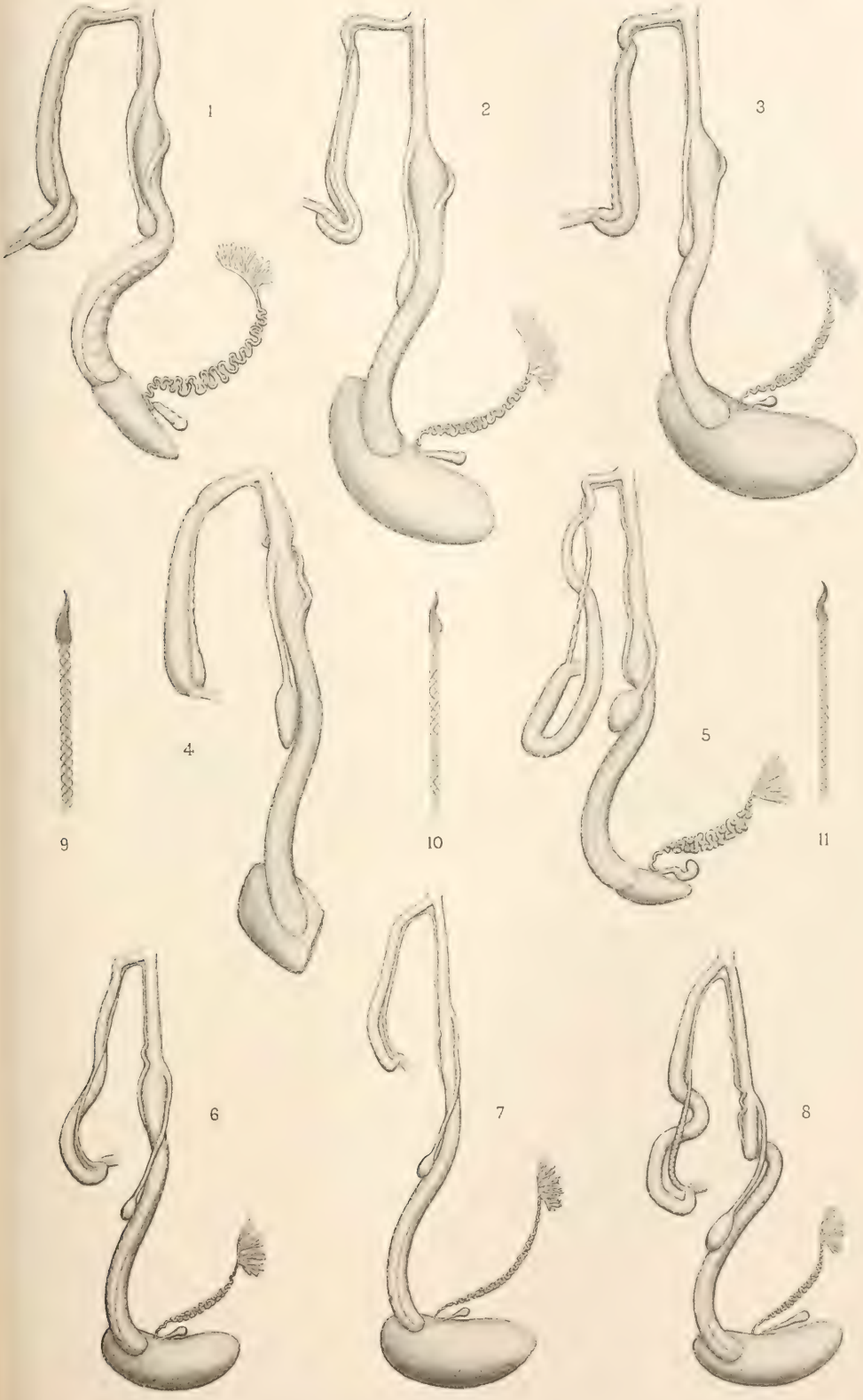
Anatomy of the Dorcasiinae.

Figs. 1–8.—*Reproductive organs*, showing the genital opening above, the albumen gland and vesicula seminalis below, the hermaphrodite gland on the right, the penis on the left, and the receptaculum seminis in the middle.

Fig. 1.—*Trigonephrus globulus* (Müll.) × 3.
,, 2.—*T. rosaceus* (Müll.) × 1·5.
,, 3.—*T. porphyrostoma* (M. & P.) × 1·5.
,, 4.—*T. namaquensis* (M. & P.) × 3.
,, 5.—*T. lucanus* (Müll.) × 2·25.
,, 6.—*Dorcasia coagulum* (v. Mts.) × 3·3.
,, 7.—*D. rogersi*, nov. × 3·3.
,, 8.—*D. alexandri*, var. *rotundata* (Mouss.) × 4.

Figs. 9–11.—*Spermatozoa*, showing the head and anterior end of the tail.

Fig. 9.—*Trigonephrus globulus* (Müll.) × 1,200.
,, 10.—*T. lucanus* (Müll.) × 1,200.
,, 11.—*Dorcasia alexandri*, var. *rotundata*, Mouss. × 1,200.



West, Newman collotype.

8.—*Notes on South African Non-marine Mollusca.*—By M. Connolly. (*Continued.*)

IV.—*A hitherto unnamed variety of* Dorcasia alexandri *Gray.*

In the Monograph of *Dorcasiinae*, published last year in these Annals, I mentioned on p. 177 a shell from the Erongo Mountains, of which I had then only seen a single specimen, as being probably worthy of a varietal name.

Through the kindness of Messrs. Henry Burnup and John Ponsonby-Fane I have now been enabled to examine an extensive series of this form, collected on Mt. Usakos by Mr. P. Ross Frames, and can thus furnish further particulars.

To Mr. Burnup I am also much indebted for copious notes, whose incorporation in the present paper adds greatly to its value, and reduces my own task to a minimum.

Dorcasia alexandri Gray, var. montana, nov. 1916.

Shell depressed-globose, widely umbilicate, rather thin, translucent, Type slightly bleached, pale chestnut above, shading to pale greyish-yellow beneath, peristome yellowish-white. Spire but little raised, though each whorl, in profile, projects clearly above the next; apex obtuse.

Whorls 5, very rounded, rapidly increasing, the 2 apical almost smooth, remainder prettily sculptured above with very fine, close, regular, curved striae, which become much fainter beneath; last whorl descending rapidly in front; suture simple, rather deep. Aperture acuminate-ovate; peristome quite free, continuous, margins not

thickened, reflexed, but not overhanging the umbilicus, which is very wide and deep, extending to and clearly exposing the transparent apex.

Diam. maj. 27·9, min. 22·5; alt. 14·1; apert. 16·2 × 13·0 mm.

Hab. Damaraland. Mt. Usakos (Frames, 1915). Erongo Mountains (Rogers, 1914). Bullspoort, between Nauchas and Maltahöhe (Tucker, 1916).

At Mr. Burnup's request I have placed the Type in the British Museum.

The chief points in which the new variety differs from typical *alexandri* are in the umbilicus, which is wide and deep instead of shallow and strangulate, and the aperture, which is more acuminate; the sculpture also, though fine and close, is markedly more pronounced than in the typical form.

Both its umbilicus and aperture closely resemble those of *var. perspectiva*, but the sculpture is so distinct that unless intermediate forms are found there will never be any difficulty in differentiating one from the other.

I have selected as Type a shell possessing the double advantage of being the freshest specimen, and also almost exactly intermediate between the two extremes in size, for the latter feature varies greatly, the largest example measuring: Diam. maj. 34·5; min. 28·0; alt. 16·4; apert. 21·1 × 15·6 mm.; and the smallest: Diam. maj. 21·7; min. 17·3; alt. 10·0: apert. 11·8 × 9·7 mm. The average size of the variety, however, would appear to be a little greater than that of the Type, the smaller specimens being in a minority.

The fact of its only occurring, so far, on mountains permits the choice of a distinctive varietal name, but I do not suppose that *montana* will necessarily prove to be confined to mountainous districts, or that such surroundings exercise any influence on the characters of the shell. The Type-set were collected at different altitudes between 300 and 1200 ft., but the size does not appear to be affected by the height. The largest example comes from the 700 ft. level, and the smallest from that of nearly 1200 ft., but there is no average uniformity, as the highest and lowest levels also produce shells only infinitesimally smaller than the maximum.

The aperture is fairly constant in form throughout the series, measuring in four other specimens 19·5 × 16, 16·8 × 14, 16·75 × 14·3, and 14·8 × 12·3 mm.

A series of bleached shells in the South African Museum from the Erongo Mountains present very nearly the same characters as the

Type-set, although the sculpture is not quite so fine, and the peristome shows a tendency to coalesce with the last whorl instead of being perfectly solute.

Since the foregoing was written two bleached examples have been received by the South African Museum from Bulls Mouth Pass (Bullspoort) between Nauchas and Maltahöhe, which undoubtedly belong to the new variety. They differ slightly therefrom, however, in that their sculpture is less pronounced than in the Type; their aperture also is more remote from the umbilicus, so that a considerable expanse of the base of the last whorls is exposed between the umbilicus and the reflexed edge of the peristome.

The shells measure respectively:

Diam. maj. 33·2, min. 26·0; alt. 17·0; apert. 17·9 × 14·7 mm.
„ „ 31·5. „ 24·8; „ 16·5; „ 16·0 × 12·0 mm.

V.—*On the introduced Land-Molluscan Fauna of South Africa.*

I have more than once been taken to task for inserting the introduced species in my Revised Reference List in their natural order instead of sequestrating them to some other portion of the volume.

My answer is that not only is it almost impossible to decide, in some instances, whether a species is indigenous or otherwise, but also that I have been often misled, in books where the last-mentioned system prevails, by not noticing or by being unable to find the introduced species; so that I much prefer including them in Generic sequence in the body of the work.

As time goes on, however, it will become increasingly difficult to determine the introduced species, so it may be well to publish a tentative list while it is still possible to collect information from living authorities as to the dates and means of their introduction.

This list combines two distinct groups. One contains, for the most part, large forms whose importation by human agency can be actually verified and whose distribution is even now confined to the most restricted limits of civilisation; the other consists of minute shells, found as often as not in primeval jungle, the date and means of whose introduction, if they were introduced at all, is problematical, and whose diffusion is probably attributable to the agency of birds and winds.

I include Land-slugs and one or two of the *Limnæidæ* in the following list, but omit semi-marine Genera such as *Melampus* and

Onchidium, owing to the uncertainty as to their correct identification and the difficulty of determining their original home.

Testacella maugei Férussac (= *T. aurigaster* Layard in MS.).

Taylor* holds that *aurigaster* Layard is synonymous with *maugei*, and as his views have recently been confirmed by H. Watson† there is no ground for the retention of the former name, a desirable result, since no description or figure of *aurigaster* can be traced and the name is really nude.

T. maugei is restricted to Cape Town, and is now becoming fairly frequent in other gardens than those of the South African Museum, in which it was first noticed by Layard. It is peculiarly spasmodic in its appearance, being moderately abundant one season and then allowing several years to elapse before again attracting attention. Its introduction to its South African habitat is easily accountable.

Vitrea crystallina (Müller).

Only known so far from a few gardens in the neighbourhood of Cape Town and Wynberg, where it has been found locally abundant by R. M. Lightfoot, who first noticed the species in 1890; it has doubtless been imported in soil.

Polita alliaria (Miller).

Frequent in gardens at Grahamstown, where Mr. Farquhar tells me that he found it in decayed leaves under bushes, fifty yards from his house, when he first went there about 1894.

Its introduction probably dates to a considerably earlier period, for the Grahamstown shells are so much more highly sculptured than typical *alliaria* that they might have been considered a distinct species, were it not that the Rev. E. Wake Bowell has pronounced their anatomy to be identical with that of the European form.

The ordinary smooth variety has existed for at least six years in the greenhouses round the South African Museum, Cape Town.

Polita cellaria (Müller).

Considering that it was noticed by Benson at Rondebosch, where it is now abundant in the woods of Groot Schuur, as long ago as 1846, and was also recorded by Gibbons from the Cape in 1878, it is

* Mon. Brit. Moll. 1902, pp. 25, 27.

† Ann. Natal Mus. 1915, iii, p. 220.

surprising that this species is not now more widely diffused than is actually the case.

It is pretty general all over the cultivated part of the Cape Peninsula, without, however, encroaching much upon the wilder districts, and it is also recorded from Stellenbosch, Somerset East and Somerset West. The only specimen which I have seen from Bulawayo has the appearance of having travelled there dead in a flower-pot, but Miss Wilman informs me that the species has been observed within the last two years at Kimberley, where it is not infrequent in one or two gardens.

Polita draparnaudi (Beck).

Found in nursery gardens by W. J. Oakley about 1908 at Rondebosch, and by myself in 1909 at Kenilworth, C.P., where it is associated with *Z. arboreus* (Say), but is confined to one or two greenhouses, whereas *arboreus* is as happy in the open as under glass.

The Kenilworth examples of *draparnaudi* grow to a large size, my finest measuring 16 × 14 mm. in diameter.

The animal has been examined and identified by the Rev. E. W. Bowell.

Zonitoides arboreus (Say).

Shells apparently inseparable from this widespread American species have been collected in nursery gardens at Kenilworth; the Botanical Gardens, Pietermaritzburg; the Zoological Gardens, Pretoria; and at Grahamstown, Queenstown, Kingwilliamstown and Port Elizabeth, to all of which localities it may easily have been transported through commerce.

Of course the presence in the Sub-continent of *Zonitoides africanus* Bttg. and *Z. cupido* M. & P. renders it by no means improbable that other endemic species of this Genus exist therein, and it is really far more remarkable that shells from so many diverse localities should be inseparable from *arboreus* than if they belonged to distinct indigenous species.

Kaliella sigurensis Godwin-Austen.

Dautzenberg and Germain * consider the above to be synonymous with *K. barrakporensis* (Pfr.). Whichever name it should bear, this little shell is abundant in many wooded districts up the eastern side of the Continent where it has certainly not been spread by human agency.

Its distribution south of the Zambesi includes the Botanical Gardens,

* Rev. Zool. Africaine, 1914, iv, p. 17.

Pietermaritzburg, and other Natalian localities in Dargle, Equeefa, Karkloof and Tyeloti, while in the Transvaal it occurs at Fountains, Pretoria, in company with introduced species like *V. excentrica, P. orcula* and *L. truncatula*, and on the banks of Hennops River, 15 miles west of Pretoria, where it is hardly likely to have been carried by the hand of man.

In regard to the group of introduced Slugs I can add but little to the bare details given in my Reference List.

Mr. Hugh Watson very kindly permits me to publish a few additional localities from which he has recently received material, with the proviso that they must be accepted for the present as purely conjectural, owing to the impossibility of accurate identification until his anatomical analyses are completed.

Limax flavus Linné.

Chronicled by Collinge under the name of *variegatus* in 1900 from Cape Town and in 1901 from Natal, where it is said to be common at Pietermaritzburg. Lightfoot writes that he first noticed it at Cape Town in 1898, but has never found it outside the precincts of gardens and outhouses.

A slug that is almost certainly attributable to this species is reported by Watson from Grahamstown (Farquhar).

Limax maximus Linné.

Discovered by Lightfoot on Table Mountain, above Newlands, in 1900, and collected by G. French in the same locality in 1913.

Milax gagates (Draparnaud).

Date of introduction uncertain, but it was collected near Cape Town by the "Challenger" Expedition in 1873, while Smith* considers that it may have provided the original material on which Krauss founded his *Limax capensis* in 1848.

M. gagates is also recorded from Ashton and Storms Vlei, Cape Province (Purcell), and from Pietermaritzburg.

Agriolimax agrestis (Linné).

Recorded by Sturany from Port Elizabeth (no finder mentioned) in 1898, and by Collinge from Cape Town (Lightfoot) in 1900, and from Pietermaritzburg in 1910.

* P. Z. S. 1884, p. 276.

Watson considers that specimens collected at Caledon and East London by Mrs. Longstaff in 1914, and at Albert Falls, Natal, by Akerman in 1910, will probably prove to belong to this species. Lightfoot has also taken it in gardens at Stellenbosch, Ceres and East London.

Agriolimax lævis (Müller).

Recorded by Sturany from "Cape" (in Vienna Museum) in 1898, by Collinge from Cape Town (finder not mentioned) in 1901, and by Taylor from Queenstown, Cape Province (Dower) in 1904.

It is probable that examples from Thornville Junction, Natal (Burnup, 1907), will eventually prove to belong to this species.

Arion fuscus (Müller).

Lightfoot found this species to be fairly common on the slopes of Table Mountain at Plaat Klip, and on Signal Hill, in 1898. It was chronicled by Collinge from Pietermaritzburg in 1910.

Arion intermedius Normand.

Stated by Simroth to have been collected on the Cape Flats by Schultze in 1904.

In addition to the chances of possible importation by the earlier Dutch and Huguenot settlers, there has more recently been established a considerable German agricultural colony in this neighbourhood, so that the presence there of any of the commoner European Molluscs is easily explainable.

Eulota similaris (Férussac).

A widespread circum-tropical species whose presence at Durban is doubtless accountable to introduction in plants from Mauritius or Ceylon. It is making little headway in South Africa, for although collected in Durban by Plant about 1860 and in a garden on the Berea, near the Botanical Gardens, by Quekett about 1900, Mr. Burnup informs me that the only fresh locality known to him is in the Stella Bush, near Durban, where specimens have been taken within the last four years. As houses have recently been built abutting on the Bush, *E. similaris* may well have been carried there in plants from the Berea, but it certainly appears probable that the species is now breeding in Natal.

Cochlicella acuta (Müller).

I believe that the only South African locality for this Mediterranean species is St. James, Cape Peninsula, where a little colony was discovered by the present writer in 1909 under spare sleepers near the railway station, in company with *P. cellaria*, which found the little helicoids a particularly appetising luxury. Dr. Péringuey courteously informs me that the sleepers have disappeared, but that *C. acuta* is now to be found on Richardia (the beautiful white arum, locally known as Pig-lily) in the vicinity of the station.

The sleepers are supposed to have been brought either from Australia or the Knysna forest, which does not account for the introduction of this species, but the shells are remarkably thin and fragile, in great contrast to the solid Mediterranean form.

Pupisoma japonicum Pilsbry.

A species inseparable from this Eastern form has evidently been long naturalised in Natal, as it is widely distributed far from the haunts of man, as well as in orchards in the neighbourhood of big towns. The localities given by Burnup are Pietermaritzburg, Edendale, Karkloof, and N'timbankulu.

Pupisoma orcula (Benson).

This Indian species is still more widely distributed than the foregoing, with which it has been found in all the above-mentioned localities. It has also been identified from Richmond and Dargle in Natal; Port Elizabeth and Grahamstown in the Cape Province; Fountains, Pretoria; and the Rain Forest, Victoria Falls.

Vallonia excentrica Sterki.

Every South African specimen of *Vallonia*, formerly attributed to *pulchella*, which has been subjected to expert examination has proved to belong to Sterki's species.

Although first found by Benson at High Constantia as long ago as 1846, it does not appear to have travelled far from civilisation, its distribution being confined to the near vicinity of large towns, and easily attributable to quite a mild tornado of that peculiarly dusty type which adds so little to the doubtful charms of life on the veldt. Thus it is found at Fountains, Pretoria, where original bush is inter-

spersed with patches of cultivation, in common with the introduced *P. orcula*, *K. sigurensis*, and *L. truncatula*, as well as the endemic *Trachycystis hottentota* M. & P.; but in the Cape Peninsula, while *hottentota* inhabits the little piece of apparently original jungle in the Admiralty Ravine, Simonstown, *excentrica* has not spread beyond gardens in Cape Town and Wynberg.

Its other localities are Somerset East, Grahamstown, Kingwilliamstown and Port Elizabeth in the Cape Province, and Pietermaritzburg in Natal.

Helix aspersa Müller.

The late Lord de Villiers informed me that he remembered this species being first brought to Cape Town by Mons. Dastre for eating purposes about 1870. The rapidity with which it adapted itself to its new surroundings is evinced by the fact that it was one of the only three land-molluscs collected in that neighbourhood by the members of the "Challenger" Expedition in 1873, while Gibbons wrote in 1878 that he had never seen the species so plentiful as it then was in the neighbourhood of Cape Town.

Outside the Cape Peninsula and Robben Island *H. aspersa* is only known from Port Elizabeth, where Mr. Farquhar found it not uncommon as long ago as 1882, and from Kimberley, where Miss Wilman informs me that it made its first appearance in gardens in 1915.

Helix faux-nigra Chemnitz.

Pallary* has shown that Müller's original description of *Helix lactea* cannot possibly be applied to the well-known Mediterranean species, which must pass in future under the hideous, though appropriate, name *faux-nigra* of Chemnitz.

Two examples of this species were found by Mrs. Barber in 1897 in a garden on the bank of the Kowie River, where it does not appear to have perpetuated itself. The erroneous record of Pondoland in Melvill and Ponsonby's Check-list refers to this occasion.

As the shells are no longer in existence it may be worth remarking that they were of the dark, bandless variety, such as is frequent at Teneriffe, a port of call for nearly half the traffic between Europe and the Cape.

Helix pisana Müller.

This species was first noticed by W. G. Fairbridge in 1881 on what was then Gallows Hill, but now forms part of Cape Town Docks.

* Nachrichtsbl. d. D. mal. Ges. 1914, p. 8.

It is now by far the commonest shell in the Cape Peninsula, where I believe it has caused the extinction of at least one native form, *Trachycystis rariplicata* Bs., for which I have often searched at Green Point, its sole locality, without unearthing anything more interesting than thousands of the European species.

From Cape Town *H. pisana* has spread across the Flats to Somerset West and Gordons Bay, and as far inland as Stellenbosch, while within the last thirty years it has become extremely plentiful at Port Elizabeth and in the Gamtoos Valley.

It was first noticed at Durban on sand-hills near the lighthouse in August, 1905, by Dr. Longstaff, and at East London in November, 1915, by R. M. Lightfoot, who rightly points out that its presence in the three last-mentioned localities is more likely to be due to separate introductions than to spreading of the species.

Leucochiloides calaharicus (Böttger).

Even if the above is identical with such as *senegalensis* Morelet, or *fallax* Say, it can hardly be classed as an introduced species until the original home of this world-diffused form is determined. South African localities are: Jansenville; Prieska; Taungs; Hay District; Ghous; Bullspoort; near Schlip in Damaraland; and the Victoria Falls.

Achatina aurora Pfeiffer.

There can be little doubt that the beach-rolled singleton which constitutes this species was neither born in Durban nor ever entered that port alive, but until it can be definitely identified with one of the equatorial forms it is impossible to determine its true habitat.

Achatina fulica (Férussac).

It is rather remarkable that this common East Coast and Mauritian species has not secured a wider footing in South Africa, the only known instance of its incursion being a half-grown specimen, which was captured in a Durban garden near some tins containing Crotons from Mauritius, and presented alive to Mr. Burnup about 15 years ago.

Cæcilioides acicula (Müller).

Widely diffused, though infrequent, throughout the continent, apparently quite inseparable from the European form. I have found

it in gardens at Wynberg, where it was very probably introduced direct in soil from England, and in the Bushveldt in the Northern Transvaal, where it is most unlikely to have been deposited by human agency. Other recorded localities are Bloemfontein, Prieska, Cradock and Kimberley, to which may now be added Grahamstown (Kincaid and Farquhar) and Macequece District, Portuguese East Africa.

I have little doubt that *C. advena* Ancey, from Disappointment Vlei, Ovampoland, and *C. ovampoënsis* M. & P., described from Ovampoland and recorded by Sturany from Matolla, near Delagoa Bay, are synonymous with *C. acicula*, but no authentic example of *advena* can be traced, while the Type-set of *ovampoënsis* is now in hardly sufficiently good condition to admit of accurate comparison.

Subulina octona (Bruguière).

A shell attributed to this circum-tropical species is common at the Victoria Falls. As it is recorded by Pilsbry from both the East and West Coasts of Africa its occurrence in the centre is not unnatural. Pilsbry remarks: "It is generally and I believe correctly held that this species in the tropics of the Old World is an emigrant from America. It appears first to get foothold in centres of trade and agriculture and to spread with extraordinary rapidity into neighbouring districts" (Man. of Conch. xviii, p. 74).

Rumina decollata (Linné).

As mentioned in my Reference List, there is no evidence that the two examples of this species which were found at Port Elizabeth in 1897 were imported in other than dead condition. They have recently been secured for the collection of the South African Museum.

Limnæa truncatula (Müller).

The species named by Küster *L. umlaasianus* and placed in the above synonymy by Bourguignat is by no means common in South Africa, being only recorded from the Umlaas River, Natal; Fountains, Pretoria, and Stellenbosch.

Planorbis gibbonsi Nelson.

As this species was described from Zanzibar its occurrence in the Black River, Maitland, where it was first found in 1910, might appear to be due to human aid, but as it has since turned up in the Congo

Free State and subfossil in a second South African locality, Newlands, near Kimberley, it may well be endemic to a great part of South-equatorial Africa.

ISIDORA CONTORTA (Michaud).

Although included in my Reference List, it is a little doubtful whether the truly typical form of this northern species exists south of the Zambesi, or whether the slightly immature examples from Grahamstown, which I have attributed to it, might not have developed into *I. tropica* (Krauss). The latter is, in my opinion, merely the southern race of *contorta*, a variable species from which not only *tropica*, but several other named forms from various parts of the continent are hardly varietally separable.

INDEX.

9.—*Two New Species of Marginella from South Africa.*—By Lewis J. Shackleford.

Marginella tomlini sp. nov.

Shell. Four whorls rather obtusely conical, smooth and very polished, pale straw-coloured, with no markings except two rows of irregularly

J. S. Gladstone, photo.

Fig. 1.—*Marginella tomlini.* × 2.

J. S. Gladstone, photo.

Fig. 2.—*Marginella tomlini.* × 2.

oblong black spots on the body-whorl, the upper of which is continued round the upper whorls, the spots becoming rounder and smaller as they approach the apical whorls, which are plain and glassy. The lower begins near the margin and ascends spirally on to the uppermost plait. There are ten spots in this row, three of which are on the plait itself. Spire raised only about 3 mm. above the summit of the outer lip. Suture not impressed. Spire moderately convex. Aperture long., 15 mm.; lat. max. 3 mm. Margin moderately thickened. Columella with four well-defined plaits, the upper two being nearly straight and rather far apart, the lower two oblique. The outer lip

is white and smooth within and considerably curved. The plicae and margin are also white.

Long. 18 mm. ; lat. 9 mm.

Hab. Cape St. Blaize (S. Africa) N. by E. ½ E., distant 68 miles—105 fathoms. s.s. "Pieter Faure."

Type unique in the South African Museum.

MARGINELLA TAYLORI sp. nov.

Shell. Subtriangular ovate, smooth, shining, colour pale cream with a faint yellow band round the base; spire blunt, the apex glassy; suture slightly impressed; whorls 4, the last whorl rising distinctly towards the aperture.

J. S. Gladstone, photo.

FIG. 3.—*Marginella taylori.* × 4.

J. S. Gladstone, photo.

FIG. 4.—*Marginella taylori.* × 4.

Columnella covered with a thin callus, with seven plaits, somewhat oblique, the three uppermost almost obsolete, the others well defined and rather far apart, the penultimate the largest, the last very oblique.

Aperture narrow for two-fifths of the upper part, thence widening as far as the base. Length of aperture 4 mm. ; greatest width 5 mm.

Labrum moderately curved, thickened, finely lirate within, minutely denticulated along its entire length and inflected backwards in the lower part.

Long. 5 mm. ; diam. max. 2 mm.

Hab. Cape St. Blaize (S. Africa) N. by E. ½ E., distant 68 miles—105 fathoms. s.s. "Pieter Faure."

Two specimens, one broken, in the South African Museum.

Named after Mr. J. Kidson Taylor (Buxton, Eng.), who has made Marginella a special study.

The apparent marking shown on the figures, especially the back view, is due to the partial erosion of the shell.

10.—*A Revision of the Lizards of the Genus* Nucras, *Gray.*—By G. A. Boulenger, LL.D., D.Sc., F.R.S. (Published by permission of the Trustees of the British Museum.)

(With Plates VI–VII.)

Introduction.

When, some twenty-five years ago, the late Dr. R. Klebs submitted to me the oldest known Lacertid (Oligocene) with the lepidosis preserved through imbedding in amber, a careful comparison with recent lizards led me to refer it to the genus *Nucras*, although the essential generic character of the position of the nostril could not be ascertained, my conclusion being based on an examination of the digits and of the scaling of the gular and pectoral regions, which agreed better with *Nucras tessellata* than with any other lizard with which I was acquainted.* Since then I have made a more thorough study of the Lacertidae from the point of view of their probable evolution, and independent, correlative reasons have confirmed my provisional identification so far that, quite apart from any palaeontological consideration, I am now inclined to regard *Nucras* as, on the whole, the most primitive genus of the Lacertidae.

At the time I examined the lizard in amber, the representatives of the genus were believed to be confined to Africa no further north than the Zambesi Basin, and my suggested identification may therefore have seemed somewhat risky from the standpoint of zoogeography. We must, however, bear in mind that, in Tertiary times, the general character of the reptile fauna of the northern parts of

* *Cf.* R. Klebs, Schrift. Phys.-oek. Ges. Königsberg, li., 1910, p. 227. As this lizard has not received a name I propose to designate it as *Nucras succineus.*

what is now the Palaearctic Region differed strongly from that of the present day. Iguanidae, now confined to the New World, Fiji, and Madagascar, occurred in the Miocene of Europe, and the Pleurodiran Chelonians, at the present time found only in Tropical and South Africa, Madagascar, and South America, were represented in the Eocene as far north as England. Within the last fifteen years the range of *Nucras* has been ascertained to extend further to the north in Africa (Lake Victoria), and, in accordance with the view of the probable origin of these lizards, the northernmost species (*N. emini*) has every claim to be considered, from the morphological standpoint, as the most primitive of the genus. I therefore believe that *Nucras* had a northern origin, an opinion further supported by the fact that the Lacertidae, like the Agamidae, being absent from Madagascar, must have extended their range towards the south only after the connection of Africa with that island had been severed, whilst the presence of Iguanidae, Gerrhonotidae, and Chamaeleontidae may be explained by these having reached Madagascar from Africa at a period previous to the southern extension of the Lacertidae and Agamidae.

The reasons for regarding the genus *Nucras* as the most primitive of the Lacertidae are the same as set forth in my recent paper on the derivation of the species of *Lacerta*,* in which *L. agilis* is held to be the surviving representative of the ancestor of most, if not all, of the species of the genus *Lacerta* with which we are at present acquainted. Of the ten characters, or sets of characters, there mentioned nine are in accordance with this view, the only two (7, 9) in which *Nucras* is not so primitive being the reduction of the dorsal lepidosis to smooth granules and the long tail, in which all the species at present known agree.† Otherwise we find (1) constant presence of teeth on the palate; (2) a non-depressed or feebly depressed skull of moderate ossification (no supraorbital fontanelle, no dermal ossifications in the temporal region), although less primitive than that of *L. agilis*, owing to the narrower internarial space (comparable to *L. vivipara* in *N. delalandii*, to *L. muralis* in *N. tessellata*); (3) presence, in some forms at least, of the foramen parietale; (4) nostril between two or three nasals, the first upper labial being well separated from it, and absence, in some species, of small scales between the supraoculars and the superciliaries; (5) lower eyelid without transparent disc; (6) no

* Tr. Zool. Soc. xxi., 1916, p. 1.

† Unless it be true that the tail of *N. boulengeri* is only $1\frac{1}{4}$ to $1\frac{1}{3}$ times the length of head and body, as stated in the description; but it is not improbable that the fact of the organ being in a regenerated condition has been overlooked.

denticulation in front of the ear-opening; (8) cylindrical or feebly compressed digits with smooth lamellae inferiorly; (10) the ideal type of primitive markings in some forms, no vivid colours on the head and body.

The main principles of the evolution of markings, as held by me, are well supported by a study of the genus *Nucras*, which embraces striated, ocellated, and barred forms. The most primitive pattern, with 11 light longitudinal streaks, at least anteriorly, occurs in *N. intertexta*, var. *holubi*, and in *N. tessellata* (*taeniolata*, Smith). In the latter species the markings may vanish towards the posterior part of the body, and the streaks on the sides break up into spots and, further, rearrange themselves into cross-bars, as happens also in *N. intertexta*, var. *holubi*. The dorsal striation may disappear and lead to ocellated forms (*N. intertexta*, typica). The most pronounced ocellar pattern, accompanied by the loss of the longitudinal streaks, is exemplified by *N. delalandii*, in which, further, the ocelli may disappear, to be replaced by black cross-bars. As a rule the white longitudinal streaks are more numerous on the nape than on the body, but I find one individual exception in a typical *N. tessellata*, which shows three dorsal streaks on the nape and four on the body.

There are two important points in which the striation in *Nucras* differs from that in *Lacerta*: (*a*) The outer light dorsal streak, instead of starting from the superciliary edge, originates on the border of the frontal shield and then follows the supraorbital border and the parietal shield; (*b*) the vertebral streak, instead of ending on the base of the tail, may be continued a considerable distance along that organ; evidently a primitive condition in accordance with Eimer's law.

The distinction of species in this genus has always been a matter of difficulty, all the greater for the small number of specimens which most authors have had at their disposal. I have been so fortunate as to be able to compare large series, preserved partly in the South African Museum, partly in the British Museum. Not long ago* I attempted a rearrangement into varieties from the South African material entrusted to me by my friend Dr. L. Péringuey, but I have since made a more profound study of the subject, resulting in the present monograph, in which detailed descriptions are given of the species and varieties. So much doubt still exists as to the value of certain characters of lepidosis and coloration, that the minute analysis of individual variations, as presented in this paper, will prove useful to

* Ann. S. Afr. Mus. v., 1910, p. 473.

those who might feel inclined to pursue further the investigation of this difficult group of lizards.

NUCRAS.

Nucras, Gray, Ann. N. H., i, 1838, p. 280; Lataste, Ann. Mus. Genova (2), ii, 1885, p. 124; Bouleng., Cat. Liz., iii, p. 52 (1887).

Lacerta, part., Dum. & Bibr., Erp. Gén., v, p. 174 (1839); Bedriaga, Abh. Senck. Ges., xiv, 1886, p. 24.

Nucras, part., Gray, Cat. Liz., p. 33 (1845).

Zootoca, part., Gray, op. cit. p. 27.

Bettaia, Bedriaga, t.c., p. 435.

Head-shields normal. Nostril well separated from the labials, pierced between two or three nasals. Lower eyelid scaly. Collar well marked. Dorsal scales small; ventral shields feebly imbricate, smooth. Digits cylindrical or very feebly compressed, with smooth lamellae inferiorly. Femoral pores. Tail long, cylindrical.

Synopsis of the Species.

I. No small scales between the supraoculars and the superciliaries, or one or two exceptionally present; head not or but little broader than deep; 16 to 20 lamellar scales under the fourth toe.

Head 4 to 4½ times in length to vent*; foot as long as or a little longer than head; parietal foramen present; 40 to 51 scales across middle of body; ventrals in 28 to 32 transverse series; transversely enlarged plates under the fore-arm	1. *N. emini.*
Head 4½ to 5½ times in length to vent; foot not longer than head; parietal foramen usually absent; 34 to 41 scales across middle of body; ventrals in 32 to 37 transverse series; transversely enlarged plates underthe fore-arm absent or small	2. *N. delalandii.*
Head 4⅓ to 5 times in length to vent; foot shorter than head; 45 to 53 scales across middle of body; ventrals in 27 to 34 transverse series .	3. *N. boulengeri.*

II. A series of 2 to 7 small scales between the supraoculars and the superciliaries; 40 to 60 scales across middle of body; transversely enlarged plates under the fore-arm.

* The head is measured to the posterior border of the ear-opening, the skull being considerably longer than the pileus, which accounts for Bedriaga's statement that the ear-opening is situated further back than in *Lacerta*, "on the side of the neck."

Head $3\frac{5}{6}$ to $4\frac{1}{2}$ times in length to vent, not or but little broader than deep; foot not or but slightly longer than head; parietal foramen usually present; ventrals in 27 to 34 transverse series; 20 to 26 lamellar scales under the fourth toe .	4. *N. intertexta.*
Head 4 to $4\frac{2}{3}$ times in length to vent, considerably broader than deep; foot considerably longer than head; parietal foramon usually absent; ventrals in 25 to 33 transverse series; 25 to 31 lamellar scales under the fourth toe	5. *N. tessellata.*

1. Nucras emini.

Nucras delalandii, Tornier, Zool. Jahrb., Syst., xiii, 1900, p. 593.

Nucras emini, Bouleng., Ann. and Mag. N. H. (7) xix, 1907, p. 488; Nieden, Mitt. Zool. Mus., Berl., viii, 1913, p. 76.

Nucras ukerewensis, Bolkay, Archivum Zool. (Budapest), i, 1909, p. 13, figs.

Nucras tessellata, Sternf. in Schubotz, Wiss. Ergebn. Deutsch. Z.-Afr. Exped. iv, ii, p. 222 (1912).

But for the longer tail, proportions much as in *L. agilis*. Head a little broader than deep, $1\frac{2}{5}$ to $1\frac{1}{2}$ times as long as broad, its length (to posterior border of ear-opening) 4 to $4\frac{1}{3}$ times in length to vent; snout obtuse; cheeks swollen in the male. Pileus twice as long as broad. Body scarcely depressed. Hind limb reaching the wrist or the axil; foot as long as the head or a little longer; digits feebly compressed. Tail nearly twice as long as head and body.

Nasals in contact behind the rostral; frontonasal broader than long; praefrontals forming a median suture, or frontal narrowly in contact with the frontonasal; frontal about $1\frac{2}{3}$ times as long as broad, as long as its distance from the end of the snout; fronto-parietals much shorter than the frontal; parietals $1\frac{2}{3}$ times as long as broad; interparietal 2 to $2\frac{1}{2}$ times long as broad; occipital very small. Four supraoculars, first and fourth small, first in contact with the frontal; 4 or 5 superciliaries, in contact with the supra-oculars.

Two superposed postnasals; anterior loreal not half as long as second; subocular not or but little narrower beneath than above, between the fourth and fifth upper labials; two large upper temporals, first much longer than the second and in contact with the fourth supraocular; lower temporal scales rather large, upper smaller and granular; a large tympanic shield. Five large and vertically elongate scales in the middle of the lower eyelid.

Parietal foramen and pterygoid teeth present.

Gular scales much enlarged towards the collar, 18 to 21 between the symphysis of the chin-shields and the median collar-plate; no gular fold. Collar serrated, composed of 7 to 9 plates.

Scales granular, round or squarish, smooth, enlarged on the lower part of the side and passing gradually into the ventral plates; 42 scales across the middle of the body. Ventral plates in 6 or 8 longitudinal and 28 or 29 transverse series.* Two large praeanal plates, one before the other, and a single semicircle of smaller plates.

A series of 7 or 8 transversely enlarged plates on the lower surface of the forearm. Scales on upper surface of tibia smaller than dorsals. 10 to 12 femoral pores on each side. 17 or 18 lamellar scales under the fourth toe.

Upper caudal scales rather broad, slightly oblique, strongly keeled, posterior border very obtusely pointed or rounded.

The two specimens examined differ in the coloration.

The smaller, the type of *N. emini*, appears to be a half-grown male. Pale reddish brown above, with very small black dots and a faint trace of a light vertebral streak; a black lateral band from the eye to the root of the tail, edged with a light streak above and beneath and bearing a series of white spots with a tendency to run together into a streak; limbs with small dark brown spots or vermiculations; tail reddish; lower parts white.

The larger specimen, an adult male of stouter habitus, agrees better with Bolkay's figure of *N. ukerewensis*. Dark brown above, with an interrupted white vertebral streak; five series of small, white, black-edged spots on each side, the upper and lower corresponding to the light streaks of the preceding specimen; hind limbs with small white, black-edged ocellar spots; lower parts white.

Measurements (in millimetres):

From end of snout to vent	63	46
,, ,, fore limb	23	16
Length of head	15	11
Width of head	10	7
Depth of head	9	6
Fore limb	20	15
Hind limb	26	24
Foot	15	14
Tail	134	—

* 32 in the type of *N. ukerewensis*, according to Bolkay.

Particulars of Specimens Examined.

	1.	2.	3.	4.	5.	6.	7.
♂, Loika . .	63	42	29	10	21	11–10	17
Hgr. ♂, type. .	46	42	28	8	18	12	18

1. Length from end of snout to vent (in millimetres). 2. Number of scales across middle of body. 3. Transverse series of ventral plates. 4. Plates in collar. 5. Gular scales in a straight line between symphysis of chin-shields and median collar-plate. 6. Femoral pores (right and left if differing). 7. Lamellar scales under fourth toe.

The type is from the southern shore of Lake Victoria, from the collection of Emin Pasha. A second specimen, from Loika, British East Africa, from the collection of Mr. W. P. Lowe, is preserved in the British Museum. A third, from Shirati, east shore of Lake Victoria, has been described and figured by Bolkay as *N. ukerewensis*.

The lizard from Katoma, German East Africa, shortly noticed by Tornier under the name of *N. delalandii*, is referred to this species by Nieden. It is stated to have 40 scales across the body, 30 transverse series of ventral plates, 14 femoral pores, and the foot a little longer than the head. Specimens from Ukamba and Taita, also referred to this species by Nieden, have 42 to 51 scales across the body, 26 to 31 transverse series of ventrals, and 12 to 14 femoral pores on each side. Sternfeld's "*N. tessellata*" is from the Kilimanjaro district.

2. Nucras delalandii.

Lacerta lalandii, M.-Edw., Ann. Sc. Nat., xvi, 1829, pp. 70, 84, pl. v, fig. 6.

Eremias (*Nucras*) *lalandii*, Gray, Ann. N. H., i, 1838, p. 280.

Lacerta delalandii, vars. *a*, *c*, Dum. & Bibr. Erp. Gén., v, p. 241, pl. xlviii (1839).

Nucras lalandii, Gray, Cat. Liz., p. 33 (1845).

Bettaia delalandii, Bedriaga, Abh. Senck. Ges., xiv, 1886, p. 435, pl. —, figs. 1, 5, 35.

Nucras delalandii, Bouleng., Cat. Liz., iii, p. 53 (1887); Werner, Jahrb. Nat. Ver. Magdeb., 1896–98, p. 141; Bouleng., Ann. S. Afr. Mus., v, 1910, p. 475.

Nucras delalandii, var. *bedriagai*, Werner, l.c.

Head small, not or but slightly broader than deep, $1\frac{1}{2}$ to $1\frac{2}{3}$ times as long as broad, its length $4\frac{1}{2}$ to $5\frac{1}{2}$ times in length to vent in males, 5 to $5\frac{3}{4}$ times in females; snout very obtuse. Pileus $1\frac{3}{4}$ to $2\frac{1}{4}$ times as long as broad. Body much elongate, cylindrical. Limbs short, just

meeting (males) or more or less widely separated when adpressed in the adult, overlapping in the young; foot $\frac{3}{4}$ to once length of head; digits short, not or but scarcely compressed. Tail thick, swollen for some distance behind the base in males, $1\frac{2}{3}$ to $2\frac{1}{4}$ times as long as head and body.

Nasals in contact behind the rostral; frontonasal broader than long, as broad as or broader than the internarial space; praefrontals forming a median suture which may be very short; frontal as long as its distance from the rostral or the end of the snout, $1\frac{1}{2}$ to $1\frac{2}{3}$ times as long as broad, usually narrower, behind, than the supraoculars; frontoparietals much shorter than the frontal, usually shorter than their distance from the posterior extremity of the pileus; parietals $1\frac{1}{4}$ to $1\frac{1}{2}$ times as long as broad, outer border sometimes feebly emarginate for the accommodation of the upper temporal; interparietal narrow, 2 to 4 times as long as broad, sometimes divided into two; occipital very small, sometimes pushed back behind the pileus, or separated from the interparietal by the parietals forming a short median suture. Four supraoculars, first and fourth small, first usually * in contact with the frontal; 5 to 7 superciliaries, rarely 4, in contact with the supraoculars, or one or two granular scales intervening between them Two superposed postnasals, rarely one †; anterior loreal $\frac{1}{3}$ to $\frac{2}{3}$ length of second; 4 upper labials ‡ anterior to the subocular, which is usually a little narrower beneath than above; an elongate upper temporal, sometimes very broad, sometimes narrow, often divided into two or three, nearly always in contact with the fourth supraocular §; temple covered with small hexagonal or granular scales, which are not or but little larger than the dorsals; a round or oval tympanic shield, rarely absent. 5 or 6 vertically enlarged scales in the middle of the lower eyelid.

Parietal foramen usually absent. Pterygoid teeth present.

Gular scales small, juxtaposed, increasing in size and imbricate towards the collar, 23 to 30 in a straight longitudinal series; no gular fold. Collar feebly serrated, composed of 7 to 14 scales (usually 8 to 10).

Scales on body round or oval, juxtaposed, smooth, 34 to 41 across the middle of the body, 2 or 3 on the side corresponding to a ventral plate. Ventral plates in 8 longitudinal series, those of the second

* In 17 specimens out of 24.

† On both sides in a male from Van Reenen, on the right side in a male from Damaraland.

‡ Five on both sides in a male from Peri Bush, on the right side in a female from Lessouto.

§ Exceptions in a male from Peri Bush and in another from Barberton.

series from the median line the broadest, the outer small, and 32 to 37 transverse series. Praeanal region covered with irregular small plates or with a large plate, which may be longer than broad or broader than long, bordered by one or two semicircles of smaller plates; sometimes with two subequal broad plates, one in front of the other.

No transversely enlarged plates on the lower surface of the fore limb, or a series of a few feebly enlarged plates. Scales on upper surface of tibia smaller than dorsals. 10 to 15 femoral pores on each side. 16 to 20 lamellar scales under the fourth toe.

Caudal scales forming whorls of nearly equal length, upper moderately broad, the median pair broader, strongly keeled, obtusely pointed behind, with distinct sensory pits.

Young pale brown above, with 8 or 10 longitudinal series of white black-edged ocellar spots, with traces of a white vertebral streak on the nape and anterior part of the back (Pl. VI, fig. 1); sides of head and sometimes of neck with black and white vertical bars; hind limbs and tail orange or reddish.

The ocelli usually persist in the adult (Pl. VI, fig. 2) which is greyish or reddish brown above, and the black rings may expand into large spots with a tendency to run together into cross-bars (Pl. VI, fig. 3), in which case the white eyes may become much reduced or disappear, leaving nothing but more or less regular black cross-bars (Pl. VI, figs. 4, 5); head with black spots above, with black spots or vertical bars on the sides, the latter sometimes extending to the throat; these black bars may be accompanied by five very conspicuous white bars between them, the first behind the eye, the fourth behind the tympanum; tail with black spots, or with ocelli as on the body. Lower parts white, uniform or with more or less numerous round black spots.

Measurements (in millimetres):

	♂			♀		
	1.	2.	3.	4.	5.	6.
From end of snout to vent	96	94	81	112	89	88
„ „ „ fore limb	30	27	24	35	26	24
Length of head	19	19	17	20	16	16
Width of head	12	12	11	14	10	11
Depth of head	11	11	11	13	10	11
Fore limb	25	24	21	27	23	22
Hind limb	35	35	31	39	29	29
Foot	18	17	15	19	15	15
Tail	215	195	155	225	145	155

1. Port Elizabeth. 2. Damaraland. 3, 5. Krugersdorp. 4. S. Africa. 6. Pirie Bush, near King Williamstown.

The specimens in the South African Museum are from the following localities: Knysna, Kentani, Uitenhage, Port Elizabeth, Burghersdorp, East London, Encobo, and West Pondoland, in Cape Colony, Umvoti in Natal, Morija in Basutoland, and Johannesburg in the Transvaal. The following particulars are taken from specimens in the British Museum:

Particulars of Specimens Examined.

	1.	2.	3.	4.	5.	6.	7.
♂ S. Africa (A. Smith) . .	90	36	36	9	29	15	17
„ „ „ . .	86	38	34	12	29	?	?
„ „ „ . .	60	38	32	9	25	13	17
♀ „ „ . .	120	40	37	9	30	13–14	19
♂ „	89	37	34	9	30	14–13	18
♀ „	112	39	35	14	27	13–11	20
♂ Port Elizabeth (Leslie) . .	96	37	36	13	31	14	18
„ „ (Moorhouse) .	75	41	34	10	27	12–13	19
♀ „ (Drege) . .	86	36	35	9	25	11–12	19
„ „ „ . .	71	40	35	11	29	15	20
„ Pirie Bush (Trevelyan) .	88	35	35	9	24	12–10	17
♂ „ (Stenning) . .	102	36	37	10	24	12	18
♀ East London . . .	106	35	37	8	23	12	16
♂ E. Cape Colony . . .	93	39	36	8	26	12–13	20
„ Van Reenen, Natal . .	83	37	34	10	23	12	19
„ Natal	102	34	32	8	26	12–13	18
♀ Sibudeni, Zululand . .	74	40	35	9	23	10–11	17
„ Lessouto, Basutoland (Lataste coll.) . .	90	35	36	10	25	13–14	17
♂ Krugersdorp, Transvaal .	81	38	35	7	29	14–15	19
♀ „ „ . .	89	35	35	9	30	13	19
♂ Barberton, „ . .	93	37	37	9	29	11	20
„ Damaraland	94	37	34	10	28	14	19

Columns as in the preceding species.

Habitat.—Eastern parts of Cape Colony, Natal, Basutoland, Transvaal.

As observed by Hewitt, Ann. Transv. Mus., ii, 1910, p. 114, the occurrence of this eastern species in Damaraland is doubtful and rests only on the specimen recorded above, which forms part of a series of Reptiles purchased in 1865, without any indication of the collector; but there is this to say in favour of the correctness of the locality, that the other specimens associated with it belong to species known to inhabit S.W. Africa.

3. Nucras boulengeri.

Nucras boulengeri, O. Neumann, Ann. and Mag. N. H. (7), v, 1900, p. 56; Sternfeld in Schubotz, Wiss. Ergebn. Deutsch. Z.-Afr. Exped., iv, ii, p. 222 (1912); Nieden, Mitt. Zool. Mus., Berl., vii, 1913, p. 76.

"Body elongate; head not depressed, its length (to ear-opening) contained $4\frac{1}{2}$ to 5 times in the length from snout to vent; two postnasals; no granules between the supraoculars and the superciliaries; interparietal not so long and narrow as in *N. tessellata* and *N. delalandii*; occipital very small; subocular bordering the lip between the fourth and fifth upper labials; two supratemporals bordering the parietals; tympanum half as large as the ear-opening. Dorsal scales small, pointed behind, larger on the sides of the body; 45 to 53 scales round the body; ventrals in 6 longitudinal and 27 to 30 transverse series. Femoral pores 11 or 12. Foot much shorter than the head. Tail thinner than in *N. tessellata* and *N. delalandii*, $1\frac{1}{4}$ to $1\frac{1}{3}$ as long as head and body.* Colour brown above, with small indistinct blackish spots; bluish white boneath."

Distinguished from *N. delalandii* by the smaller size, the smaller and pointed dorsal scales, fewer ventrals, and the shorter foot.

Lubwas, Usoga, British East Africa (two specimens).

This species, which is only known to me from the above description, appears to be perfectly distinct.

A third specimen, a male 63 mm. long from snout to vent, from Lake Victoria, has since been described by Sternfeld. 51 scales round the body, ventrals in 8 longitudinal and 34 transverse series, 12 femoral pores on each side. A fourth, from the Eldama River, British East Africa, with 10–11 femoral pores, has been noticed by Nieden.

4. Nucras intertexta.

Forma typica.

Lacerta intertexta, A. Smith, Mag. N. H. (2), ii, 1838, p. 93.†
Lacerta delalandii, var. *b*, Dum. & Bibr. Erp. Gén., v, p. 243 (1839).

* Tail probably regenerated. In the specimen noticed by Nieden, it is nearly twice as long as head and body.

† The type specimen, described by A. Smith and by Duméril and Bibron, was presented to the British Museum by the former author in 1865, under the name of *L. delalandii*, along with the types of the other *Nucras* in his private collection, and its absolute concordance with the original description was overlooked by me, when, following Smith himself, I placed *L. intertexta* in the synonymyof *N. delalandii*. Although not labelled as such, the specimen is certainly A. Smith's type. It was referred by me to *N. tessellata*.

Nucras tessellata, part., Boulenger, Cat. Liz., iii, p. 52 (1887); Hewitt, Ann. Transv. Mus., ii, 1910, p. 112.

Nucras tessellata, var. *ocellata*, Bouleng., Ann. S. Afr. Mus., v, 1910, p. 475.

Nucras delalandii, part., Hewitt, t.c., p. 111.

Head small, slightly broader than deep, $1\frac{1}{2}$ to $1\frac{3}{5}$ times as long as broad, its length 4 to $4\frac{1}{6}$ times in length to vent; snout obtuse. Pileus $2\frac{1}{5}$ times as long as broad. Body feebly depressed. Limbs moderate, the hind limb reaching the wrist or the elbow; foot as long as the head; digits feebly compressed. Tail tapering from the base, $1\frac{1}{2}$ to $2\frac{1}{5}$ times as long as head and body.

Nasals forming a short or very short suture behind the rostral; frontonasal broader than long, broader than the internarial space; praefrontals forming a short or very short suture; frontal as long as its distance from the end of the snout, $1\frac{1}{2}$ to $1\frac{2}{3}$ times as long as broad, narrower, behind, than the supraoculars; frontoparietals much shorter than the frontal or than their distance from the posterior border of the pileus; parietals $1\frac{2}{3}$ times as long as broad, outer border sometimes emarginate for the accommodation of the anterior upper temporal; interparietal narrow, 3 times as long as the occipital, which may be broader or rudimentary and pushed back behind the pileus; parietals and interparietal shorter in proportion to their width in the very young. Four supraoculars, first and fourth small, first narrowly in contact with the frontal; 5 or 6 superciliaries; 2 to 4 small scales between the supraoculars and the superciliaries. Two superposed postnasals; anterior loreal barely half as long as second; 4 upper labials anterior to the subocular, which is usually narrower beneath than above; an elongate upper temporal, in contact with the fourth supraocular, followed by 2 or 3 smaller shields; temple covered with small hexagonal or granular scales, which are about as large as the dorsals; a round or oval tympanic shield. Lower eyelid with 5 or 6 vertically enlarged scales in the middle.

Parietal foramen and pterygoid teeth present.

Gular scales small, juxtaposed, increasing in size and imbricate towards the collar, 27 to 36 in a straight longitudinal series; no gular fold. Collar even-edged or feebly serrated, composed of 10 to 13 plates.

Scales on body oval, juxtaposed, smooth, 40 to 44 across the middle of the body, 2 and 3 on the side corresponding to a ventral plate. Ventral plates in 6 or 8 longitudinal series, those of the second series from the median line the broadest, and 29 to 34 transverse series

Praeanal plate large, with a smaller one on each side and a large pair in front, or two subequal praeanals, one in front of the other.

A series of 4 to 7 transversely enlarged plates on the lower surface of the fore limb. Scales on upper surface of tibia smaller than dorsals. 11 to 14 femoral pores on each side. 20 to 25 lamellar scales under the fourth toe.

Caudal scales forming whorls of nearly equal length, upper rather narrow, the median pair sometimes broader, rather strongly keeled, truncate behind, with distinct sensory pits.

The type specimen, a female from Latakoo, near Kuruman, now rather bleached, has the markings well preserved, although the black has turned to a pale brown, and answers to A. Smith's diagnosis: "Colour above, reddish brown, with two rows of circular white spots, discontinued about half-way between the anterior and posterior extremities, each spot surrounded by a black ring; sides chequered, black and white, the latter colour disposed in narrow vertical stripes. Tail light brown, with a dotted black line on each side, and the space between them above marked with small black spots. Under parts white." This description is supplemented by a very good account of the same specimen by Duméril and Bibron, of which this is a translation:

Instead of a great number of small black spots with white pupils (as in *L. delalandii*), there are only two series, but a little larger, on each side of the back. Two or three irregular blackish spots on the upper lip. Two vertical blackish stripes on the temple, which is white; a third above the ear, and three or four on the neck. Others along the flanks, but shorter; on examining them carefully, one may guess how they were formed. It is probable that, in early youth, white spots encircled with black existed on the flanks; gradually, as they enlarged, the black circle opened above and beneath; then each of the two portions became raised and fused with the other, whilst simultaneously the white central spots enlarged vertically, thus producing alternating black and white vertical bars. Upper surface of hind limbs with some white spots incompletely surrounded with blackish. Here and there some black spots on the upper surface of the base of the tail; others, smaller, are present on the sides, so regularly arranged and so crowded as to form a longitudinal stripe (Pl. VI, fig. 8).

The interpretation given to the markings by the authors of the 'Erpétologie Générale' is fully confirmed by the examination of the young, with which we are now acquainted (var. *ocellata*, Blgr.).

Very young specimens (37–40 mm. to vent), from Pietersburg, Transvaal, are dark brown above and blackish on the sides, with

numerous white ocelli in three or four series on the back and three series on each side; a white vertebral streak on the nape, which may be continued, interrupted, on the body; sides of head and neck with black and white vertical bars; upper orbital border whitish; a white streak on each parietal shield, continuous with the outer dorsal series of ocelli; tail coral-red. In a larger young (43 mm.), from Kokong, Bechuanaland, the dorsal markings are the same, but the ocelli on the sides of the body have fused to form vertical bars (Pl. VI, fig. 7).

A half-grown female, from Rustenburg, Transvaal, is reddish brown above, with an interrupted light, black-edged vertebral streak, a dorso-lateral series of ocelli, and three series of ocelli on each side, the lower of which are more or less confluent into a light longitudinal streak from the shoulder to the root of the hind limb; head and neck as in the preceding (Pl. VI, fig. 6).

A half-grown male, from Rustenburg, Transvaal, is similar to the preceding, but the white eyes of the ocelli on the nape are in the form of longitudinal lines, whilst the black borders of the ocelli run together to form cross-bands on the back, as is frequent in *N. delalandii*, from the young of which it is hardly to be distinguished, so far as the coloration is concerned.

Measurements (in millimetres):

	1.	2.	3.
From end of snout to vent . . .	80	63	55
„ „ fore limb . .	25	21	17
Length of head	17	14	12
Width of head	11	9	8
Depth of head	9	7·5	7
Fore limb	22	20	16
Hind limb	34	29	26
Foot	17	15	13
Tail	117	106	112

1. ♀, type, Latakoo. 2. ♀, Pietersburg, Transvaal. 3. ♂, Rustenburg, Transvaal.

Under the name of var. *holubi*, Stdr., I group together a number of specimens which, whilst agreeing essentially in structure with *N. intertexta*, differ from the type in the back being striated throughout life.

Var. *holubi*.

Lacerta tessellata, part., Peters, Reise Mossamb., iii, p. 44 (1882).
Eremias holubi, Steind., Sizb. Ak. Wien, lxxxvi, i, 1882, p. 83, pl. —.

Lacerta cameranoi, Bedriaga, Abh. Senck. Ges., xiv, 1886, p. 378 pl. —, figs. 2, 9, 11, 31.

Nucras tessellata, part., Bouleng., Cat. Liz., iii, p. 52 (1887).

Nucras tessellata, Bouleng., in Distant, Nat. Transv., p. 174 (1892).

Nucras tessellata, var. *taeniolata*, Bocage, Herp. Ang., p. 30 (1895).

Nucras tessellata, var. *ornata*, Bouleng., Ann. Natal Mus., i, 1908, p. 225.

Nucras tessellata, vars. *holubi*, *ornata*, Bouleng., Ann. S. Afr. Mus., v, 1910, p. 474.

Nucras holubi, Sternf. in Schubotz, Wiss. Ergebn. Deutsch. Z.-Afr. Exped., iv, ii, p. 222 (1912).

Head $3\frac{5}{6}$ to $4\frac{1}{4}$ times in length to vent, sometimes as deep as broad, sometimes a little broader, the cheeks often swollen in the males, Pileus usually twice as long as broad. The hind limb reaches the wrist or the elbow, rarely the axil * or just overlaps the fore limb †; foot as long as or slightly longer or slightly shorter than the head.

Lepidosis as in the typical form, but suture between the praefrontals sometimes longer, frontal sometimes nearly twice as long as broad. interparietal often broader (2 to 3 times as long as broad), first supraocular often extensively in contact with the frontal, the fourth sometimes separated from the anterior upper temporal ‡; 2 to 6 small scales between the supraoculars and the superciliaries, of which there may be 7; anterior loreal sometimes more than half as long as second §; tympanic sometimes very small, rarely absent. 25 to 33 gular scales in a longitudinal series; collar composed of 7 to 14 plates. 44 to 60 scales across the middle of the body. Ventral plates in 27 to 34 transverse series. A large praeanal bordered by 4 or 6 smaller shields, or 2 large praeanals, one in front of the other, or 3 forming a triangle bordered by a semicircle of small plates. 11 to 20 femoral pores on each side. 20 to 26 lamellar scales under the fourth toe.

* Male and young from Bulawayo.

† Female from Lake Nyassa.

‡ Males from Vredefort Road and Rustenburg, females from Lydenburg and Kimberley. The upper temporal is then entirely on the temple. Bedriaga observes, *à propos* of his *L. cameranoi*, that the upper temporals are on the upper surface, forming part of the pileus, in the South African species (my *Nucras*). The series of specimens here referred to *N. intertexta* shows this character to be by no means a constant one, as these shields may be lateral and perpendicular to the parietals. There is thus in *Nucras* the same amount of variation with respect to this feature as in *L. muralis*, in which Méhely has used it for the distinction of his *Archaeolacertae* and *Neolacertae*.

§ A single postnasal on one side in a young from Bulawayo.

Varies much in markings. The principal variations may be arranged as follows, starting with the most primitive.

A. (*N. tessellata*, var. *taeniolata*, Bocage.). Four or five* white dorsal streaks separated by wider dark brown interspaces, and three white streaks on each side, the upper (proceeding from the temple above the ear-opening) broken up, anteriorly, into a series of round spots; on the posterior part of the body, these markings fade into a pale buff colour, which also occupies the upper surface of the limbs and tail. The coloration is thus very similar to that of Smith's *L. taeniolata*.—Dongwenna, Mossamedes. (Pl. VII, fig. 1.)

B. (*E. holubi*, Stdr., l.c., lower figure). Three white dorsal streaks separated by broader black or dark brown interspaces, and 2 (sometimes broken up into spots) along each side; the white vertebral streak continued for a short distance on the tail, which bears 3 dark longitudinal streaks; the outer dorsal light streak extends on the parietal shield, where it joins the light supraorbital border.—Limpopo Valley, Transvaal (Steindachner); Rustenburg, Transvaal; Vredefort Road, Orange River Colony; Kimberley, Burghersdorp, Cape Colony. (Pl. VII, fig. 2).

C. (*E. holubi*, Stdr., l.c., upper figure). Back reddish brown, with 3 dark-edged light streaks; a broad dark brown or black lateral band from the temple to above the hind limb, bearing 1, 2, or 3 series of roundish white spots, and edged below by a white streak which may be broken up into spots.—Limpopo Valley (Steindachner); Zoutpansburg, Transvaal; Lydenburg, Transvaal; Vredefort Road, Orange River Colony; Bulawayo; Port Elizabeth. (Pl. VII, fig. 3).

D. As in the preceding, but temple and side of neck with black and white vertical bars.—Umfolosi River, Natal; Pretoria; Bindura, S. Rhodesia. (Pl. VII, fig. 4).

E. The black and white vertical bars are continued, more or less distinct, on the flanks.—Umfolosi River. (Pl. VII, fig. 5).

F. Back reddish brown with black dots and mere traces of the 3 light streaks; a blackish lateral band with very numerous small round white spots; sides of head with black and white vertical bars, tail with numerous small dark and light spots.—Lake Nyassa. (Pl. VI, fig. 10). This form appears to represent Bedriaga's *L. cameranoi*, from Tette, Mozambique, but the fingers are not quite so short†, the figure accompanying the description showing them to be very similar to those of *N. delalandii*.

* Four in the male, five in the female; only two specimens examined.

† They are shorter and thicker in the female than in the male.

G. As in E, but without the light vertebral streak, and with black dots on the back and on the sides of the belly.—Umfolosi River.

H. As in D, but no light vertebral streak, and the light dorso-lateral streak ending midway between the fore and hind limbs; black dots on the sides of the belly. This variation forms a complete connection with the typical *N. intertexta*, the only difference being that the light ocellar spots on the nape and anterior part of the back have fused to form a dark-edged lateral streak.—De Kaap Goldfields, Transvaal. (Pl. VI, fig. 9).

All the young specimens examined have 3 or 5 light dorsal streaks and the tail is of a coralline red.

The var. *holubi* must be regarded as more primitive than the typical form, and the pattern described under A, along with the *taeniolata* form of *N. tessellata*, as the original from which all others in the genus can be derived without the least difficulty.

Measurements (in millimetres):

	1.	2.	3.	4.	5.	6.	7.	8.	9.
From end of snout to vent	80	96	95	75	86	55	62	58	70
„ „ „ to fore limb.	28	29	34	25	30	19	20	21	23
Head	19	20	24	17	20	13	14	13	15
Width of head	12	13	15	11	12	8	9	8	10
Depth of head	11	11	13	10	10	7	7	8	8·5
Fore limb	25	26	29	22	25	17	17	18	20
Hind limb	38	39	45	33	36	26	26	29	33
Foot	19	20	21	17	18	13	13	14	16
Tail	170	—	215	123	180	—	—	116	135

1. ♂, Nyassa. 2. ♀, Nyassa. 3. ♂, Umfolosi R. 4. ♀, Zoutpansberg. 5. ♀, De Kaap Goldfields. 6. ♂, Vredefort Rd. 7. ♀, Vredefort Rd. 8. ♂, Dongwenna. 9. ♀, Dongwenna.

Particulars of Specimens Examined.

	1.	2.	3.	4.	5.	6.	7.	8.	9.
Forma typica.									
♀ Latakoo (type)	80	40	8	32	12	34	11	24	4–3
Hgr. Kokong, Bechuanaland	44	42	6	31	13	33	13	24	4–3
♂ Rustenburg, Transvaal	55	44	6	29	13	34	13–14	22	3
♀ Pietersburg, „	63	44	8	34	12	36	14	25	4
Yg. „	40	43	8	30	10	37	13–12	23	3
„ „	38	42	8	31	11	31	12	20	2
var. holubi.									
♂ Port Elizabeth	56	50	6	28	9	26	11	21	4–5
„ Burghersdorp, Cape Col.	50	49	6	28	11	28	12	24	5
♀ Kimberley (S. A. Mus.)	52	44	8	28	11	29	12–13	22	4
♂ Vredefort Road, O.R. Col.	55	46	8	29	12	28	12	24	4–5
„ „ „ „	52	48	8	28	10	26	12–14	21	5

	1.	2.	3.	4.	5.	6.	7.	8.	9.
var. holubi.									
♀ Vredefort Road, O.R. Col. . .	62	48	8	30	12	26	14–13	21	4
„ „ „ „ . .	50	52	8	30	10	27	12	21	4–3
„ „ „ „ . .	48	55	8	29	8	28	13	20	5
♂ Umfolosi R., Zululand . . .	95	60	8	31	12	32	17–16	22	2–3
„ „ „ . . .	65	58	6	31	13	33	15	25	4–6
Yg. „ „ . . .	46	57	6	32	14	33	16	25	5–4
♂ De Kaap Goldfields, Transvaal .	86	55	6	30	12	32	15–16	23	4–3
Yg. Pretoria, „ .	44	48	6	30	10	28	14	26	3–4
♂ Rustenburg, „ .	53	45	8	29	14	31	13	21	5–6
♀ Lydenburg, „ .	66	52	8	31	9	28	17–18	25	5
„ „ „ .	64	49	8	31	11	30	17–16	24	6
„ Zoutpansberg „ .	75	55	8	32	11	32	20–19	24	3
♂ Bulawayo	50	50	8	27	7	28	13–15	22	6–4
Yg. „	42	58	6	29	9	33	15	23	5
♀ Bindura, S. Rhodesia (S. A. Mus.)	49	46	6	28	10	25	15–17	25	4
♂ L. Nyassa	80	44	6	30	10	30	16–15	25	4
♀ „	96	46	6	31	8	31	16–17	25	4–2
♂ Dongwenna, Mossamedes . .	58	45	8	28	10	27	14–13	25	2–3
♀ „ „ . .	70	45	8	34	12	30	14	26	4–5

1. Length from snout to vent. 2. Number of scales across middle of body. 3. Longitudinal series of ventral plates. 4. Transverse series of ventral plates. 5. Plates in collar. 6. Gular scales in a straight line between symphysis of chin-shields and median collar-plate. 7. Femoral pores (right and left if differing). 8. Lamellar scales under fourth toe. 9. Scales between supraoculars and superciliaries.

Habitat.—The range of *N. intertexta* extends from Portuguese East Africa, Nyassaland, and Angola to the northern and eastern parts of Cape Colony. The specimens in the South African Museum are from Burghersdorp, Little Namaqualand, and Kimberley in Cape Colony, Smithfield in the Orange River Colony, Barberton in the Transvaal, Bindura and Bulawayo in Southern Rhodesia.

5. Nucras tessellata.

Lacerta tessellata, A Smith, Mag. N. H. (2) ii, 1838, p. 92; Dum. & Bibr. Erp. Gén., v, p. 244 (1839); Bedriaga, Abh. Senck. Ges., xiv, 1886, p. 374.

Lacerta livida, A. Smith, l.c.

Lacerta elegans, A. Smith, l.c.

Lacerta taeniolata, A. Smith, t.c., p. 93; Dum. & Bibr., t.c., p. 247 Bedriagia, t.c., p. 381.

Zootoca taeniolata, Gray, Cat. Liz., p. 29 (1845).

Nucras tessellata, Gray, op. cit., p. 33; Werner, Jen. Denkschr., iv, p. 329 (1910).

Teira ornata, Gray, Proc. Zool. Soc., 1864, p. 58.

Lacerta tessellata, part., Peters, Reise Mossamb., iii, p. 44 (1882).

Lacerta tessellata, subsp. *pseudotessellata*, Bedriaga, t.c., p. 377, pl. —, figs. 8, 21.

Nucras tessellata, part., Bouleng., Cat. Liz., iii, p. 52 (1887).

Nucras tessellata, vars. *elegans*, *livida*, *taeniolata*, Bouleng., Ann. S. Afr. Mus., v, 1910, p. 474.

Head small, considerably broader than deep, $1\frac{1}{2}$ to $1\frac{2}{3}$ times as long broad, its length 4 to $4\frac{2}{3}$ times in length to vent; snout obtuse. Pileus 2 to $2\frac{1}{4}$ times as long as broad. Body feebly depressed. Hind limb reaching the elbow, the axil, or the shoulder; foot considerably longer than the head; digits slender, feebly compressed. Tail flattened and widened at the base in males, nearly 2 to $2\frac{3}{4}$ times as long as head and body.

Nasals forming a short suture behind the rostral; frontonasal broader than long, broader than the internarial space; praefrontals forming a short suture; frontal as long as or a little longer than its distance from the end of the snout, $1\frac{1}{2}$ to 2 times as long as broad, narrower, behind, than the supraoculars; frontoparietals much shorter than the frontal or than their distance from the posterior border of the pileus; parietals $1\frac{1}{2}$ to $1\frac{3}{4}$ times as long as broad, outer border sometimes emarginate for the accommodation of the anterior upper temporal; interparietal narrow, $2\frac{1}{2}$ to 4 times as long as broad; occipital very short, sometimes broader than the interparietal. Four supraoculars, first and fourth small, and sometimes divided into two, first extensively in contact with the frontal; 7 or 8 superciliaries; 2 to 7 small scales between the supraoculars and the superciliaries. Two superposed postnasals, rarely one *; anterior loreal $\frac{1}{2}$ to $\frac{3}{4}$ times as long as second; 4 upper labials anterior to the subocular, which is a little narrower beneath than above; an elongate anterior upper temporal, often in contact with the fourth supraocular †, followed by 1 or 2 smaller shields; temple covered with small hexagonal or granular scales, which are about as large as the dorsals or smaller; tympanic shield roundish, often small or absent.

Parietal foramen usually absent. Pterygoid teeth present.

Gular scales small, juxtaposed, increasing in size and imbricate

* Types of *L. taeniolata*. Also in a young from Clanwilliam which, in its markings, agrees with the typical *L. tessellata*.

† Not in contact in five specimens: one of the types of *L. taeniolata*, two of the types of *L. livida*, male from Deelfontein, and female from Little Namaqualand.

towards the collar, 25 to 33 in a straight longitudinal series; no gular fold. Collar even-edged, composed of 8 to 13 plates.

Scales on body roundish or oval-hexagonal, smooth, 40 to 60 across the middle of the body, 2 and 3 on the side corresponding to a ventral plate. Ventral plates in 6 or 8 longitudinal series, those of the second series from the median line the broadest, and 25 to 34 transverse series. Praeanal region covered with several irregular shields, or with two large shields one in front of the other.

A series of 6 or 7 transversely enlarged plates on the lower surface of the fore limb. Scales on upper surface of tibia smaller than dorsals. 11 to 16 femoral pores on each side. 25 to 31 lamellar scales under the fourth toe.

Caudal scales forming whorls of nearly equal length, upper rather narrow, the median pair often broader, rather strongly keeled, truncate or very obtusely pointed behind, with more or less distinct sensory pits.

As in the preceding species, the markings differ very strikingly according to individuals, and some at least of the different patterns, on which species have been founded, perhaps indicate local forms or varieties. I here enumerate those with which I am acquainted, beginning with the most primitive:

A. (*L. taeniolata*, Smith).—Eight white streaks on the back and sides, sometimes nine on the nape and anterior part of back, separated by black streaks; the outer dorsal light streak extending to the fourth supraocular, the upper lateral, originating just above the ear, sometimes broken up into spots. Posterior part of back and tail brown above, the latter inclined to red near the extremity and with a blackish lateral streak. Lower parts white.—"Grassy districts of Cape Colony," Smith; Little Namaqualand; Pine Town, Natal (South African Museum). (Pl. VII, fig. 6.)

B. (*L. livida*, Smith).—Back with light and dark streaks as in the preceding, or pale buff behind with black vermiculations; sides black with numerous small white spots, which form irregular vertical bars on the temple and neck.—"Northern parts of Cape Colony," Smith; Little Namaqualand; Deelfontein. (Pl. VII, figs. 7, 8.)

C. (*L. tessellata*, Smith; *T. ornata*, Gray).—Neck and anterior part of back black, with 3 or 4 white lines above and very regular white vertical bars on the sides; posterior part of body grey or pale buff, with more or less distinct black bars on the sides. Feet and tail coral-red or reddish, at least in the young.—"Eastern parts of Cape Colony," Smith; Clanwilliam, Calvinia, Worcester, Klipfontein, in Cape Colony; Zambesi (Sir J. Kirk). (Pl. VII, figs. 9, 10.)

In the var. *pseudotessellata*, Bedr., from Mozambique, there are 5 white lines on the nape.

D. (*L. elegans*, Smith).—Pale reddish brown above and on the sides; two white, black-edged streaks on the neck.—"Little Namaqualand and the country towards the Orange River," Smith; Smithfield, Orange River Colony.

In the following tabulation of specimens examined the same arrangement is adopted:

Measurements (in millimetres):

	♂			♀		
	1.	2.	3.	4.	5.	6.
From end of snout to vent	70	65	47	74	80	62
„ „ „ fore limb	24	24	18	25	28	20
Head	15	15	11	16	17	13
Width of head	9	10	7	10	12	8
Depth of head	7	7	5	7·5	9	6
Fore limb	20	22	16	22	22	18
Hind limb	34	37	27	39	40	29
Foot	19	20	15	21	21	16
Tail	—	—	125	—	—	120

1. Type of *L. tessellata*. 2, 4. Little Namaqualand. 3. Klipfontein. 5. Type of *L. livida*. 6. Type of *L. taeniolata*.

Particulars of Specimens Examined. (1).

	1.	2.	3.	4.	5.	6.	7.	8.	9.
A.									
♀ Type of *L. taeniolata*	62	48	6	32	11	28	15–14	26	6–7
Yg. „ „	40	45	6	27	11	30	15–16	25	5
♀ Little Namaqualand	57	52	8	29	10	29	13	28	4
B.									
♂ Type of *L. livida*	54	46	6	25	8	29	13	27	4–3
„ „ „	47	56	6	29	8	33	12–13	30	2
♀ „ „	80	47	8	30	11	33	11	28	5
♂ Deelfontein, Cape Colony	72	48	8	27	11	31	13	26	4–3
C.									
♂ Type of *L. tessellata*	70	47	6	31	9	31	15–13	27	7–6
„ Little Namaqualand	65	45	6	29	9	29	15	27	4
♀ „ „	74	42	6	31	12	30	15	27	5–4
♂ Guires, Little Namaqualand	58	44	6	27	12	31	15	28	4
Yg. Clanwilliam, W. Cape Colony	40	41	6	31	9	29	14–15	30	7–6
„ „ „	40	40	6	31	9	32	14	26	5–4
♂ Klipfontein, E. Cape Colony	47	45	6	30	11	38	15–16	27	6–4
Yg. Zambesi, type of *T. ornata*	32	46	6	30	13	26	14	26	4
D.									
♀ Type of *L. elegans*	80	45	8	33	8	?	16–14	31	?
„ „ „	62	47	8	32	8	?	14–15	30	4
„ Smithfield, O.R. Col. (S.A. Mus.)	63	45	6	32	8	33	14	29	3

(1) Tabulated as in the preceding species.

I have examined in addition 19 specimens preserved in the South African Museum. Scales across the body 40 to 60; femoral pores 12 to 16. One specimen, from Little Namaqualand, with a single postnasal.

The habitat of *N. tessellata* is a wide one, extending from Great Namaqualand to the Karroo and Natal, and the species being also on record from Mozambique (Berlin Museum) and the Zambesi (Sir J. Kirk), it will probably be discovered in Southern Rhodesia.

The species of *Nucras* appear to be of very local occurrence, and much more collecting will have to be done before their distribution can be properly mapped out. It is hoped that this contribution to the knowledge of them may be an incentive to the collecting and study of further material.

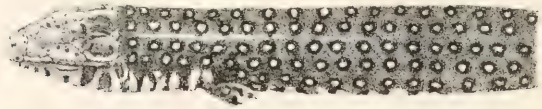
EXPLANATION OF THE PLATES.

Plate VI.

Fig. 1. *Nucras delalandii*, young. East London. $\frac{2}{1}$.
2. „ „ ♂. Van Reenen, Natal. $\frac{5}{7}$.
3. „ „ ♂. Krugersdorp, Transvaal.
4. „ „ ♂. Barberton, Transvaal.
5. „ „ ♀. Krugersdorp, Transvaal.
6. „ *intertexta*, ♀. Pietersburg, Transvaal. $\frac{6}{5}$.
7. „ „ young. Kokong, Bechuanaland. $\frac{7}{4}$.
8. „ „ ♀, type. Latakoo, near Kuruman.
9. „ „ var. *holubi*. ♀. De Kaap, Transvaal.
10. „ „ „ „ ♂. Lake Nyassa.

Plate VII.

Fig. 1. *Nucras intertexta*, var. *holubi*. ♀. Dongwenna, Mossamedes. $\frac{5}{4}$.
2. „ „ „ „ ♂. Burghersdorp, Cape Colony. $\frac{3}{1}$.
3. „ „ „ „ ♂. Barberton, Transvaal. $\frac{2}{3}$.
4. „ „ „ „ ♂. Umfolosi, Natal, $\frac{11}{9}$.
5. „ „ „ „ ♂. „ „ $\frac{5}{6}$.
6. „ *tessellata*, young, type of *L. taeniolata*. Cape Colony. $\frac{2}{1}$.
7. „ „ ♂. Deelfontein, Cape Colony. $\frac{11}{9}$.
8. „ „ ♂, type of *L. livida*. Cape Colony. $\frac{11}{8}$.
9. „ „ ♂, type. Cape Colony. $\frac{4}{3}$.
10. „ „ young. S. Africa. $\frac{2}{1}$.



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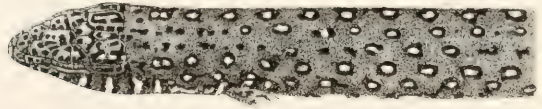

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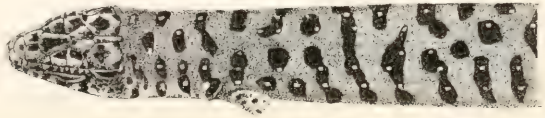

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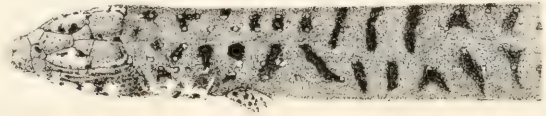

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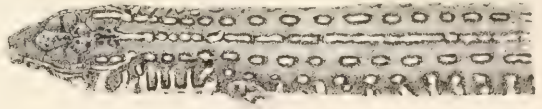
Nucras intertexta.



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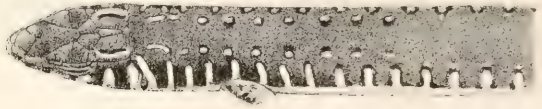

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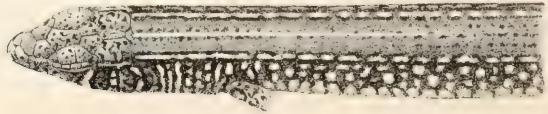

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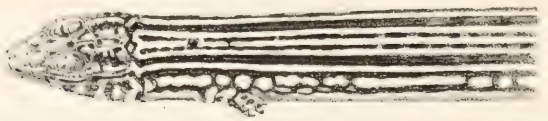
Nucras delalandii.



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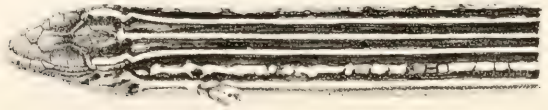

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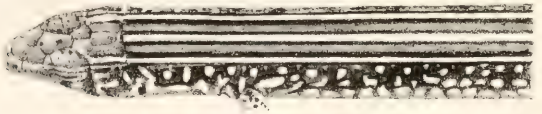

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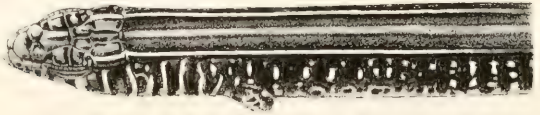

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Nucras tessellata

6

7

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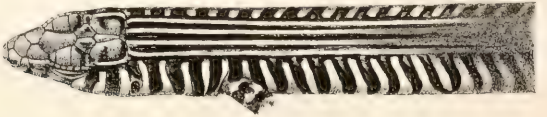

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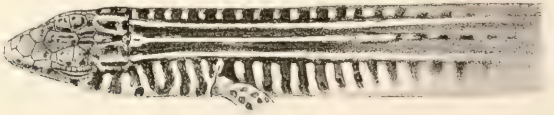

10

Nucras intertexta.

Adlard & West Newman imp

J. Green. del. et lith.

11.—*Description of a New South African Lizard of the genus* Eremias. —By G. A. Boulenger, LL.D., D.Sc., F.R.S. (Published by permission of the Trustees of the British Museum.)

Eremias aspera, sp. n.

Head and body rather strongly depressed. Head $1\frac{1}{3}$ times as long as broad, its length 4 to $4\frac{1}{4}$ times in length to vent, its depth equal to the distance between the centre of the eye and the tympanum; snout obtusely pointed, with the nasals very feebly swollen, as long as the postocular part of the head; a feeble concavity in the middle of the upper surface of the snout, extending to the middle of the frontal shield. Pileus nearly twice as long as broad. Neck a little narrower than the head. Hind limb reaching the collar or a little beyond; foot $1\frac{1}{4}$ times as long as the head; toes rather slender, feebly compressed. Tail twice or a little less than twice as long as head and body.

Upper head-shields flat, very rugose, with granular asperities. Nasals in contact with each other behind the rostral, the suture between them $\frac{1}{6}$ to $\frac{1}{4}$ the length of the frontonasal, which is a little broader than long; praefrontals as long as broad or longer than broad, separated by an azygos shield; frontal a little shorter than its distance from the end of the snout, $1\frac{1}{2}$ to $1\frac{2}{3}$ times as long as broad, separated from the supraoculars by a series of small scales; parietals as long as broad; interparietal larger than the frontoparietals, in contact with or narrowly separated from a very small occipital. Two supraoculars, together hardly $\frac{2}{5}$ the length of the supraocular region, the first shorter than the second, the space in front of them filled by 4 or 5 transverse series of granules; 6 or 7 superciliaries, separated from the supraoculars by 2 or 3 series of granules. Three nasals, lower in contact with the rostral and the first upper labial; anterior loreal as long as deep or a little deeper than long, shorter than the second; 4 or 5 upper labials anterior to the subocular, which is keeled below the eye and largely borders the mouth, its lower border much narrower than the upper. Temporal scales granular, keeled; no

tympanic shield; no auricular denticulation. Lower eyelid with a transparent disc formed of two large black-edged scales.

4 pairs of chin-shields, the first 3 in contact in the middle.

31 or 32 gular scales in a straight line between the symphysis of the chin-shields and the median collar-plate; no gular fold. Collar straight, free, composed of 11 plates.

Scales granular and keeled on the nape, rhombic, feebly imbricate, and strongly keeled on the body, graduating into the caudals, larger and smooth towards the ventrals; 51 to 56 scales across the middle of the body. Ventral plates in 12 or 14 rather irregular longitudinal and 33 to 37 rather angular transverse series, the plates as long as broad or a little broader than long. Praeanal region covered with small irregular plates.

Scales on upper surface of fore limb moderately large, keeled.

Scales on upper surface of tibia rhombic, feebly imbricate, keeled, as large as the posterior dorsals; one series of very large and one of small plates on the lower surface; 13 or 14 femoral pores on each side. Subdigital lamellae bicarinate, spinulose, 21 under the fourth toe.

Upper caudal scales oblique, truncate behind, strongly and diagonally keeled, basal subcaudals feebly keeled; 24 or 26 scales in the fourth or fifth whorl.

Pale greyish-brown above, with 2 dorsal and 2 lateral darker bands, and 4 series of whitish, brown-edged ocellar spots on the back; a white streak below the dark lateral band, from below the eye, through the tympanum, to the groin; tail yellowish with a brown lateral streak in the anterior half. Lower parts white.

Measurements:

From end of snout to vent	51	millim.
„ „ fore limb	20	„
Head	12	„
Width of head	9	„
Depth of head	6	„
Fore limb	19	„
Hind limb	33	„
Foot	15	„
Tail	102	„

Habitat.—Bechuanaland. Described from two female specimens from Mochudi, received by the South African Museum from Mr. J. Fenton, along with examples of *Eremias lugubris* and *Ichnotropis capensis* from the same locality.

This species is closely related to the typical *E. lineo-ocellata*, differing in the very rugose upper head-shields, the absence of projecting scales

in front of the ear, and the lower number of subdigital lamellae (21 instead of 24 to 28). The number of scales across the body is low (51 or 56 as against 53 to 73), as compared with *E. lineo-ocellata*, in which I have counted the scales in 64 specimens and find only 8 with less than 57. A further difference resides in the chin-shields, of which the 3 anterior pairs are in contact in the middle, instead of 2, as is the rule in *E. lineo-ocellata*.

12. — *The Echinoderm Fauna of South Africa.* — By Hubert Lyman Clark. (With Plates VIII—XXIII.)

INTRODUCTION.

Knowledge of the Echinoderm fauna of South Africa has not kept pace either with our zoological knowledge of the region or with our knowledge of echinoderms in general. The literature dealing with it is scanty and scattered and there are vast stretches of coast line where no collector has yet been. During the years preceding the voyage of the *Challenger*, a few echinoderms taken at the Cape of Good Hope came into the hands of zoologists in Europe but prior to 1875, there were scarcely thirty species recorded from the region; with the exception of one comatulid and three or four holothurians, these were about equally divided among the sea-stars, brittle-stars and sea-urchins. The visit of the *Challenger* marks the real beginning of our knowledge of the echinoderm fauna of South Africa. During her stay of seven weeks at Cape Town, her naturalists collected 23 species of echinoderms of which about half were new to science. At stations 141 and 142, just off the Cape, 18 additional species were taken of which half were new. The reports on the echinoderms taken by the *Challenger* are in every case monographic and it is possible to determine from them the species known from the Cape region during the 'eighties" including the *Gazelle* collection. We find there were all told some 80 species listed but not all of these were reliable records, so that it is safe to say the number of echinoderms actually known from South Africa at the close of the nineteenth century was not in excess of 75 species. There were about thirty additional species recorded from Mozambique, but many of these were improperly identified and for this, and similar reasons, it is hard to say how many valid species really were known from that Portugese settlement.

The early years of the present century saw a great advance in the collecting and study of the echinoderms of the South African region. The *Valdivia* made a short stay at Cape Town and several of the Antarctic exploring vessels have stopped there. A German expediton collected at Angra Pequena Bay in 1903–05 and also secured material at the Cape. The holothurians of this collection were reported on

by Britten (1910, Schultze's Zool. Anthrop. Erg. Forsch. Südafrika, vol. IV, pt. I, pp. 239–243) but the other echinoderms served for a very important paper by Döderlein, in the same series of reports (1910, pp. 245–258, pls. IV, V). He gives lists of the sea-stars, brittle-stars and sea-urchins recorded from South Africa up to 1910 and including his own new species of which there were three. More detailed reference to these lists will be found beyond (pp. 237, 310 and 366).

In 1897, the Cape Department of Agriculture began an investigation into the marine resources of the colony and accumulated a large amount of very valuable material, a portion of which was finally sent to the British Museum for identification. Bell's reports on the echinoderms appeared during 1904 and 1905 and were a great disappointment to students of the group, they are so brief and summary. Many species whose occurrence at the Cape warranted an interesting discussion are listed with scarcely any comments and even the new species are described very briefly and inadequately. A. H. Clark (1911, Proc. U.S. Nat. Mus., vol. 40, p. 5) has already commented on this unfortunate state of affairs so far as the crinoids are concerned, but the reports on the sea-stars, brittle-stars and sea-urchins are on the same plane. No report on the holothurians was published.

Early in 1916, Dr. Péringuey sent to me the collection of Echinoderms which had accumulated at the South African Museum, subsequent to Bell's reports. With this collection as a basis I have been able to prepare the present report on the Echinoderms of South Africa. I have included not only all the species examined by me but all species recorded by previous writers, unless the validity of the record was so dubious as to warrant its rejection. The collections sent me have been largely made by the Cape Government vessel, the *Pieter Faure*, and include a considerable number of deep-water species, some hauls of the dredge or trawl having been made at depths of 900—1000 fms. These deep-water hauls are of very great interest. Excepting the holothurians the material is in excellent condition. Much of that taken along shore, particularly Mr. K. H. Barnard's collections, has very interesting and valuable data on the labels, with reference to habitat and colour in life.

The area included in this report extends from Mozambique on the east coast around to Mossamedes on the west, and outward to the thousand-fathom line. Of course, the collections hitherto made only represent isolated and widely separated spots in this vast area. Something like four thousand miles of coastline is included but excepting between Cape Town and Durban, there are not half a dozen

places on all this reach of shore where collections of echinoderms have been made. As a matter of fact we know nothing of the western coast of South Africa from Cape Town to Mossamedes, yes even to the mouth of the Congo, excepting only Saldanha Bay and Angra Pequena Bay. It was only at the earnest request of Dr. Péringuey that I consented to include Mozambique, for so far as the echinoderms are concerned that region is distinctly Indo-Pacific and has a very different fauna from that of Natal and Cape Colony. I think this will be clearly shown in the following discussion of the South African fauna.

For the privilege of preparing this report and for the honour done me in entrusting these valuable collections to my care, it gives me pleasure to express my sincere thanks to Dr. Péringuey, who has spared no pains to assist my work in every possible way.

Museum of Comparative Zoölogy,
Cambridge, Mass., U.S.A.
August 1, 1922.

THE ECHINODERM FAUNA OF SOUTH AFRICA.

The collections of the South African Museum entrusted to my charge contained 1854 specimens of echinoderms, representing 157 species. Of these 32 seem to have been hitherto undescribed and one of these represents a new genus (*Spatagobrissus*). It has also seemed desirable to establish a new genus (*Tropholampas*) for the remarkable little sea-urchin called by Studer *Catopygus loveni*, and another genus (*Dictenophiura*) is instituted for a small group of brittle-stars of which *Ophiura carnea* Ltk. is the type.

In addition to the 157 species of the present collection, there are valid records for 59 other species, so that the present report includes 216 species, or more than double the number known from this region twenty years ago. The importance of the work done by the Pieter Faure and the South African Museum during the past twenty years could scarcely be better emphasized than by that simple statement of fact. Of the 216 species treated herein, 118 are strictly littoral, occurring in less than 20 fms. of water, while 23 are abyssal, occurring only beyond the 600 fms., line. The remaining 75 species may be called continental.

Of the 118 littoral species, 45 are endemic and 2 are, if not actually cosmopolitan, of such wide distribution that they may be ignored in considering the origin of the echinoderm fauna. Of the remaining 71 species no fewer than 66, or 93%, are species of the Indo-Pacific region or at least of the western Indian Ocean. Only three seem to have an Atlantic origin and only two are distinctly austral.

Of the 75 continental species, on the other hand, 50 are endemic and 4 are of too wide a distribution for consideration, while of the 21 remaining only 4, or 19%, are of Indo-Pacific affinities, while 10 are austral and 7 are Atlantic Ocean forms. The abyssal fauna is like the continental except that of the 23 species only 5 are endemic. There are 6 of very wide distribution and of the remaining 12, only two, or 17%, are Indo-Pacific, while 2 are austral and 8 are Atlantic.

These figures show at a glance what a highly characteristic fauna

South Africa possesses, but this will be more evident if we first see what the relation is between the Mozambique fauna and that of the Cape. Of the 216 species here listed, 59 occur at Mozambique; of these, 32 or 54 % are not known from south of that district and 5 others are not known south of Delagoa Bay, and 12 others either are not known west of Durban or the records for them on the Cape Colony coast are dubious. There are then only 10 species common to the South African coast and to that of the Mozambique region. On the other hand, of the 59 species occurring at Mozambique, 50 occur at Zanzibar or further northward and 5 others are known from some other part of the Indo-Pasific region. Examination of the list of ten species common to Cape Colony and Mozambique shows that one (*Tropiometra carinata*) ranges from Zanzibar, around the Cape of Good Hope to Brazil and the West Indies, and another (*Parechinus angulosus*) is one of the endemic species of the Cape, which apparently has extended its range northward along the coast far enough just to reach the Mozambique region. Still another (*Asterina exigua*) is very common in southeastern Australia and may possibly have reached Mozambique via Cape Colony. The records of the remaining seven species, like *Oreaster mammillatus* and *Ophiocnemis marmorata* are based on single specimens or single instances or on old unreliable Museum specimens, so that there are not more than two or three species of echinoderms which can really be called common to both Cape Colony and Mozambique. As already pointed out 55 of the 59 species listed from Mozambique are characteristic Indo-Pacific species so that there can be no question in what zoögeographical region the Portugese colony belongs.

If we subtract from the 216 species included in this report, the 32 species not known from south of Mozambique, we shall be able to emphazize better the peculiarities of the South African fauna. Of the 184 species of echinoderms known from south of Mozambique, no fewer than 100 or 54 % are endemic, certainly a very large number. Not quite half (86) of the species are littoral and 45 of these are endemic, while only 7 seem to belong to some other than the Indo-Pacific fauna. Even the 45 endemic forms as a rule show their affinity to some Indo-Pacific species. The littoral echinoderms of South Africa then seem to have come from the east but with the passage of time have become very largely specifically differentiated. The additions from the west have been so exceptional (*Ophiothrix fragilis* for example) as to be conspicuous.

When we examine the continental and abyssal faunas however we find a striking difference. There are 98 species in this combined

group and of these 55 are endemic, about the same percentage as among the littoral species. But the remaining 43 species show very little Indo-Pacific connection. Only half a dozen are really species of that region, while at least 15 are from the Atlantic and a dozen more are distinctly austral. The remainder are more or less cosmopolitan. When we examine the 55 endemic species we find that their nearest relatives are very largely Atlantic Ocean or West Indian forms or at least they belong in genera occurring in the Atlantic. It seems clear then that the deeper water fauna of the Cape region has not come in from the east but has largely come from the west and north, with the addition of a considerable austral element, the significance of which is not clear.

Examination of a chart showing the ocean currents on the coasts of South Africa suggests that they have been a determining factor in the development of the echinoderm fauna of the region. The warm Agulhas current has brought the shoal water Indo-Pacific fauna clear to the Cape itself but the further south and west this fauna has been carried the more it has become modified until no truly Indo-Pacific species occurs at the Cape itself. The Benguela current flowing northward along the western coast has effectually prevented any influx of northern littoral species from the Atlantic. The few notable exceptions such as *Ophiothrix fragilis* and *Ophioderma leonis* (an endemic species of a West Indian genus) may perhaps be accounted for as the result of artificial introduction, for example on the foul bottom of a sailing vessel. It is worthy of note that the cold winter water at the Cape, westward of the bend in the Agulhas current, has acted as a very effective barrier in preventing any considerable extension of the echinoderm fauna of Natal and southeastern Cape Colony up the west coast. The west coast fauna as revealed by collections at Saldanha Bay and Angra Pequena is a small one made up of about sixteen species, of which only one (*Parechinus angulosus*) is known from east of Algoa Bay.

On the other hand the great surface currents seem to have had little to do with the development of the deeper water fauna, which seems rather to suggest changed continental boundaries. The very evident relation of this fauna to that of the North Atlantic and the West Indies is difficult to account for with the present ocean depths and their boundaries as they are to day. Moreover the distinct and considerable austral element suggests the possibility of former continental lines to the south very different from those of to day. And finally the considerable percentage of widely distributed, if not cosmopolitan, species, such as those occurring in the North Pacific,

indicates the lapse of a long time since this deep water fauna entered the South African region.

Perhaps the conclusion is more sweeping than the facts warrant but the impression left by the study of the South African fauna is that the region south of Delagoa Bay now forms a very distinct zoögeographical region, only superficially connected with the Indo-Pacific region to the north and east, and quite isolated from any other region; that its original echinoderm fauna was common to a large continental area to the northwest in the Atlantic and to the southward; and that its present day littoral fauna has moved in from the northeast under the influence of the Agulhas current, but restricted by the cold winter water from the southeast.

SEA-LILIES. CRINOIDEA.

The crinoids form a very insignificant part of the Echinoderm fauna of South Africa. They were listed in 1915 by Mr. Austin Hobart Clark (Deutsche Süd-Polar Exp.: Zoologie, vol. 8, p. 163) who gives three species as occuring along shore in 0–30 fms. and two species as occuring in deep water, 250–450 fms. The collection of the South African Museum (45 specimens) contains four of these five species and also four species not known hitherto from the South African region. Of these, one is from comparatively shallow water (90 fms.) but the other three were taken by the Pieter Faure only in depths of 900–1000 fms. It is interesting to see therefore that the South African crinoids fall into three groups of three species each, an "abyssal" group of two stalked forms and a five-armed comatulid, a "continental" group of comatulids and a "littoral" group of comatulids.

Of the abyssal group, one (*Monachocrinus coelus*) appears to be a new species of a genus previously known from both the Atlantic and Indian Oceans. A second species (*Bythocrinus chuni*) was hitherto known only from the western part of the Indian Ocean near the Somaliland coast in something over 900 fms. The third species (*Pentametrocrinus varians*) was hitherto known only from the northeastern Indian Ocean, the vicinity of the Philippine Islands and southern Japan, in 361–1050 fms. It is interesting to note that the Valdivia took an as-yet-undescribed species of *Pentametrocrinus* in the same region where *Bythocrinus chuni* was taken, but in slightly shallower water. The Pieter Faure found the two genera at the same station.

Of the three continental comatulids, one (*Liparometra multicirra*) appears to be an undescribed species of a wide-spread East Indian

group, while the other two are also apparently endemic species of East Indian genera.

The three littoral species are of particular interest in connection with questions of geographical distribution. One (*Cominia occidentalis*) is a peculiar, endemic species of a genus known otherwise only from Korea Strait in 170 fms. while a second (*Comanthus wahlbergii*), also endemic, finds its nearest relative in a South Australian species. The third South African littoral comatulid is the wide-ranging *Tropiometra carinata*, which occurs from Zanzibar, the Seychelles and Mauritius, southward around the Cape of Good Hope and thence northwestward to St. Helena, the coast of Brazil and the extreme southeastern West Indies. The genus is otherwise distinctly East Indian.

It is evident therefore that the South African crinoid fauna is essentially East Indian in its relationships and no doubt in its origin also. The only exception is the *Comanthus* which is closely allied to a species known only from southern Australia in shallow water. This clearly hints at a common origin for the two and suggests interesting speculations.

In the following key to South African crinoids, I have used only the simplest and most obvious characters. There are two reasons for this: first, Mr. Austin Hobart Clark, in his most useful work on the Crinoids of the Indian Ocean (1912, Echinoderma of the Indian Museum, pt. 7) has given admirable keys to the families and genera and it is therefore quite superfluous for me to repeat his work; second, the South African species of *Cominia* is so unlike the *Comanthus* that it is not feasible to fit them into the same section of a brief, artificial key and I have therefore ignored their family relationship. Consequently the following key is absolutely artificial and does not give the natural sequence of the species, a sequence which is followed in the subsequent pages. The number of species involved is, however, so small that little inconvenience will result from the inconsistency.

Key to the South African Species of Crinoids.

Stalk present.

Only one or two short discoidal segments at top of stalk, immediately below calyx . . . . . *Bythocrinus chuni.*

More than a dozen short discoidal segments at top of stalk *Monachocrinus coelus.*

Stalk wanting (Comatulids).

Arms 10 or more.

Cirri numerous, 35—40.

Cirrus segments few, 14—18 . . . *Cominia occidentalis.*

Cirrus segments many, 30—36 . . *Liparometra multicirra.*

Cirri not so numerous, 12—30.
Cirrus segments few, 12—20.
Mouth excentric; basal pinnules of arms with terminal comb *Comanthus wahlbergii.*
Mouth central; no terminal combs on pinnules.
Arms 10, more or less compressed; arm-segments beyond middle of arm, short, the distal portion more or less rough and projecting . . . *Tropiometra carinata.*
Arms 10, or more in adults, not compressed; arm-segments beyond middle of arm not short with the distal portion more or less rough and projecting *Pachylometra sclateri.*
Cirrus segments numerous, 60—63 . *Crotalometra magnicirra.*
Arms only five. . . . . *Pentametrocrinus varians.*

BOURGUETICRINIDAE.

Bythocrinus chuni.

Rhizocrinus chuni Döderlein, 1907, Siboga Stalked Crinoids, p. 14, fig. 6; pl. 1, fig. 5.
Rhizocrinus (*Bythocrinus*) *chuni* Döderlein, 1912. Valdivia Stalked Crinoids, p. 14, pl. 3.

The specimens of *Bythocrinus* in the collection all lack the arms, and only two have the calyx still intact. The best has the stalk 47 mm. long and half a millimeter thick at the top; the calyx is 3 mm. high and rather more than 1·5 mm. in diameter at the top. All the specimens are white. They answer so well to Döderlein's description and figures of his specimens from off the Somaliland coast, that, in spite of their imperfect condition, their identity seems sure.

Pieter Faure. 17350. Cape Point. N. 86° E., 43 miles. 900—1000 fms. Gray mud. 4 specimens.

Monachocrinus coelus, * sp. nov.

Plate VIII. Fig. 1.

Fragment of upper part of stem present, not quite 7 mm. long, about ·30 mm. in diameter at broken end, a very little thicker where it joins calyx; it is made up of 29 segments of which the topmost 12 are very low and discoidal, the height about one-fifth or one-sixth the diameter; the next six are discoidal but successively higher; the nineteenth is nearly, and the twentieth quite, as high as thick, and

* κοῖλος = hollowed, in reference to the slightly concave lines of basals and radials.

the remainder are much higher than broad (the 29th is three times as high as thick), smooth and cylindrical.

Basals completely fused into a truncated cone, about half a millimeter high, nearly half a millimeter in diameter, where it joins the radials, and about one-third of a millimeter where it joins the stem. Seen from the side, the lateral margins of this cone are distinctly though very slightly concave.

Radials 5, about ·75 mm. high; the upper (distal) diameter of the cup they form is one millimeter. Seen from the side, the lateral margins of this cup are distinctly though slightly concave.

I Br_1 about 1·10 mm. long and ·85 mm. wide, very little wider distally than proximally. The lateral margins are very slightly thinned and flaring. The median line is not at all carinate but is barely elevated on the distal two-thirds of the plate.

I Br_2, the axillary, is remarkably low and wide; it measures about ·85 mm. in width, but is only about ·60 mm. high, even in the median line where it is slightly higher than at the sides. The lateral portions are flat, in contrast to the middle, but are hardly flaring.

The brachials are about twenty in number; the lowest is about ·40 mm. wide where it joins the axillary but is only about ·35 mm. at the distal end, and that is the approximate width of the following segments. The brachials are arranged in pairs, ·75–·80 mm. long, the total length of the arms, from axillary to tip being about 8 mm. The latero-distal margin of the distal brachial of each pair is slightly projecting and overlapping, first on the outer side of the arm (second brachial), then on the inner (fourth), and thus in regular alternation, but the projection is much too slight to give the arm a serrate or even a rough appearance.

Colour, nearly white.

P.F. 17350. Cape Point N. 86° E., 43 miles. 900–1000 fms. Gray mud. 1 specimen only. Holotype South African Museum, no. A 6434.

This is a most interesting little crinoid, clearly a *Monachocrinus*, but differing from all the previously known members of the genus in the very wide, low axillaries, and in the slightly concave radials and basals. These two characters taken in connection with the large number of discoidal columnars and the structure of the arms, make the species easily recognizable. As the genus is known from both the Atlantic and Indian Oceans, its occurrence off South Africa is quite natural.

COMASTERIDAE.

Cominia occidentalis.

A. H. Clark, 1915. Deutsche Süd-Polar Exp.: Zool., vol. 8, p. 164; pl. 10.

This little comatulid is a most perplexing form, for while the general appearance is quite like a comasterid, the central mouth and excentric anal tube combined with the absence of terminal combs on the basal pinnules completely conceal the family relationship. Mr. Clark in his original description says: "Die Zähne des Endkammes sind so wenig entwickelt dass sie bei gewöhnlicher Untersuchung nicht auffallen." I have failed to detect the combs even with the aid of a magnification of 70 diameters, in either alcoholic or dry material. It is true that with high magnification, on dry pinnules an uneven margin can be found at the tip, but it is not enough to consider even as a rudimentary comb. In view of this absence of combs and the central position of the mouth, it is hard to see why this species should be considered one of the *Comasteridae* but in deference to Mr. A.H. Clark's much wider experience and greater knowledge of the group, I leave it where he has placed it.

Some of the Pieter Faure specimens are a little larger than those of the Gauss and there are some trivial differences. The cirri are about XL, 16–18, and the longer ones measure 12–15 mm. The dorsal interradial perisome has calcareous plates more or less abundant but it is not "heavily plated". The three lower pairs of pinnules are approximately equal. Genital glands occur out as far as the twentieth pinnule. The color is yellow-brown with no trace of olive.

The Gauss specimens were taken in False Bay (west side, Simon's Bay) while those of the Pieter Faure, it is interesting to note, were collected well up on the Atlantic coast of Cape Colony,

P.F. 14905. Saldanha Bay, Cape Colony, 10–14 fms. Sand and mussel-beds. 16 specimens.

Comanthus wahlbergii.

Plate VIII. Fig. 3.

Alecto wahlbergii J. Müller, 1843. Arch. f. Naturg., Jahrg. 9, vol. 1, p. 131.
Comanthus wahlbergii A. H. Clark, 1911. Proc. U.S. Nat. Mus., vol. 40, p. 17.
Actinometra parvicirra Bell, 1905. Mar. Inv. South Africa, vol. 4, p. 141.

It is interesting to note, although the fact may not be of any significance, that the distribution of this characteristically South

African species is from Simon's Bay, eastward to the Tugela River, Natal, while the preceding species seems to range rather from Simon's Bay westward and northward. This apparent difference of distribution may however be quite unreal and due only to our present ignorance.

P.F. 18282. Simon's Bay, False Bay, Cape Colony, 8–10 fms Rocks. 3 specimens.

MARIAMETRIDAE.

Liparometra multicirra,* sp. nov.

Plate VIII. Fig. 2.

Disk about 23 mm. across, very deeply incised; arms about 85 mm. long but they are not quite equal and some scarcely exceed 75 mm. Disk membrane full of crowded, small, calcareous plates. Centro-dorsal large, thick, dorsally flat or a little concave, 6 mm. in diameter; bare dorsal area, nearly 4 mm. across. Cirri XLIII, 30–36, cylindrical at base, but compressed distally; the segments 7–10 have the length about equal to or even a little exceeding the diameter, but elsewhere the greatest diameter exceeds the length; beginning usually with the tenth or eleventh segment, but on some cirri further out, there is a median, dorsal elevation, at first rather blunt but soon with a short compressed tip or even a sharp point; on the last segment this becomes an opposing claw as long as half the diameter of the segment; terminal claw longer than last segment, very sharp.

Arms about 50, all but two broken and detached from disk at or near base; arm-segments numerous, exceeding 150, the distal ones being quite short. Division series all 2, well-separated, rounded and smooth. First syzygy between brachials 3 and 4 of the free arm; second syzygy far out, usually after an interval of more than 20 segments and often 30–40, rarely before segment 20; subsequent syzygies few and at very wide intervals. Low and relatively inconspicuous synarthrial tubercles occur on all the division series.

Lower pinnules not noticeably larger on outer side of arm than on inner. P_1 (P_a similar) about 9–10 mm. long, consisting of 17–21 segments, all but the basal three longer than wide and all but the basal five or six, cylindrical. P_2 and P_b very similar but noticeably larger, 12–13 mm. long, with 24–26 segments. P_3 and P_c similar to P_2 and approximately equal, or a little smaller and with 1–3 fewer segments. P_4 and P_d distinctly smaller, about equal to P_1.

* *Multicirrus* = having many cirri.

Succeeding pinnules somewhat smaller, about 7 mm. long. All the basal pinnules are moderately stout at base but taper to a slightly flagellate tip, which is not however very slender.

Colour, pale fawn with the oral surface of disk and arms very dark brown, almost black; margins of food grooves on disk, black.

P.F. 12157. Durnford Point, Zululand, N.W. $^3/_4$ W., 12 miles. 90 fms. Broken shells. 1 specimen. Holotype, South African Museum, No. A 6435.

It is with no little hesitation that I put this fine new comatulid in the genus *Liparometra*, but as P_2 and P_3 are of approximately equal size, it seems to me clear that it cannot be placed in either *Dichrometra* or *Lamprometra*, as those genera are diagnosed by their founder, Mr. Austin H. Clark. I am somewhat inclined to question the desirability of recognizing these three very closely allied genera, but here again I must defer to the much wider experience of my friend. The present species is, I think, quite distinct from any previously known form, as the large number of arms and cirri, with their numerous segments, are quite characteristic. The few and widely spaced syzygies is also a noticeable feature.

TROPIOMETRIDAE.

Tropiometra carinata.

Comatula carinata, Lamarck, 1816. Anim. s. Vert., vol. 2, p. 534.
Tropiometra carinata, A. H. Clark, 1907. Smithson. Misc. Coll., vol. 50, p. 349.
Antedon capensis, Bell, 1905. Mar. Inv. South Africa, vol. 4, p. 139; pl. 2.

The distribution of this species is of considerable interest. It ranges from the Seychelles, Réunion, Mauritius and Zanzibar southward to the Cape of Good Hope and thence northwestward to St. Helena, Brazil and the southernmost West Indies. It is true that Mr. A. H. Clark considers the specimens from the latter regions specifically distinct from those taken on the east coast of Africa, but a prolonged comparison of specimens from Tobago, B. W. I., with individuals of the same size from Zanzibar has satisfied me that the supposed differences do not exist.

The specimens from the South African Museum are not notable, except that the smallest (12405–c) has the arms only 20 mm. long, and, like specimens from Tobago of a similar age, the colors are pale yellow and pink-purple.

Mozambique; low tide. Nov. 1912. K. H. Barnard coll. 2 specimens.

Delagoa Bay, Portugese East Africa. Oct. 1912. K. H. Barnard coll. 1 specimen.

P.F. 12405–c. Itongazi River, Natal, N.W. $^3/_4$ W., 3 miles. 25 fms. Sand and stones. 1 young specimen.

THALASSOMETRIDAE.

* Crotalometra magnicirra.

Antedon magnicirra, Bell, 1905. Mar. Inv. South Africa, vol. 4, p. 141; pl. 4.
Crotalometra magnicirra, A. H. Clark, 1909. Proc. Biol. Soc. Washington, vol. 22, p. 80.

This species is not now in the South African Museum, the original specimens having apparently all been retained at the British Museum. It was taken in 300–450 fms., 15–20 miles off the coast of Cape Colony, near East London.

Pachylometra sclateri.

Antedon sclateri, Bell, 1905. Mar. Inv. South Africa, vol. 4, p. 140; pl. 3.
Pachylometra sclateri, A. H. Clark, 1909. Proc. Biol. Soc. Washington, vol. 22, p. 21.

This characteristic species is represented in the present collection by an armless adult specimen and a number of quite young individuals. The latter were rather puzzling owing to the small centrodorsal and the relatively long 1 Br series, and the presence in every case of just ten arms. On the other hand, the cirri are essentially like those of the adult (XV–XVI, 15–17) and the 1 Br series and lower brachials are distinctly wall-sided and in close apposition. The radials are conspicuous, the height being equal to half the breadth, while in the adult specimen they are not only completely concealed but even 1 Br_1 is barely visible. The adult specimen has the calyx about 12 mm. in diameter and the cirri 18–20 mm. long, while the young ones are only 2 mm. in diameter through calyx and the cirri are but 4–6 mm. long. It is to be regretted that the condition of the adult does not permit of a full description for Bell's account is utterly inadequate. In the young specimens, P_1 is stiff, erect with 7 segments and P_a is similar. P_2 is a little longer, with 9 segments; P_b, the same. P_3 (and P_c) is a little longer, with 11 segments and is more flagellate at the tip. Subsequent pinnules are shorter.

P.F. 12872. East London, Cape Colony, N. 15 miles. 310 fms. Mud. 1 adult specimen, with arms all broken off.

* Those species marked with an asterisk are not represented in the South African Museum collections.

P.F. 12884. East London, Cape Colony, N. 15 miles. 310 fms. Mud. 1 young specimen.

P.F. 13227. Cove Rock, near East London, N.W. $^3/_4$ W., 13 miles. 80–130 fms. Coral rock. 13 young specimens.

PENTAMETROCRINIDAE.

Pentametrocrinus varians.

Eudiocrinus varians, P. H. Carpenter, 1882. Jour. Linn. Soc., Zool., vol. 16, p. 496. 1888, Challenger Comatulae, pl. VIII, figs. 3–7.
Pentametrocrinus varians, A. H. Clark, 1908. Proc. Biol. Soc. Washington, vol. 21, p. 135.

Although this specimen lacks cirri and has all the arms broken, it is so similar to specimens of *varians* from southern Japan, with which I have compared it, that I do not doubt it belongs to that species. The nearest point to South Africa at which the species has previously been taken is near the Andaman Islands in the north-eastern Indian Ocean.

P.F. 17351. Cape Point, N. 86° E., 43 miles. 900–1000 fms. Grey mud. 1 specimen.

SEA-STARS. ASTEROIDEA.*

The sea-stars form a very large and important part of the South African Echinoderm fauna. They were listed in 1910 by Döderlein (Schultze's Zool. Anthrop. Ergeb. Forschungsr. Sudafrica, vol. 1, pt. 1, p. 246) but he did not include species occurring only at depths over 278 fms. (500 m.) nor did he extend the South African region to include Mozambique. His list includes 30 species, but two are synonymous (*Astropecten capensis* and *pontoporaeus*) and one (i. e. Sladen's record of *Asterina gunnii*) is probably due to a mistaken identification or a misplaced label. The collection sent me from the South African Museum contains 51 species but of these only 14 are in Döderlein's list. There are however 9 additional species previously recorded from Mozambique or from deep water off South Africa and hence not listed by Döderlein which fall within the scope of the present report, which thus includes 74 species; 18 seem to be new to science and are here described for the first time.

* After this section was ready for the press I had the pleasure of a visit from Dr. W. K. Fisher, the well-known authority on sea-stars, who very kindly examined many of the specimens and permitted me to profit by his wide knowledge and sound judgement. For this help I beg to offer him herewith my best thanks.

Of these 74, 35 are truly littoral occurring in water less than twenty fathoms deep, while 9 are strictly abyssal, occurring only in depths beyond 600 fms. The remaining 30 species may be classed as continental.

Of the 35 littoral species, 13 are endemic so far as our present knowledge goes; as 10 of these have been known for a considerable time and have not yet been reported from elsewhere, it is probable that they are truly characteristic forms. Of the remaining 22, 18 are East Indian or Indian Ocean species, of which 15 were previosuly known from the east coast of Africa, north of Mozambique. There are two littoral species (*Asterina calcarata*, *Henricia ornata*) which occur on the shores of the southern end of South America, but both these cases require further investigation; each belongs in a genus in which specific limits are ill-defined. There are also two littoral species known from the coasts of southern Australasia; one of these (*Coscinasterias calamaria*) is a well-defined species and its occurrence at Mauritius has long been known; it is unquestionably a valid link between the littoral faunas of Australasia and Africa; the other species however is the dubious *Henricia ornata*, a name under which several species are perhaps involved. Of the two remaining South African littoral species, one is the rare and little known *Culcita veneris*, originally from St. Pauls Island, southern Indian Ocean, and since recorded by Bell only, from Cape Colony; the other is the northern starfish, *Marthasterias glacialis*, whose occurrence at the Cape no longer admits of doubt. It is of importance to note that 12 of the littoral seastars here listed as South African, are not known from south of Mozambique and there are two or three others whose occurrence south of that point is known from only a single record.

Of the 30 Continental species, 20 appear to be endemic, but 12 of these are here described as new and may later be found elsewhere. Nevertheless the Continental fauna is very characteristic for in addition to the endemic forms, three are known only from the Kerguelen region. There are three species hitherto known from the Atlantic, two from the East Indian region and one from Australia. The thirtieth, one of the most remarkable members of the Continental fauna is *Ceramaster patagonicus*, which occurs not only in South American waters but along the Pacific coast of North America to the region of the Commander Islands in Bering Sea. One of the Atlantic members of this fauna (*Diplopteraster multipes*) has an equally remarkable range, as it occurs in the North Atlantic from about 35° North to Barents Sea and Norway and in the North Pacific

from San Diego, California, and Suruga Gulf, Japan, to Bering Sea.

Of the 9 abyssal species occurring in the present list, only 3 are endemic, while 5 are already known from the deep waters of the Atlantic and one is Antarctic. The endemic species are all new to science. It is of interest to note that none of the abyssal species seems to have come from the east, whereas the littoral fauna has nearly all come from the Indian Ocean.

In conclusion then, we may say that so far as our present knowledge goes the sea-star fauna of South Africa is highly characteristic. Nearly half (36) of the species are endemic and several others occur only in the region of Kerguelen or St. Pauls Island. Of the non-endemic forms, 20 are from the Indo-Pacific region and 10 from the Atlantic, while the remainder are Australian or South American. The affinities of the littoral fauna are distinctly Indo-Pacific, but if the tropical species, not known from south of Mozambique, are left out of account, it is evident that most of the littoral starfishes of South Africa have become specifically differentiated. On the other hand the continental and abyssal faunas, while perhaps equally well differentiated and as characteristic, have slight East Indian but rather strong Atlantic affinities. The impression made by the study of the South African sea-stars is that the shallow-water forms are of Indian origin and the deeper-water forms are from the Atlantic.

There is very little evidence of an Australian or South American influence in the composition of the fauna. It is true that *Coscinasterias calamaria* is a characteristic Australian species, but it seems to be very rare in South African waters. As already stated no reliance can be placed on evidence offered by such forms as *Henricia ornata* and *Asterina calcarata*. The occurrence of the characteristically Antarctic genus *Cryaster* in Algoa Bay is worthy of more than passing notice, since the entire family is otherwise unknown outside of the Antarctic region.

The 74 species included in this report belong to no fewer than 16 families. They can be most easily recognized if these families are first differentiated from each other. Under each family will be found the necessary key to the species included in it, which occur in South African waters.

Key to the South African Families of Asteroidea.

Marginal plates large, defining the contour of the body; abactinal skeleton never reticulate or imbricated but made up of plates, which often bear paxillae or granule-bearing tabulae.

Cribriform organs* present in each interradius . . *Porcellanasteridae.*
No cribriform organs.
Marginal plates very spiny, more or less alternate; papulae restricted to special areas at base of rays . . . . *Benthopectinidae.*
Marginal plates opposite; papulae not restricted to special areas at base of rays.
Abactinal surface covered with paxillae.
Superomarginal plates well developed . *Astropectinidae.*
Superomarginal plates aborted . . . *Luidiidae.*
Abactinal surface not covered with paxillae.
Disk large with big actinal interradial areas, but no actinal papulae.
Marginal plates large and conspicuous; disk more or less flat; papulae single or a few together *Goniasteridae.*
Marginale plates not conspicuous; disk elevated or at least very thick; papulae numerous in large groups.
Marginal plates large; abactinal skeleton more or less conspicuous. . . . . *Oreasteridae.*
Marginal plates small and with abactinal skeleton covered and concealed by a thick skin . . *Poraniidae.*
Disk small with very small actinal interradial areas, or if the latter are well developed there are actinal papulae; marginal plates small; tegumentary developments, granulate (rarely wanting) *Ophidiasteridae.*

Marginal plates small or wanting; abactinal skeleton more or less imbricated or reticulate.
Disk not circular and sharply set off from long, more or less terete, and readily detachable arms; marginal plates small but regularly present (except Cryasteridae).
Pedicellariae rare or wanting, never pedunculate forcipiform; ambulacral ossicles rarely crowded; pedicels usually in two series.
Oral plates rather small, not shovel- or plowshare-shaped; ambulacral furrows narrow.
Marginal plates conspicuous; actinal plates regularly radiatingly arranged . . . . . *Ganeriidae.*
Marginal plates quite inconspicuous.
Abactinal skeleton formed of closely imbricated plates, bearing very small spinelets . . . . *Asterinidae.*
Abactinal skeleton not imbricate.
Abactinal skeleton more or less reticulate *Echinasteridae.*
Abactinal skeleton entirely aborted *Cryasteridae.*
Oral plates big and shovel- or plowshare-shaped; ambulacral furrows wide.
Abactinal skeleton with paxillae or pseudopaxillae, not concealed by a supradorsal membrane . . . *Solasteridae.*

* Technical terms used in this or subsequent keys are fully explained and illustrated in Sladen's CHALLENGER report (1889) or in Fisher's North Pacific Asteroids (Bull. 76 U. S. Nat. Mus, 1911).

Abactinal skeleton with paxillae concealed, more or less, under a remarkable supradorsal membrane . . . *Pterasteridae.*
Pedicellariae abundant, especially forcipiform; ambulacral ossicles crowded; pedicels in four series . . . . . *Asteriidae.*
Disk circular sharply set off from the long, more or less terete and readily detachable arms; marginal plates microscopic or wanting . *Brisingidae.*

PORCELLANASTERIDAE.

This deep water family is represented in the South African region by only a single species.

Porcellanaster cæruleus.

Wyville Thomson, 1877. Voy. Challenger: Atlantic, vol 1, p. 378; figs. 97, 98.

The specimens are all small, with R = 7–9 mm. They are too young to make their specific identity certain but comparison with somewhat larger specimens of *cæruleus*, taken by the Challenger and the Blake, indicates that they are immature examples of that species. The only noteworthy differences are the absence of spines on the superomarginal plates and the incomplete calcification of the interbrachial areas below. Both these however are easily accounted for as evidence of immaturity. On account of the locality, it would be natural to refer these specimens to *P. eremicus* Sladen but I am myself satisfied that the specimen on which that species is based, is a young *cæruleus*.

P.F. 16905. Cape Point, N.E. by E. $^1/_4$ E., 40 miles. 800–900 fms. Green mud. 1 specimen; young.

P.F. 17351. Cape Point, N. 83° E., 43 miles. 900–1000 fms. Gray mud. 3 specimens; young.

BENTHOPECTINIDAE.

This family of deep-water starfishes was not known from the South African region hitherto, but the Pieter Faure has found two species, each representing an interesting genus. One of these forms was known only from near Kerguelen while the other is a widely distributed Atlantic species. They may be separated from each other by the characters given in the following key, but it is evident that each is somewhat variable and does not conform exactly to a strict specific description.

Key to the South African Species of Benthopectinidae.

Papularium a small, circular elevated area; one large spine on actinal surface of adambulacrals . . . . . *Pectinaster filholi.*

Papularium V-shaped; three large spines on actinal surface of each adambulacral . . . . . *Luidiaster hirsutus.*

PECTINASTER FILHOLI.

Perrier, 1885. Ann. Sci. Nat. (6), vol. 19, no. 8, p. 71.
Sladen, 1889, CHALLENGER Ast., pl. 8, figs. 3, 4 (as *forcipatus*).

The South African specimens show slight, but obvious differences from a *cotype* of *filholi* with which I have compared them, but agree very closely with a cotype and other specimens, from the northwestern Atlantic, of Sladen's *Pontaster forcipatus*. From the geographical point of view they would naturally, and I think correctly be referred to Sladen's variety *echinata* (*sic*) but Ludwig considers *forcipatus* a synonym of *filholi* and after a comparative study of the material in the M. C. Z., I believe he is right. The species has a wide range from near Nova Scotia in the northwest to the vicinity of Marion Island in the southeast, but it is always an abyssal form, ranging from 699 fms. down to 1700. The specimens taken by the PIETER FAURE are of varied size, the smallest having $R = 8$ mm. and $r = 2$ ($R = 4r$), while the largest has $R = 59$ mm. and $r = 11$ ($R = 5{\cdot}4r$); the body form is thus assumed very early in life. In spinulation, the smallest specimen is surprisingly like the largest, the only difference of importance being the presence, in the adult, of *two* spines on many inferomarginal plates. The youngster has only a very minute madreporite, scarcely distinguishable, and the papularia are each represented by a single pore, or two, but in the largest specimen there are only 10–12 pores in each papularium. The number and distribution of the pedicellariae shows great diversity in this species; in the PIETER FAURE specimens they are rather numerous but are confined to the actinal surface.

P.F. 16902. Cape Point, N.E. by E. ¼ E., 40 miles. 800–900 fms. Gr. m. 3 specimens; young.

P.F. 16905. Same station. 1 specimen; very young.

P.F. 17332. Cape Point, N. 86° E., 43 miles. 900–1000 fms. Gray m. 6 specimens; adult and young.

P.F. 17351. Same station. 1 specimen; young.

LUIDIASTER HIRSUTUS.

Studer, 1884. GAZELLE Ast., p. 47; pl. 4, figs. 7*a–d*.

This species was originally found northwest of Kerguelen, on sandy bottom, in 130 fms. of water. Its occurrence in South African waters is thus of much interest, though not surprising. The individuals before me show a range in size from R = 20 mm. to R = 65 mm. but the growth changes are trivial between these two extremes. In the largest specimen, there are not infrequently 3 large spines on the actinal surface of the adambulacral plates and there are 2 large inframarginal spines. It is remarkable that Ludwig in his otherwise useful key to the species of *Luidiaster* (1910. Sitz. K. Preus. Acad. Wiss. Berlin, p. 453) says of *hirsutus* "untere Randplatten mit einem Stachel", when Studer distinctly says they bear two long spines. Even in the smallest specimen at hand, there are two such spines on the basal inferomarginals.

P.F. 18904. 36° 40′ S × 21° 26′ E, 200 fms. Gr. s. 3 young specimens.

P.F. 18913. Same station. 2 adult specimens.

ASTROPECTINIDAE.

This family is represented in South African waters by 10 species, most of which are however continental rather than truly littoral forms. One, apparently new species, is distinctly abyssal. They may be distinguished from each other as follows:

Key to the South African Species of Astropectinidae.

No specialized spines or spinelets on either series of marginal plates *Leptychaster kerguelenensis.*

More or less conspicuous spines or spinelets on inferomarginals and often on superomarginals as well.

Actinal interradial areas more or less extensive; madreporic body hidden by paxillae on its surface.

Inferomarginals, and often superomarginals also, with single large spinelets.

No large spine on actinal surface of adambulacral plates *Plutonaster intermedius.*

A large erect spine on actinal surface of each adambulacral plate, at least distally . . . . . *Plutonaster proteus.*

Inferomarginals with a few insignificant spinelets on each, none on superomarginals . . . . . *Dipsacaster sladeni.*

Actinal interradial areas small; madreporic body small not hidden by paxillae on its surface.

Marginal plates, especially inferior, more or less vertical, at least at base of ray, the vertical height of ray at base being approximately equal to combined height of both series of marginals.

Papillae of marginal plates squamiform, and spinelets short and very flat . . . . . *Bathybiaster robustus.*
Papillae of marginal plates not at all squamiform; spinelets of inferomarginals slender and rather long . . . *Psilaster acuminatus.*
Marginal plates, at least inferior, oblique or nearly horizonal; vertical height of ray at base not remarkable.
Large sharp spines present on superomarginals *Astropecten polyacanthus.*
Spines on superomarginals small or wanting.
Small spinelets on at least some superomarginals.
R = 2·5—3·5 *r*; radial paxillar areas much wider than combined marginal plate series . *Astropecten pontoporaeus.*
R = 4—5 *r*; radial paxillar areas narrower than combined marginal series . . . *Astropecten hemprichii.*
No superomarginal spinelets . *Astropecten granulatus.*

* Leptychaster kerguelenensis.

E.A. Smith, 1876. Ann. Mag. Nat. Hist. (4), vol. 17, p. 110. Sladen, 1889. Challenger Ast., pl. 31, figs. 1, 2.

Although Bell (1905, Mar. Inv. South Africa, vol. 3, p. 242) records this starfish from three stations, there are now no specimens in the South African Museum, and I include it here solely on the strength of Bell's identification.

Plutonaster intermedius.

Goniopecten intermedius Perrier, 1881. Bull. M. C. Z., vol. 9, p. 25. 1884, Blake Ast. pl. 7, figs, 1, 2.
Plutonaster intermedius Perrier, 1894. Trav. et Tal. Ast., p. 316.

Comparison of the South African specimens with others from off the east coast of the United States fails to reveal any differences worthy of note. The African specimens are adult, the greater radius being 53–75 mm.

P.F. 17394. Cape Point E. $^1/_2$ N., 34 miles. 500–550 fms. Green mud. 1 specimen; adult

P.F. 18110. Cape Point N. E. $^1/_4$ N., 46 miles. 760 fms. Green mud. 1 specimen; adult.

Plutonaster proteus * sp. nov.
Plate XIII. Figs. 3–7.

R = 58 mm.; *r* = 14·5 mm.; R = 4 *r*. Br = 14·5 mm. R = 4 *br*. Disk moderately large, rather flat; rays narrow, flat, tapering, at

* *Πρωτεύς* = Proteus, in reference to the remarkable change in appearance during growth.

first very slightly, but distally more abruptly, to a somewhat blunt tip. Disk and rays, within area bounded by superomarginal plates, covered by numerous low, rounded pseudopaxillae, each ·10–·25 mm. in diameter, the height, little, if any, greater; each carries about ten (6–16) short slender spinelets, some of which form a slightly radiating marginal circle; these are rather longer than those within it and the latter may be scarcely more than rounded granules; the pseudopaxillae show no regular arrangement. Papulae small, single, numerous. Madreporic body large, nearly 4 mm. across, concealed under some 14 pseudopaxillae of varied size; the outer margin of the madreporite is less than ·3 mm. from the inner margin of the superomarginal plates. The latter are 29 in number on each side of the ray; interradially they are nearly square but conspicuously swollen or elevated at center; distally they soon become longer than wide and less swollen and on the distal half of the arm they are scarcely swollen at all but are evidently wider than long; each plate bears a single large spinelet, which is, in the interradial regions, 1 mm. high and basally ·5 mm. in diameter and occupies the center of the plate but becomes smaller and smaller distally and is placed more and more near the outer (lower) edge of the plate; on most of the proximal plates a second, but much smaller spinelet occurs on the inner (upper) margin of the plate; the rest of the surface of each superomarginal is covered by a fairly uniform but well-spaced coat of low spinelets or spiniform granules, longest and most numerous along the lateral margins of the plates. Terminal plate moderately large; it has all its spinelets rubbed off in the only instance where the plate itself is not missing.

Inferomarginals almost exactly like the superomarginals in all particulars, except that the large spinelets are rather longer, and the second spinelet on the inner edge of the interradial plates is larger and so is quite conspicuous. The two series of marginal plates form a vertical wall for each side of the ray, about equally in evidence above and below; the fasciolar channels between the plates are moderately developed more particularly in the interradii. Actinal intermediate plates wanting at tip of ray and indeed on the entire distal half; the first one adjoins the sixth inferomarginal (counting from interradial line) and there are rather more than a dozen, lying next to the adambulacrals, between that point and the oral plate; a second series begins at the fourth marginal and contains nine or ten plates; some 25–30 smaller plates fill up, more or less irregularly, the remainder of the notably small actinal interradial area; all the intermediate plates are covered, but not very thickly, with

short, well-spaced, rough spinules; a few of these are enlarged here and there into short, thick spinelets and rarely a little group make up a pedicellaria of a rudimentary sort.

Adambulacrals about 37 on each side of the furrow; except the first two or three and the distalmost half dozen, they are longer than wide; furrow-margin of each plate with about 8 conspicuous spinelets, the middle ones 1·5 mm. long, the adoral one shortest; outside this series, on the actinal surface of the plate, near its distal margin, is a single large spinelet, nearly equal to those on the marginal plates; the rest of the surface of each adambulacral plate is sparsely covered by spinelets like those on the actinal intermediate plates. Oral plates rather large, swollen; each bears a marginal series of a dozen spinelets, of which the first (inner) two are the largest (about 2 mm. long), the others being gradually smaller; surface of plate rather thickly covered with spinelets, of which those near the interradial margin are largest, particularly those at inner end of plate. Color, dull brownish-yellow, in the present condition, dried from alcohol.

Cutting through and laying back the skin of one ray reveals large double ampullae, the complete absence of dorsal muscle bands, and the genital glands confined to the interradial regions. Seen from within the plates of the dorsal skeleton are circular and isolated, but seemingly more crowded along the sides of the ray.

P.F. 16743. Cape Point, N.E. by E. $^1/_4$ E., 38 miles. 755 fms. Gr. m. 1 specimen; adult.

P.F. 16902. Cape Point, N.E. by E. $^1/_4$ E., 40 miles. 800–900 fms. Gr. m. 5 specimens; young.

P.F. 16931. Same station. 1 specimen; adult.

P.F. 16944. Same station. 4 specimens; young.

P.F. 17351. Cape Point, N. 86° E., 43 miles. 900–1000 fms. Grey m. 2 specimens; young.

Holotype, South African Museum no. A 6427, P.F. 16931.

This species is undoubtedly near to *P. bifrons* (Wyv. Th.) but it is at once distinguished from that species by the absence of large spinelets on the actinal interradial areas and the presence of a second series of spines on both sets of marginal plates in the interradii. Another very marked difference is that in very young *bifrons*, the infero marginal spines are well developed while in much larger specimens of *proteus*, they are lacking or just beginning to appear.

The series before me affords opportunity for a very interesting study of growth changes which are of more than ordinary interest

in this species. The smallest specimen (R = 6 mm.) has R = 1·5 *r* and is thus somewhat pentagonal with deeply concave sides; the pseudopaxillae are similar to those of the adult and the madreporite is completely concealed; there are 8 marginal plates in each series, on each side of a ray and they are quite uniformly covered with minute rough spinules; the actinal interradial plates are few and covered like the marginals. In two particulars this youngster is quite different from the adult; the large spines and spinelets of the adambulacral and marginal plates are wanting and there are distinct, though simple, pedicellariae on the abactinal surface and between the marginal plates, as well as actinally. On the most interradial of the inferomarginals, one spinule is distinctly larger than the others and may be considered the first indication of the spine, later so prominent. The terminal plate of each ray is relatively very large; on each side of the tip, near the oral surface is a large spinelet and back of this (orally) are two smaller spinelets.

The next larger specimens have R = 7·5 mm., *r* = 3·5; hence R = 2·1 *r*. The spinulation of these individuals is exactly like that of the smallest, except that on some of the distal adambulacral plates, one of the actinal spinelets is noticeably bigger than the others; pedicellariae are very noticeable, especially among the marginal plates. A specimen with R = 10 mm. is not essentially different in any way. A specimen with R = 12·5 mm. and *r* = 4·5 mm. (R = 2·75 *r*) has the large spinelet indicated on most of the inferomarginal plates, quite distinct on nearly all the adambulacrals, and evident on the interradial superomarginals; there are no pedicellariae except on the actinal interradial areas. A specimen from the same station as this one, with R = 13 mm. and *r* = 5·5 mm. (R = 2·37 *r*) has distinctly wider rays and there are many pedicellariae, chiefly of two spinelets, all over the abactinal surface; large spinelets are indicated only on the interradial inferomarginals and doubtfully on a few distal adambulacrals. The largest of the young individuals, from the same station as the holotype, has R = 19 mm. and *r* = 7; R = 2·7 *r*; there are no pedicellariae, the large spinelets of the inferomarginals are conspicuous while those of the superomarginals are evident; the proximal adambulacrals show no large actinal spinelet but on all of those on the distal half of the arm it is perfectly distinct. The adult specimen from 16743 has R = 48 mm., *r* = 14 and hence R = 3·5 *r* but in only one other particular does it show any notable difference from the holotype; there is no second large spinelet on any marginal plate.

To sum up the growth changes of this species then we may say

that it changes from a nearly pentagonal form, uniformly covered with pseudopaxillae and minute rough spinules, with no large spinelets whatever, into a stellate form with moderately long rays, having conspicuous spinelets on all adambulacral and marginal plates. During this change pedicellariae are wholly lost, at least abactinally. It is worthy of special note that the large spinelet of the adambulacral plates appears first on the *distal* part of the ray and occurs proximally only after the individual is half grown. The second set of spinelets on the marginal plates appears only in what is apparently the fully grown individual.

Dipsacaster sladeni.

Alcock, 1893. Ann. Mag. Nat. Hist. (6), vol. 11, p. 87; pl. 5, figs. 3, 4.

These specimens answer so well to Alcock's description that I feel satisfied they should be referred to *sladeni*, but in two particulars they are different; the pedicels of the paxillae are certainly not "long, slender", as I understand those terms, and the adambulacral spines are not what I should call "needle-like". Such terms ought not however to be construed too rigidly. The adambulacral armature of the South African specimens is almost exactly like that of *laetmophilus* Fisher, and the only point in Fisher's description to which the present specimens do not answer is the covering of the inferomarginal plates, in describing which Fisher uses the word "squamiform". There is nothing "squamiform" in the spinelets covering the inferomarginals of the African specimens. Comparison of Fisher's description and figures of *laetmophilus* with Alcock's of *sladeni* certainly suggests the identity of the two, but oddly enough Fisher makes no reference whatever to *sladeni*.*

The present series reveals some very interesting growth changes in this starfish. The smallest specimens have R = 15 mm, and $r = 7$, while the rays are nearly 10 mm. across at their very base; thus R = $2r$ and about $1{\cdot}5\,br$. A somewhat larger specimen has R = 26 mm., $r = 11$ and $br = 13$; thus R = $2{\cdot}36\,r$ and $2\,br$. The next larger specimen has R = 45 mm., $r = 17$ and $br = 18$; thus

* After critical examination of the South African specimens of *sladeni*, Fisher finds at least half a dozen differences between them and *laetmophilus*. Of these the most obvious, if not the most important, is in the spinelets of the inferomarginals, which are distinctly *squamiform* in the Alaskan species and *spiculiform* in the African. Other important differences are to be found in the form of the inferomarginals, in the plates and fasciolar channels of the actinal intermediate areas, and in the mouth plates. The two species, although nearly allied, seem to be perfectly distinct.

R = 2·65 *r* and 2·5 *br*. In the largest specimen, R = 78 mm., *r* = 26 and *br* = 28; thus R = 3 *r* and 2·78 *br*. It is thus obvious that the larger the specimen of this species, the longer and proportionately narrower are the rays. The number of superomarginal plates on each side of a ray in these four specimens is 16, 22, 28 and 39 respectively. The number of marginals is relatively greater therefore in proportion to the length of the ray in young specimens than in adults; thus, while the length of ray increases five times the number of marginals is increased only two and a half times. It will be noticed that the largest African specimen has several more superomarginal plates than much larger specimens of *sladeni* and *laetmophilus*, but I think this is merely a matter of individual, or possibly, geographical variation.

In the smallest specimen, the enlarged spinules on the outer ends of the inferomarginal plates are barely recognizable and then only in the interbrachial arcs. They are more pronounced but are not at all conspicuous in the specimen with R = 26 mm. The adambulacral armature shows very little change with growth; in the smallest specimen there are 5 and often 6 adambulacral spines and they are somewhat compressed, especially near base; in the largest specimen, there are 7, occasionally 8, adambulacral spines and they are markedly compressed at base.

Colour in life: upper surface reddish orange, lower surface pale.

P.F. 2285. Lion's Head, Cape Town, N. 67° E., 25 miles. 131–136 fms. Black specks. 2 specimens; adult.

P.F. 2330. Same station. 2 specimens; young.

P.F. 2798. Vasco de Gama Peak, N. 71° E., 18 miles. 230 fms. St. 1 specimen; adult.

P.F. 17604. Cape Point, E. by N., 30 miles. 345 fms. Green sand and mud. 4 specimens; very young.

Bathybiaster robustus.

Archaster robustus Verrill, 1884. Amer. Journ. Sci. (3), vol. 28, p. 383.
Bathybiaster robustus Verrill, 1894. Proc. U. S. Nat. Mus., vol. 17, p. 256.

These specimens range in size from R = 7 mm. to R = 80 mm. The largest has been critically compared with similar specimens of *robustus* from off the Eastern coast of the United States and there is no doubt of their identity. The growth changes of this species are very interesting. Small individuals were described by Sladen (1889, Challenger Ast., p. 236, pl. 40, figs. 3–6) as *Phoxaster pumilus*, supposedly representing a new genus, distinguished from *Bathybiaster*

by the presence of an epiproctal cone and the absence of pedicellariae, but Verrill has shown that both these features are youthful and quite unreliable. In the present series, there is no epiproctal cone in the large specimen, but it is obvious in all the small ones; it is however *smallest* in the smallest specimen (1 mm. high) and largest (3 mm.) in a specimen with R = 17 mm. Apparently therefore it reaches its fullest development in late youth and then disappears, but is still evident in specimens one-third grown. The terminal plate is but very little larger in the big specimen than in the smallest and has entirely lost the three conspicuous spines which it bears in youth. The adambulacral plates are relatively considerably longer in the adult but the adambulacral armature changes but little, as there are 3 spines in the smallest specimen and only 5 in the big one. There is no indication of a superomarginal spinelet in the smaller specimens but in the largest it is evident on a dozen plates or more in each series; it is however remarkably low and squamiform.

P.F. 16742. Cape Point N. E. × E. 1/4 E., 38 miles. 755 fms. Green mud. 1 specimen; adult.

P.F. 16902. Cape Point N. E. × E. 1/4 E., 40 miles. 800–900 fms. Green mud. 2 specimens; young.

P.F. 17351. Cape Point N. 83° E., 43 miles. 900–1000 fms. Green mud. 2 specimens; young.

Psilaster acuminatus.

Sladen, 1889. Challenger Ast., p. 225; pl. 40, figs 1, 2.

It is not without some hesitation that I refer these specimens to Sladen's species, for in one particular they are very different from his description. He says the marginal plates are more or less bare (lower part of superomarginals, upper part of inferomarginals) and covered by a membrane, while in the African specimens, papillae cover the plates; along the margins the papillae are slender but on the surface of the plates they are quite squamiform. In one specimen, the lower portion of the largest superomarginals is only sparsely covered with papillae so perhaps if the specimens were larger these plates would be bare. But in these specimens, R = 60 mm. ± and Sladen's type had R only 65 mm.

Another difficulty is that these specimens are so unlike a much larger *Psilaster* from Australia which in my Endeavour report I have called *acuminatus*, that it is hard to believe they are the same species. Sladen however called attention to differences between the African, Australian and New Zealand specimens of the Challenger

collection, but he felt that more material was necessary before it could be conclusively determined whether all were the same species or not. I certainly have not sufficient available material to enable me to satisfy myself in the matter, so I follow Sladen's example and let all remain under the name which he gave.

P.F. 2330. Lions Head, Cape Town, N. 67° E., 25 miles. 131–136 fms. Black specks. 1 specimen; adult?

P.F. 14976. Lions Head, Cape Town, S.E. $^1/_2$ E., 47 miles. 175 fms. Green sand. 4 specimens; adult?

Astropecten polyacanthus.

Müller and Troschel, 1842. Syst. Ast., p. 69.

The occurrence of this species south of Zanzibar is noteworthy and its presence on the coast of Natal is really remarkable. The present specimen (R = 70 mm.) though the rays are somewhat broken, is in admirable condition for study. The superomarginal spines are unusually small and slender, the largest (those on the interradial pair of plates) being less than 3 mm. high and about two-thirds of a millimeter in diameter at base. The paxillae bear many spinelets; those on the convex surface are very low and papilliform while those on the margin are relatively long and slender. The oral surface is much less spiny than in typical examples of *polyacanthus*, this appearance being due to the somewhat squamiform spinelets and the absence of large spines on the adambulacral end of the inferomarginal plates. The species is so widespread and so diversified that local races will probably be recognized ultimately, and when that is done the South African form will probably be given a subspecific name. The more typical form is well figured by Savigny, 1803. Pl. d'Ech. Égypte, pl. 4, fig. 1.

P.F. 12516. Off Umhlanga River, Natal, $2^1/_2$ miles. 22–26 fms. Fine sand. 1 specimen; adult.

Delagoa Bay. K. H. Barnard.

Astropecten pontoporæus.

Sladen, 1883. Jour. Linn. Soc. Zool., vol. 17, p. 259. 1889, Challenger, Ast., pl. 35, figs. 1, 2.

Astropecten capensis Studer, 1884. Gazelle Ast., p. 44.

The present specimens (R = about 35 mm.) are a trifle smaller than Studer's but they leave no doubt in my mind as to the identity of *capensis* and *pontoporæus*. The differences mentioned by Studer are trivial. The relatively longer arms in Sladen's specimens are

due to their larger size, while the degree of projection of the inferomarginal plates and the exact form of their spines is a matter of individual diversity. Bell (1905, Mar. Inv. South Africa, vol. 3, p. 243) records *pontoporæus* from 21 stations and *capensis* from one, but he does not hint at the means by which he distinguished them.

P.F. 15835. Cape Point, N.W. 5 miles. 47 fuss. Sand and rocks. 4 specimens; adult?

* Astropecten hemprichii.

Müller and Troschel, 1842. Syst. Ast., p. 71. De Loriol, 1885. Cat. Rais. Ech. Mauritius: Stellérides, pl. 21, figs. 7–8.

This species is reported by Peters (1852) from Inhambane, P.E.A. and by Bell (1884) from Mozambique. I have not myself seen specimens from the African coast, south of Zanzibar.

Astropecten granulatus.

Müller and Troschel, 1842. Sys. Ast., p. 75. Döderlein, 1896. Jena Denksch., vol. 8, lief. 3, pl. 18, figs. 30, 30*a*.

These South African specimens were at first identified with *monacanthus* Sladen but in the larger specimens the paxillae always show several to many central granules, and Sladen emphasizes the single central granule as an important species character. Koehler however has stated that the number of central granules on the paxillae is a matter of age and examination of these specimens satisfies me that he is correct. Careful study of his text and figures, and those of Döderlein, with Sladen's, convinces me that *monacanthus* is identical with *granulatus*. The only point on which I am doubtful is the coloration, some specimens (none from South Africa however) showing a conspicuous mottling of the upper surface. This mottled form is figured by Sladen as *granulatus* and Koehler says his specimen from the Aru Islands is exactly like it in color. On the other hand he says his specimen is identical with that figured by Döderlein from Torres Strait and Döderlein's specimen is unicolorous. Probably the coloration is more or less subject to individual diversity. The length of the superomarginal plates and the extent to which they occupy the dorsal surface of the arms is a matter of age; they are longest and dorsally most conspicuous in the smallest individuals before me (R = 7·5 mm); they are relatively shortest and least visible from above in the largest specimens (R = 38 mm). These large specimens are just the size of Koehler's from the Aru Islands, and considerably larger than those seen by Sladen and Döderlein, but they are smaller

than some which Koehler has had from India. One of the smaller African specimens shows six superomarginal spines and similar spines occur in one of the larger specimens of the Indian Museum. It is interesting to note that the proportion of R to *r* is practically the same in the smallest and largest specimens, namely R = 4 *r*, but the arms are broadest in the smallest specimens, R = 2·7 *br*; in the large individuals, R = 3·5 *br*.

In spite of a deficiency of material which is much to be regretted, I think we may say then that *granulatus* is a small species of *Astropecten* with unarmed superomarginal plates, which ranges from India to South Africa on the west and to Torres strait on the east.

One of the specimens here referred to *granulatus* (18904) may perhaps represent a different species. The colour is a noticeably deeper brown, there are usually two and often three infero-marginal spines, and the spinules everywhere, but especially on the oral surface, appear to be more or less sacculate. This individual is obviously immature (R = 19 mm.) and comes from deeper water than the others, so that the probability of its not being *granulatus* is rather strong.

P.F. 10975. Tongaat River, Natal, N. W. by N. ¼ N., 5 miles. 36 fms. Sand and rocks. 2 specimens, very young.

P.F. 12516. Off Umhlanga River, Natal, 2½ miles. 22–26 fms. Fine sand. 9 specimens; adult? and young.

P.F. 18904. Cape Agulhas, Cape Colony, N. W. 175 miles (36° 40′ S., 21° 26′ E.). 200 fms. Green sand. 1 specimen, Young and dubious.

LUIDIIDAE.

It is not certain whether two or three species of this family are found on the coast of South Africa, but it is likely that at least three occur and not improbable that others will be found when the marine fauna is better known. The species recorded from the region may be distinguished from each other as follows;

Key to the South African Species of Luidiidae.

Rays 5; no enlarged central spinelet on paxillae . . *Luidia africana.*

Rays 7 or more.

No enlarged central spinelet on any paxillae; latter with quadrate tabulum *Luidia maculata.*

An enlarged central spinelet on many paxillae; latter with a stellate crown *Luidia savignyi.*

Luidia africana.

Sladen, 1889. Challenger Ast., p. 256; pl. 44, figs. 1 and 2.

I have not seen this species but Sladen records it from Simon's Bay, Cape of Good Hope and Bell lists it from four stations in 85–90 fms.

* Luidia maculata.

Müller and Troschel, 1842. Sys. Ast., p. 77. H. L. Clark, 1916. Endeavour Ech., pl. 5.

This species is recorded by Peters from Mozambique (1852, Monatsb. Berlin Akad., p. 178) but de Loriol thinks he probably had *L. savignyi*. While this is quite possible, it does not seem to me unlikely that ***maculata*** occurs as far south as Mozambique and I therefore let Peter's record stand.

Luidia savignyi.

Asterias savignyi Andouin, 1826. Expl. som. des pls. Echinod. de l'Egypte pub. par Savigny, p. 208; Rayonnés, pl. 3.
Luidia savignyi Gray, 1840. Ann. Mag. Nat. Hist. (1), vol. 6, p. 183.

This fine *Luidia*, originally noted from the Red Sea, was known only as far south as Mauritius and Zanzibar. In the Pieter Faure collection however, I find a badly broken specimen with R = 170 mm., which is undoubtedly this species, thus greatly extending the known range to the southward. It would be interesting to know by what characters Sladen distinguished his Challenger species *aspera* from *savignyi*, for they seem to me identical, but he makes no reference to the old species.

P.F. 10833. Natal: Umhloti River, N. W. by W. $^3/_4$ W., $2^3/_4$ miles, 25 fms. 1 specimen; adult.

GONIASTERIDAE.

Up to the present time only three species of this large family had been taken in South African waters. All of these are in the collection at hand and in addition the Pieter Faure captured eight species, six of which seem to be new to science. Nearly all of the eleven species are deep water (85–500 fms.) forms and none seems to be common. Indeed not a species of *Goniasteridae* is represented in the collection by more than *four* specimens, and of four species there is but a single example of each. Unfortunately two at least

of these four appear to be new. The following key shows how easily the South African goniasterids can be distinguished from each other.

Key to the South African Species of Goniasteridae.

Abactinal surface of disk covered with pseudopaxillae or granule-bearing tabula.
- Rays more or less elongated; R more than $2r$.
  - Each inferomarginal with 1—3 small, more or less appressed spinelets; no true (alveolar) pedicellariae present.
    - R = 3—4 r; superomarginals occupy less than $^1/_4\,r$; paxillar area at base of arm about ·60 of arm-width . *Pseudarchaster tessellatus.*
    - R = 2—2·5 r; superomarginals occupy $^1/_3\,r$; paxillar area at base of arm about ·40 of arm-width . . *Pseudarchaster brachyactis*
  - No spinelets on inferomarginals; at least a few true pedicellariae present *Mediaster capensis.*
- Rays short, form more or less pentagonal; R less than $2r$.
  - Interradial superomarginals squarish, often longer than wide, but occasionally wider than long; distal subambulacral spines not conspicuously enlarged.
    - Inner ends of interradial superomarginals distinctly squarish; their length equals or exceeds width; paxillae granules very close set, the marginal series with vertical outer sides *Ceramaster chondriscus.*
    - Inner ends of interradial superomarginals markedly rounded; their width exceeds length; paxillae granules rounded and not close-set *Ceramaster trispinosus.*
  - Interradial superomarginals nearly twice as wide as long; distal subambulacral spines conspicuously enlarged *Ceramaster patagonicus*, var. *euryplax.*

Abactinal surface of disk with no pseudopaxillae or distinct tabula.
- Actinal intermediate plates, each with a heavy spine, more or less elongated.
  - Pedicellariae wanting; adambulacral furrow series of 3 or 4 stout spines *Calliaster baccatus.*
  - Pedicellariae present; adambulacral furrow series with 6—9 slender compressed spines . . . . . *Calliaster acanthodes.*
- Actinal intermediate plates with granules, tubercles and pedicellariae, but no spines.
  - No marginal plates with spines or conspicuous tubercles *Tosia tuberculata.*
  - Many marginal plates with tubercles or stout spines.
    - No disk plates with stout capitate spines or big central tubercles *Cladaster macrobrachius.*
    - Many disk plates with stout capitate spines or big central tubercles *Hippasteria phrygiana.*

Pseudarchaster tessellatus.

Sladen, 1889. Challenger Ast., p. 112; pl. 17, figs. 3, 4.

The specimens at hand (R = 32–50 mm.) are about the same size as Sladen's (R = 48 mm.) and answer very closely to his description. There is however a median unpaired spine at the tip of the jaw

which is not mentioned by Sladen. Bell (1905, Mar. Inv. South Africa, vol. 3, p. 242) lists the species from five stations but gives no data about the specimens. It way be mentioned here that he, consistently and erroneously, throughout his report gives the date of Sladen's Challenger report as 1887.

P.F. 15436. Cape Point, N.E. by N. $7^3/_4$ miles, 85 fms. F. gn. s. 4 specimens; adult.

Pseudarchaster brachyactis *, sp. nov.

Plate XII. Figs. 1, 2.

R = 33 mm.; r = 15 mm.; R = 2·2r. Br = 18 mm., with paxillar area 6 mm. wide at same point. Disk large, flat, about 6 mm. thick. Arms also flat and nearly as thick as disk, except distally; they taper rapidly from the wide base to the bluntly pointed tips. Interbrachial arcs broadly curved. Abactinal area of disk and rays, within the boundary of superomarginals, covered by low pseudopaxillae which typically bear one central granule and a marginal series of 6–8; the granules are large, somewhat angular, rather close-set and more or less nearly subequal; near the superomarginals the granule-bearing plates lose their tabulate form and the granules are arranged more or less evidently in rows parallel to the margin. Madreporite small but distinct, about half way between the inner end of the superomarginals and the center of the disk. Superomarginal plates very oblique, approaching the horizontal, in position, about 22 on each side of each ray but the distalmost three are very small, with their inner ends abutting on the somewhat swollen but not large terminal plate; the two plates on either side of the interradial line are about 5 mm. wide, but only 1 mm. long at the outer end and less than 1·5 mm. at the inner; the succeeding plates gradually become longer and narrower but even near the tip of the ray they are twice as wide as long; each plate is closely covered by granules like those on the pseudopaxillae but more rounded; the largest granules (·25–·30 mm. across) are at the outer (lower) end of the plate while the smallest are along the inner margin; there are no spinelets or tubercles on any of the plates. Inferomarginals exactly like those of upper series, with granulation and end-width reversed; on all however, one or more (sometimes as many as four) of the median granules is, or are, enlarged, lengthened and flattened to form a small and appressed but distinct spinelet; the largest of these however rarely exceeds half a millimeter in length and they

* βραχύς = short + ἀκτίς = ray, in reference to the relatively short arms.

are only bluntly pointed. Actinolateral plates about 40 in each area; the series next to the adambulacrals extends out only as far as the fifth inferomarginal; beyond that the inferomarginals abut directly on the adambulacrals; actinal areas covered so closely with coarse granules like those on the inferomarginals that it is almost impossible to make out the plates; near the oral plates are two or three very simple and slightly differentiated pectinate pedicellariae, formed by the marginal granules of adjoining plates.

Adambulacral plates 28–30 in each series, about as long as wide or longer, markedly convex on inner margin and slightly swollen on the oral surface. Each plate, on proximal half of ray at least, carries a marginal series of 6, rarely 7, spines, subequal as to length (about 1 mm.) or the first and last shortest, the middle pair most slender and distal pair evidently the stoutest; on the oral surface of each plate are two or three slightly oblique series of 2–4 blunt well-spaced spinelets or granules; those nearest the furrow margin are most spine-like, while those of the opposite margin are only granules; one spinelet of the series nearest the furrow or of the next series, is somewhat enlarged and distally becomes conspicuous as a thick, blunt but not very long subambulacral spine; not rarely two such spines occur on a plate, especially near tip of arm. Oral plates not much swollen; each plate carries two series of 8–10 spinelets, one along the sutural margin, the other following the outer margin; in each series, the longest spines are proximal and they become shorter and stouter distally quite rapidly; sometimes there is an isolated spine between the two series. Whether an unpaired median spine is present at the tip of the jaw is not easy to determine in the holotype as the jaws are turned upward into the mouth. But on at least one jaw it seemed to be present while on another it was almost certainly wanting. Colour, uniformly brownish-yellow.

P.F. 17965. Cape Point, N. 41° E., 38 miles. 315–400 fms. S., blk. sp. 3 specimens; very young.

P.F. 18904. 36° 40′ S., 21° 26′ E., 200 fms. Gr. s. 1 specimen, adult.

Holotype, South African Museum, no. A 6430, P.F. 18904.

The specimens from 17965 are not only young but are in very poor condition and it is not impossible that they are the young of *tessellatus* or even that they represent some other species. The tips of the arms are missing and the granules are largely rubbed off from both surfaces. The holotype however is in good condition and I have little doubt that it is quite a different species from any as yet described. The short wide rays with the almost horizontal marginals give it a very characteristic appearance. In the young

specimens, the median, unpaired spine at the tip of the jaw is very conspicuous in every case, so there is reason to believe it is normally present in the adult. The smallest specimen has R = 7·5 mm., $r = 4{\cdot}5$ mm., $R = 1{\cdot}66\,r$; the unpaired spine on the jaw is perhaps ·35 mm. long by ·25 mm. thick. In the largest of the young specimens, $r = 5{\cdot}5$ mm. while R was certainly more than twice as much; the unpaired jaw-spine is about ·70 mm. long by ·30 mm. wide. There is no indication of spinelets on any of the inferomarginal plates.

Mediaster capensis *, sp. nov.

Plate XVI. Figs. 1, 2.

R = 53 mm.; $r = 19$ mm.; $R = 2{\cdot}8\,r$. Br = 20 mm.; at middle of ray, 8 mm.; at tip, 2·5 mm. Disk large, somewhat swollen in the radial regions; arms wide at base, narrowing rapidly at first and then, on distal half of arm, very gradually to the blunt tip. Abactinal plates of disk and base of rays, tabulate, more or less paxilliform, crowned with a marginal series of 12—15, slightly angular, blunt spinelets or coarse granules and within this circle 3—8 similar and scarcely smaller granules; in the interradial regions, near the superomarginals and on the distal part of the rays, the plates are less paxilliform and carry 5–10 small granules, variously arranged; occasionally one of the granules, on the larger plates, is replaced by a small 2-jawed pedicellaria, but these are neither numerous nor conspicuous. Papulae numerous, large, arranged quite regularly, so that around each plate, there are six, but around any two plates there are ten and around any four plates only sixteen. Madreporite small, rounded triangular, about as large as one of the larger abactinal plates, only half as far from centre of disk as from disk-margin.

Superomarginal plates about 29 on each side of each ray, all wider than long, the interradial ones almost twice as wide as long; they are closely covered with granules, almost exactly like those on the adjoining abactinal plates; there are 50–60 granules on one of the interradial superomarginals; occasionally a pedicellaria replaces a granule. Terminal plates small, slightly swollen, almost circular or rounded hexagonal. Inferomarginals apparently one fewer than superomarginals on each side of each ray; the series alternate more or less clearly at least at the middle part of the arm; the covering

* In reference to the geographical occurrence, the region being a new one for the genus.

of the inferomarginals is like that of the upper series. Actinolateral plates in about eight series; the first (next the adambulacrals) extends from the oral plates to about the fourteenth inferomarginal (counting from interradius); the second series extends to the eighth inferomarginal and the third reaches the sixth; remaining series irregular and made up of somewhat smaller plates than the first three; each actinolateral plate carries a marginal series of 7–9 angular granules, more widely spaced than on the abactinal plates, and a *single* central granule, or rarely two; there seem to be no pedicellariae on these plates.

Adambulacral plates about 56 on each side of the furrow; they are distinctly wider than long and their armature is in three very sharply defined parallel series; the furrow series consists of 4, rarely 5, subequal, almost cylindrical, blunt spines, over a millimeter long; the second series consists of 3, rarely 4, very similar but somewhat more prismatic spines of about the same size; the third and outermost series is made up of 3 angular spinelets not much larger than the granules on the adjoining plates. Oral plates not at all conspicuous and little swollen; their outlines are quite indistinct; proximally there are 5 spines on each side, the ones at tip of jaw longest (about 2 mm.); these spines are very strongly compressed, with widened and rounded tips; on the surface of each plate are a dozen or more smaller and more prismatic spines, the distalmost much like the actinolateral granules. Colour, brownish-yellow.

P.F. 18183. Cape Point, N. by E., 9 miles. 81–87 fms. Gr. m. and s. 2 specimens; adult.

P.F. 18230. False Bay, 21 fms. Fne. s. 2 specimens; adult.

Holotype, South African Museum, No. A 6422, P.F. 18230.

Examination of the internal anatomy confirms the evidence of the external characters, and proves this to be a true *Mediaster*: The internal radiating ossicles of the abactinal skeleton are well developed and rudimentary superambulacral plates are present. As regards the latter feature, however, I do not place very much confidence in its value, for unless these plates can be shown to have a real morphological value in some group of sea-stars, I must doubt their phylogenetic significance, and their presence in a rudimentary condition, or their absence, would not seem a matter of any real importance. Their position is such with reference to the ambulacrals and adambulacrals that their independent origin in totally unrelated groups would appear to be highly probable.

There is no doubt that *Mediaster capensis* is very nearly related to *M. australiensis* H. L. C. but I think the differences in the paxilliform

plates of both surfaces justifies regarding them as different species. Abactinally these plates in *capensis* are noticeably larger, especially in the midradial line, and they carry more granules within the marginal circle, than in *australiensis*, while actinally the reverse is true, the actinolateral plates of *capensis* rarely having more than one central granule while in *australiensis* there are almost always 2–5. The papulae in *capensis* are noticeably larger and more regularly arranged than in *australiensis*. In this particular, *capensis* is more like *ornatus* Fisher of Hawaii, but the differences in the actinolateral plates and adambulacral armature prevent any confusion with that species.

The specimens from 18183 are smaller than those from 18230 but they are like them in all essentials and call for no special comment.

Ceramaster chondriscus *, sp. nov.

Plate XIV. Figs. 5, 6.

R = 52 mm.; *r* = 30 mm.; R. = 1·7 *r*. Interbrachial arcs very broadly round; the interradial margins of the body are almost perfectly straight; rays well marked and rather abruptly projecting. Abactinal plates tabulate, completely granulated; the six primary plates are easily seen as the largest tabulae; otherwise the largest tabulae are at the center of the disk and on the median line of the basal half of each ray; these larger tabulae are more or less perfectly hexagonal, but the plates of the proximal part of each interradial area are more rhomboidal (in the holotype, they are perfectly rhomboidal) or pentagonal or irregular; distally in the interradii the plates become very small, and are roughly oblong or hexagonal; the sides of the tabulae are very straight, their marginal granules being sharply cut vertically on the outer side; on the larger tabulae there are about 20 marginal and about 25 central granules, all closely crowded. In the holotype and the smallest specimen, one or several of these granules are, on a few tabulae, replaced by large, bivalved, often excavate pedicellariae; on the third specimen, these are remarkably abundant.

Superomarginal plates 16–18 (17 in the holotype) on each side of each ray. Those in the interradii are nearly or quite square and there are only 6 or 7 on the basal half of the ray, as against 10 or 11 on the outer half; the distalmost three or four are however very short and this increase in number is no doubt correlated with the relatively long rays. The bare area, which in some species of *Ceramaster* may occupy the whole abactinal surface of the plate, is

* χονδρίσκος = a granule, in reference to the numerous abactinal granules.

greatly reduced, and is entirely wanting on the large plates of the interradial region of the larger specimens; it is evident on *all* the plates of a specimen with R = 42 mm. On the inferomarginals, the bare space is present though small on 5 or 6 plates on each side of the interradius in this small specimen but is wholly wanting in the larger specimens. It looks therefore as though with increasing age and size, the marginal plates tend to become wholly covered with granules. The number and distribution of the pedicellariae is very variable; in the small specimen they are very few but in the larger ones they are more abundant; in one of the latter, they are present on a large proportion of the dorsal tabulae, and on all the superomarginals, except those near tip of ray, there is at least one, often there are two and not infrequently, three; on most of the inferomarginals too they are present, and even on the actinolateral plates a few are to be found; in the region just back of the oral plates are 3 or 4 pedicellariae notable for their large size, fully twice that of those on the abactinal surface; on the adambulacrals, there seem to be no pedicellariae.

Actinolateral plates rather numerous and crowded but their outlines are very distinct at the center of each area, less so near mouth and least so on the outer part of each ray; except near the mouth and distally, the two series adjoining the adambulacrals are wider than long and oblong; those at center of area are rhomboidal; elsewhere they are irregularly polygonal or rounded; the granulation is much coarser than abactinally and there is no obvious distinction between the marginal and central granules; even the largest plates have only 20–25 altogether. The series adjoining the adambulacrals extends out to about the sixth or seventh inferomarginal from the tip; the next series reaches only to the ninth. At the middle of each interradial margin there are about $3^1/_2$ actinolateral plates abutting on each inferomarginal.

Adambulacral plates 40–45 on each side (in the holotype) wider than long at first but becoming squarish distally. The armature consists of a furrow series of 4, blunt, thick, somewhat prismatic or slightly flattened, subequal spines about 1·5 mm. long; back of these is a nearly parallel series of 3 similar but shorter spines and the outer end of the plate is occupied by 2–4 still smaller, but yet somewhat similar spinelets; these last are distinctly larger than the biggest granules of the adjoining actinolateral plates. Oral plates large but flat and not at all swollen; the armature is almost exactly similar to that of the adjoining adambulacrals; there are about 8 large spines on each free margin and a series of about 8 prismatic

granules along each of the opposed margins. — Colour in alcohol, pale brown, becoming brownish-white on drying.

P.F. 15147. Table Mountain, E. by S. $^1/_2$ S., 25 miles, 190 fms. Gr. s. and bl. sp. 3 specimens. Adult.

Holotype, South African Museum, no. A 6414.

I had determined to call these three specimens *patagonicus* but Fisher thinks they are nearer to his recently described *C. smithi* from the Philippines, in 554 fms. He says that the South African specimens differ from *smithi* in the clean cut hexagonal tabulae of the mid-radial areas, the more numerous abactinal granules (only 10–15 central granules on largest tabulae in *smithi*), in the smooth tips of the subambulacral and furrow spines, in the lower abactinal pedicellariae, and in the larger oral plates. From *patagonicus* (of which I have seen no specimens) Fisher tells me the South African species differs "in having narrow, sunken, wholly granulated marginal plates, broader abactinal radial plates with more crowded, numerous granules, large instead of small plates in center of disk, a different sort of actinal pedicellaria, etc." It seems to me very clear that *patagonicus*, *smithi* and *chondriscus* are very closely related forms and that we shall not know the true interrelationship until we have far more material.

Ceramaster trispinosus*, sp. nov.

Plate XIV. Figs. 3, 4.

R = 41 mm.; r = 21 mm.; R = 1·95r. Interbrachial arcs broadly rounded; rays bluntly pointed. Abactinal plates tabulate, polygonal, of diverse sizes and closely crowded; most of the plates are rather large with a marginal series of 10–20 coarse, rounded granules and 10–20 similar, not crowded, granules within the marginal series; smaller plates have 6–12 marginal granules and 4–10 more on the top; the five basal plates are easily distinguishable, as one is somewhat crescent-shaped and encloses the madreporite on its outer side, while the other four have more numerous and smaller granules than the other tabulae, about 30 in the marginal series and about 35 within. Superomarginal plates 13 or 14 on each side of each ray or 26 or 28 on each side of the pentagon; the interradial pair are, each 4 mm. wide and 3 mm. long, with the inner end so curved as to be almost a semicircle; they are fully covered by about 150 granules, of which the largest are on the lower margin, next

* *trispinosus* = having three spines, in reference to the armature of the adambulacral plates.

the inferomarginals; there are 8–10 on that margin, 8 or 9 in the marginal series up each side and 18–20 on the semicircular inner (upper) margin; the second, third and fourth superomarginals are similar but progressively slightly smaller and with more square cut inner ends; on the fifth plate is a small bare area and this increases in size on the succeeding plates, until on the distal plates only a marginal series of granules remains; the last three superomarginals of the two sides meet in the midradial line, so the abactinal plates do not reach the terminal plate; the latter is of moderate size, rounded triangular or pentagonal and decidedly swollen. Madreporite small, only 1·5 mm. in diameter, its outer margin 12 mm. from edge of disk. Inferomarginals 14 or 15 on each side, always one more and sometimes two more than the superomarginals of the same side; in the neighborhood of the sixth superomarginal there are two inferomarginals and at the tip of the ray another extra inferomarginal is often to be found; the inferomarginals are very similar in form and granulation to the adjoining superomarginals. Actinolateral plates numerous, but so crowded and so closely granulated that the series can be made out only with difficulty; that adjoining the adambulacral plates extends to the eighth inferomarginal while the next series reaches only to the sixth; the granulation is much coarser than that on the marginals or abactinal plates and is well-spaced; there are rarely as many as 20 granules on a plate,

Adambulacral plates about 50 in each series, short and crowded, much wider than long except distally where the length nearly equals the width. Each plate carries a series of 3 (or rarely 2) stout spines on the furrow margin; these spines are a millimeter long, subequal, blunt, cylindrical or more or less compressed; back of this series, there are on the oral surface of each plate, three pairs of spines; the first (innermost) of these is much stouter and a little shorter than the furrow-spines, and the distal spine is larger than the proximal; on the terminal part of the arm, this larger spine becomes quite conspicuous as relatively the biggest adambulacral spine; the other two pairs of spines are much smaller, and the outer one is scarcely larger that the granules of the actinolateral plates; on some adambulacrals, one (or even two) of these six surface spines is wanting. Oral plates not at all swollen; on each free margin is a series of 5 or 6 stout, more or less prismatic, subequal spines; just back of these is a series of 5 similar but shorter spines, and on the distal part of each plate are about 5 still shorter spines or coarse prismatic granules. There seem to be no pedicellariae anywhere. Color of dried specimen, uniformly dingy, brownish-yellow.

P.F. 2798. Vasco de Gama Peak, N. 71° E., 18 miles, 230 fms. Stones. 1 specimen, adult.

Holotype, South African Museum, no. A 6415.

This species has a very characteristic appearance due to the form of the marginals, the absence of pedicellariae and the crowded adambulacral plates with their furrow-series of three spines. The form is distinctly less pentagonal than in most members of the family, the tips of the rays being markedly prolonged. The granulation both above and below is noticeably coarse, but it is especially so on the actinolateral plates.

Ceramaster patagonicus var. euryplax * var. nov.

Plate XIV. Figs. 1, 2.

R = 32 mm.; *r* = 20 mm.; R = 1·6 *r*. Form nearly pentagonal but the sides are slightly concave. Abactinal plates tabulate, polygonal, of diverse sizes and closely crowded, so that the sides are very straight and clear cut, as in *C. patagonicus*; radially the plates are perfectly hexagonal and interradially they are rhombic; they are smallest at center of disk and near the marginal plates; the larger plates have a marginal series of 12–14 coarse granules and 10–18 similar but slightly smaller granules are within the marginal series; the latter have their outer sides quite vertical and the adjoining angles sharp; a central plate and the five basals are distinguishable by their smaller granules. Superomarginal plates 10 or 11 on each side of each ray or 20–22 on each side of the pentagon; the interradial pair are each 4 mm. wide and 2·5 mm. long, approximately rectangular, with nearly straight edges; succeeding plates similar but progressively shorter; there is little change in width until very near the tip of the ray; the central abactinal part of each plate is slightly tumid, bare and smooth; this bare area is largest distally and smallest on the interradial pair; elsewhere the plates are closely covered with a coat of granules of very uniform size, of which there may be more than 200 on a plate. Terminal plate of moderate size, very tumid, pentagonal, smooth. Madreporite small, wider than long, 1·75 mm. across, its outer margin 13 mm. from edge of disk. Inferomarginals of the same number as the superomarginals; the interradial pair underlie the interradial superomarginals but each succeeding plate lies progressively more distal so that near the tip of the ray the two series alternate; in granulation the inferomarginals resemble

* *ἐυρύς* = wide + *πλάξ* = plate, in reference to the very wide interradial superomarginals.

the upper series exactly except that the bare area is smaller, while in form they are perfect complements of the adjoining superomarginals. Actinolateral plates numerous and crowded, arranged in about eight series parallel to the adambulacrals; first series extends from oral plates to sixth inferomarginal and is made up of about 21 plates, which, excepting 2 or 3 at each end, are distinctly wider than long; succeeding series very crowded and hard to distinguish, the component plates about square; all the plates are covered by a close granulation like that on the inferomarginals but becoming coarser on the series near the adambulacrals.

Adambulacral plates about 33 in each series, not much wider than long (if any) and not specially crowded. Each plate carries a series of 4 or 5 stout spines on the furrow margin; these spines are about a millimeter long, blunt and thickened at tip, more or less compressed; when 4 are present, the middle pair are a trifle longer than the others; if a fifth spine occurs it is proximal in position and much smaller than the others; back of this marginal series, there are, on the oral surface of each plate, parallel with the furrow, three series of spinelets, of which two have three spinelets each and the outermost usually has four; the outermost series is no larger than the adjoining granules of the actinolateral plates, while the other series are slightly more spine-like; near the mouth, the outer series merges with the third or disappears altogether; distally the number of spinelets in each series is reduced. Just beyond the middle of the ray the distal spinelet of the second series is somewhat larger than its fellows: this disproportion increases as the tip of the ray is approached and the number of spinelets decreases, until, on the last ten or a dozen adambulacral plates, this spinelet is a conspicuous subambulacral spine, about a millimeter long and half a millimeter thick. Oral plates not at all swollen; on the free margin is a series of 9 stout, prismatic spines, the innermost stoutest; parallel to the sutural line between the two plates is a series of 8 crowded spinelets, of which the distal ones are scarcely larger than the granules of the adjoining actinolateral plates; a secondary series of 6 smaller spinelets runs irregularly parallel to this sutural series and there are 2 additional spinelets between it and the marginal series. There seem to be no pedicellariae. Colour of dried specimen, dingy brownish-yellow.

P.F. 15366. Cape Point N. 16° E., 10 miles, 85 fms. Gm. m. 1 specimen; adult.

Holotype, South African Museum, no. A 6413.

This handsome goniasterid is very near *patagonicus* of the same size from Alaska. Dr. Fisher has kindly compared them and finds

so little difference that he advises considering this specimen, for the present, as only a variety of *patagonicus*. He says the abactinal plates are larger than in *patagonicus*, being more as in *granularis*. It is possible that in larger specimens, the bare area on the marginal plates would disappear, at least interradially.

Calliaster baccatus.

Sladen, 1889. Challenger Ast., p. 280; pl. 56, figs. 1–4.

The Pieter Faure specimens agree well with Sladen's description and figures. The larger has R = 44 mm. and the smaller, 40 mm.; the former is thus just the size of the original specimen. The Mossel Bay specimen is somewhat larger as R = 52 mm. On a single actinal plate of this specimen is an indubitable pedicellaria and there are several of the pits where pedicellariae have been. The pedicellariae are thus not invariably wanting in this species. Their usual absence is however one of the many good species characters which *baccatus* possesses. The single pedicellaria seen has unequal, asymmetrical, non-denticulate valves; the larger valve is scarcely higher than wide and is a little bent sideways; the smaller is more decidedly bent and is distinctly narrower.

P.F. 1173. 34° 18′ S., 22° 13′ E., 38 fms. 1 specimen; adult?

P.F. 1710. Cape St. Blaize, N. by E. $^3/_4$ E., $6^1/_4$ miles, 35 fms. M., s. 1 specimen, adult?

Mossel Bay. C. W. Black, 1913. 1 specimen, adult.

Calliaster acanthodes * sp. nov.

Plate XII. Figs. 3, 4.

R = 79 mm.; *r* = 27 mm.; R = nearly 3*r*. Br = 30 mm.; at fifth superomarginal, *br* = 14 mm. and at 12th, *br* = 9 mm. Disk large, slightly tumid but with depressions near interradial margins. Rays tapering at first abruptly but beyond fifth superomarginal, very gradually. Abactinal surface of disk covered with irregularly circular plates, which are more or less tumid and bare, though there is a marginal series of coarse, flat, irregular granules around each one; the median radial series comprises the largest plates and runs almost to the tip of the ray but the distalmost plates are separated from the terminal plate and from each other also, by the meeting in the midradial line of the distal superomarginal plates; the series of plates on either side of the radial runs as far as the 12th superomarginal;

* ἀκανθώδης = full of thorns, in reference to the numerous abactinal spines.

all the larger abactinal plates and many small ones too, bear a single, central blunt spine, 1–3 mm. long and about $^1/_2$ mm. in diameter; not rarely the spine, on the smaller plates, is replaced by a large non-denticulate spatulate-jawed pedicellaria; on the larger plates, spine and pedicellaria may both occur. Madreporite large, tumid, about 3 mm. in diameter and 12 mm. from the disk margin.

Superomarginal plates 16 on a side, bare and tumid; the proximal are squarish and about as long as wide but distally the plates become much wider than long; each plate (except near tip of ray) carries 2, and sometimes 3, stout spines like those on the abactinal plates; these are placed one above the other; besides these spines one or more coarse granules or small tubercles may be present or, occasionally, one or even two pedicellariae occur instead of the tubercles; the usual series of marginal granules surrounds each of the plates. Terminal plate quite small, swollen and with no spines or tubercles whatever; it is possible that these may have been present in life and have since been knocked off but if so they have left no scars. Inferomarginal plates 17 on each side, the basal ones longer than wide and longer than the corresponding superomarginals, but distally they decrease in length rapidly and an extra one is intercalated below the twelfth of the upper series, or thereabouts; these plates carry 2–5 spines in a central group, or in a vertical or horizontal series; the spines are similar to those of the upper plates, and like them may be accompanied by pedicellariae. Actinolateral plates in six or seven series, the first parallel to the adambulacrals and reaching as far as the seventh inferomarginal; the second series does not quite reach the fifth inferomarginal; the remaining series are confined to the disk; each plate is surrounded by the usual marginal granules and these also occur more or less abundantly on the surface of the larger plates, especially near the mouth; each plate, excepting only the small ones, carries a large, central spine, similar to those of the abactinal surface but perhaps a little bigger; on some of the plates, the large characteristic pedicellariae occur.

Adambulacral plates 57 in each series but 21 of these are on the last 18 mm. of the arm; there are 6–9 (usually 8 or 7) slender compressed spines on the furrow margin, which are subequal or the end ones may be much the smallest; on the surface of the plate are 2 large spines, placed one behind the other, and on the adoral, inner corner there is usually a big pedicellaria; the plates are surrounded by the usual marginal granules and a number of these occur on the face of the plate, particularly around the base of the outer spine. Oral plates long and narrow, but not swollen; on the free margin

is a series of 8 or 9 long, blunt, compressed or prismatic spines, the innermost largest; on the face of each plate is a single big spine, between which and the tip of the jaw are three or four sharp, angular spinelets; distally a series of 10 or 11 granule-like spines runs along the outer margin, and 5 or 6 much coarser granules lie along the sutural margin. Colour of holotype, in alcohol, yellow-brown; of paratype, dull brownish-red above, more or less irregularly bleached; lower surface, nearly white.

P.F. 12831. Buffalo River, N.N.E. 17 miles, 195 fms. St., r. 1 specimen; small adult.

P.F. 14232. Cape St. Francis, N.E. 29 miles, 75 fms. S., sh., r. 2 specimes; adult; one very poor.

Holotype, South African Museum, no. A 6424. P.F. 14232.

This fine species is quite different from *baccatus* but is very near *corynetes* Fisher and *spinosus* H. L. C. It is readily distinguished from the former by the spiny upper surface and the pedicellariae on the adambulacral plates, and from *spinosus* by the bare abactinal plates and the presence of only one large spine on each oral plate. I was at first inclined to consider these specimens as adult *baccatus* but careful comparison shows that this idea is absurd. The differences in the adambulacral armature are fundamental and cannot possibly be construed as growth stages, and the same must be said of the condition of the marginal plates. One of the specimens from 14232 was evidently dried directly from salt water, perhaps with the laudable purpose of preserving the colour, but unfortunately, with the passage of time, it has disintegrated sadly and is now of little value. It was somewhat larger than the holotype, as $r = 30$ mm. The present colour is deep red brown, the marginals being darker than the abactinal plates.

Tosia tuberculata.

Plate IX. Figs. 1, 2.

Astrogonium tuberculatum Gray, 1847. Proc. Zool. Soc. London, p. 79.
1866. Syn. Starfish, p. 10; pl. 1, fig. 2.
Tosia tuberculata Verrill, 1899. Trans. Conn. Acad., vol. 10, p. 161.

Although Bell (1905, Mar. Inv. South Africa, vol. 3, p. 246) recognized the fact that this species is very little known, he does not give one word of information about the numerous specimens he had before him, except that the species is now "found to grow to a good size". What "a good size" may be each reader must decide for himself! However, two of Bell's specimens are now in the collection

of the Museum of Comparative Zoölogy and have been examined by Fisher, who has published some notes on them (1911, Bull. 76 U. S. Nat. Mus., p. 166). In the PIETER FAURE collection, I find a single starfish (P.F. 18154. Cape Point, N.E. by E. $^3/_4$ E., 28 miles. 300 fms. Fne. s.) which is undoubtedly identical with these M. C. Z. specimens (as comparison side by side shows) but it is considerably larger and differs in certain details. Its most striking feature is the abundance of large bivalved, and often excavate, pedicellariae all over the abactinal and marginal plates; they are rather infrequent on the actinal surface and seem to be wholly lacking on the adambulacral plates, the only plates on which they are to be found in the M. C. Z. specimens, one would infer from Fisher's notes (*op. cit.* p. 167). However Fisher probably does not mean to imply that, for there are numerous pedicellariae on the abactinal surface of both these specimens, while the adambulacral pedicellariae occur only in the larger. Judging from the three individuals at hand, in which R = 42, 48 and 54 mm. respectively, one would say of this species: large, bivalved, often excavate, pedicellariae occur commonly and even abundantly on the abactinal and superomarginal plates, but are less frequent and may be wanting on the inferomarginal and actinal plates; their occurrence on the adambulacrals is unusual and when present there, they are strictly bivalve and have high, rather narrow jaws.

Both Verrill and Fisher put this species in *Tosia* but it would seem to be nearer to *Plinthaster*. Verrill apparently had not seen any specimens but, except for the large size of the pedicellariae, the individuals at hand, answer well to his diagnosis of *Plinthaster*. They also run down to *Plinthaster* most naturally and without question in Fisher's admirable key to the genera of *Goniasteridae* (*op. cit.*, pp. 169—174); here again the only difference is in pedicellariae. On the other hand the obvious presence of secondary plates in the radial areas seems an obstacle to putting this species in *Tosia*, and the general facies is quite as unlike that genus as it is that of *Plinthaster*. Dr. Fisher thinks that the species these South African specimens represent might well be made the type of a new genus but I think it will be well to wait until more material is available and further study has been made of Gray's type material in the British Museum.

The PIETER FAURE specimen has much longer rays relatively than either of the M. C. Z. specimens, so that the body form is quite different. This can best be shown by the following comparison. In the larger M. C. Z. specimen, R = 48 mm.; *r* = 28 mm.; *br* halfway to tip of ray, 22 mm.; *br* three-quarters of the way to tip, 8 mm.;

thus R = 1·7 *r*; or 2·2 *br* at half-way point; or 6 *br* at three-quarters point. In the PIETER FAURE specimen, R = 54 mm.; *r* = 26 mm.; *br* at half-way point, 13 mm.; *br* at three-quarters point, 7 mm.; thus R = 2·1 *r*; or 4·1 *br* at half way point; or 7·7 *br* at three-quarters point. Probably a large series of specimens would show that there is considerable individual diversity in these proportions, and very likely, an increasing ray-length, with age.

Colour in life: upper surface reddish orange, lower surface pale.

Perhaps it ought to be added that it is not certain that the specimens identified by Bell are really *tuberculata*; he does not say whether he compared them with the type or not. Certainly Gray's figure does not resemble at all closely any one of the three specimens at hand.

CLADASTER MACROBRACHIUS * sp. nov.

Plate XIII. Figs. 1, 2.

R = 40 mm.; *r* = 16 mm.; R. = 2·5 *r*; *br* = 18 mm. but at half-way to tip it is only 9 mm. Disk large, somewhat convex but only about 8 mm. thick, even at center. Rays flat, tapering, at first rapidly, then gradually to the blunt tip. Abactinal plates moderate in both size and number, irregularly polygonal, with rounded corners, thick and close together; papulae few, single, typically six about any one plate on center of disk or base of rays but usually one or more of the six, lacking. Each plate, in life, was evidently surrounded by a marginal series of small, well spaced granules and bore on top, several larger, more widely spaced granules, one of which was here and there replaced by a large bivalved, more or less excavate pedicellaria; in the preserved specimen (dry) all the top granules, some pedicellariae and many marginal granules have been rubbed off but each has left a shallow pit to indicate its location. Median radial series of plates shut off from terminal plate by the meeting of the five distal pairs of superomarginals; series of plates adjoining radials only extends as far as the fourth or barely to the fifth superomarginal. Madreporite small (less than 2 mm. in diameter), pentagonal, situated about 10 mm. from the disk margin. Superomarginals 13 or 14 on each side of each ray, wider than long, more or less markedly tumid; like the abactinal plates, each is surrounded by a marginal series of small granules, and in life was very sparsely covered by much coarser and more widely spaced granules; on the upper end of each plate, where it is most markedly tumid, there are two or three (distally one or none) large, shallow scars, which indicate that in life rather

* μακρός = long + βραχίων = arm, in reference to the relatively long rays.

coarse granules or big tubercles were present. Terminal plate small and swollen; there are indications that in life it may bear 1–3 tubercles. Inferomarginals agreeing with superomarginals in number, form, size, position and granulation, except that the large, shallow scars are as a rule less well-marked and often seem to be wanting. Actinal plates few, irregularly arranged (except for series adjoining adambulacrals), of diverse sizes; the smaller ones are pretty well covered by the very large marginal granules, but all the larger plates show a bare central area on which is a big, wide-valved pedicellaria, and rarely a single big granule also; the series adjoining adambulacrals extends out only as far as the fourth inferomarginal.

Adambulacral armature conspicuously heavy; the plates themselves are numerous, about 45 in each series, crowded, much wider than long proximally, but squarish distally; each plate carries a series of 3 (rarely 2) furrow spines, about a millimeter long near middle of arm (longer proximally, shorter distally) subequal, or middle one longest, markedly compressed at right angles to furrow and more or less conspicuously widened at tip; back of these is a second series of which the adoral is very small, the middle one is much larger and the aboral is a stout, somewhat capitate subambulacral spine, the largest spine on the plate; on the outer margin of the plate is a third series of three spines of which the middle one is much the largest; the two small ones are hardly bigger than the marginal granules of the adjoining actinal plates; proximally all the adambulacral spines are longer, heavier and more conspicuous, while distally they decrease in number as well as in size. Oral plates not swollen, their outlines hard to determine; each has a marginal series of strongly compressed spines, about 2 mm. long, with much widened tips; there is also a series along the sutural margin consisting of 5 or 6 spines of which the first is small and pointed, the second is a long heavy spine like those of the free margin, the third is like it but a little smaller and the remainder are successively shorter and smaller in every way. Color of dried specimen, light yellowish-brown.

P.F. 2798. Vasco de Gama Peak, N. 71° E., 18 miles. 230 fms. Stones 1 specimen; adult?

P.F. 17998. Cape Point, N.E. $^3/_4$ N., 39 miles, 310–500 fms. Gn. m. 1 specimen; adult?

Holotype, South African Museum, no. A 6429, P.F. 17998.

Aside from these interesting individuals, which differ little from each other, only two specimens of *Cladaster* are known; one, the holotype of *C. validus* Fisher with R = 17 mm. was taken near the Aleutian Islands; the other, the type of *C. rudis* Verrill with

R = 25 mm., was taken in the West Indies. The present individuals are thus much larger and it is noticeable that they have clearly the longest arms; *validus* is most nearly pentagonal. Probably the relative length of the rays increases with age. Perhaps the number of spines in the furrow series also increases with age, for the South African form has three as against two in the other species. Whether these South African specimens are adult seems doubtful and it is probable that a fully grown specimen would throw much light on the relationships of the genus. If it is true that the superomarginal plates in *macrobrachius* bear coarse tubercles, the definition of the genus will need some modification.

Hippasteria phrygiana.

Asterias phrygiana Parelius, 1768. K. Norske Vid. Sels. Skrift., vol. 4, p. 423; pl. 14, figs. 1, 2.

Hippasteria phrygiana Verrill, 1885. Rep. U. S. Fish Comm. for 1883, p. 542.

Up to the present time only a single specimen of *Hippasteria* has been recorded from the southern hemisphere. This was from the Strait of Magellan and was first described by Perrier as *H. hyadesi*, later as *H. magellanica*, and subsequently he used either name, apparently interchangeably. Verrill adopted *magellanica* but *hyadesi* seems to have priority, if the species has any validity. Perrier himself says it is very difficult to distinguish from *phrygiana*, and the differences which he points out are no greater than are to be found between two specimens of *phrygiana* from the New England coast. He gives no measurements and no figures so that there is no way of determining whether his specimen was adult or young.

The two specimens in the Pieter Faure collection only add to the difficulty; they are quite unlike each other and neither is like Perrier's specimen. But I am quite unable to estimate the value of the characters they show, for while they seem like representatives of two different species, they are not so unlike each other as are two specimens of *phrygiana* from the north-eastern coast of America, which lie before me. All four specimens are young, not half grown, but their peculiarities are not to any great degree due to their youth, I feel quite sure. I am forced to conclude that either all four represent one species, or each one represents a separate species. The former seems to me the more probable alternative and I am therefore referring the Pieter Faure specimens to *phrygiana*. It is quite likely however that a good series of adult *Hippasteria* from

either South Africa or the southern part of South America will show some constant specific characters. Meanwhile it may be well to record briefly the chief peculiarities of each of the Pieter Faure specimens.

Specimen A. R = about 52 mm.; r = 21 mm.; R = 2·5 r; br = 21 mm. but at half-way point is only 11 mm. Disk large, rather flat; rays tapering rapidly to an almost pointed tip. There are no large spines on the abactinal surface but each of the larger plates carries a big pedicellaria or a short spine or a high tubercle. Superomarginal plates, each with one or interradially two rather stout spines; on the interradial plates there are some large granules in addition. Inferomarginals with a shorter and thicker spine and 2–10 coarse granules in addition; the interradial plates have the most granules. Actinal plates usually with a big central pedicellaria and a marginal series of few very coarse granules; often a big granule or two replaces the pedicellaria. Adambulacral armature usually of a single large spine on the furrow margin, a similar but shorter subambulacral spine and 3 or 4 granules on outer end of plate; proximally there are 2 and rarely 3 spines on the margin, but they are more slender, and compressed, and there is no conspicuous subambulacral spine. Oral plates with only 4 or 5 marginal spines, but they are big, somewhat compressed and blunt; there are no big spines on the oral surface of plates.

P.F. 2798. Vasco de Gama peak, N. 71° E., 18 miles. 230 fms. Stones 1 specimen; young?

Specimen B. R = 50 mm.; r = 25 mm.; R = 2 r; br = 30 mm. but at half-way point is 17 mm. Disk large, slightly tumid; rays broad, rather flat, tapering uniformly to a blunt point. There are no spines at all on the abactinal surface; many plates carry a pedicellaria or a single large granule at center but some are quite bare; the result is an unusually smooth surface for a ***Hippasteria.*** Superomarginal plates, each with a single, short thick spine; on the interradial pair, a second shorter spine is below the first; on a few plates a large granule accompanies the spine. Inferomarginals with a single large tubercle or thick spinelet; interradially, several granules accompany this tubercle. Actinal plates as usual with a big central pedicellaria or occasionally a large tubercle. Adambulacral armature made up of a furrow series of two stout, bluntly pointed spines, the aboral the larger, a very stout sugar-loaf shaped subambulacral spine with one or two granules adoral to it, and about 4 coarse, angular granules on the outer end of the plate. Oral plates forming a rhomb, on each side of which are 3 stout spines;

those of the inner sides are quite markedly compressed; on the surface of each plate is a single, stout spine.

P.F. 17997. Cape Point, N. E. ¾ N., 39 miles, 310–500 fms. Gn. m. 1 specimen; young?

A specimen of *phrygiana* taken by the CHALLENGER on La Have Bank, south of Nova Scotia, in which R = about 57 mm. is much like A in form and proportions but in its adambulacral armature it is much like B. On the other hand, a specimen with R = 48 mm., collected near Grand Manan, has so many big nearly spherical tubercles on the abactinal, marginal and actinal plates that its general appearance is quite different from any of the others; the adambulacral armature approaches that of A but the big furrow spine usually has a very small spine adoral to it and sometimes an aboral one is present also.

There is little question that *Hippasteria phrygiana* is very variable. Possibly more than one species is now included under that name or it may be that varieties or subspecies should be recognized. But until the growth changes are known and a large series of specimens from many localities has been gotten together and studied, it seems to me best to let a single name cover all the Atlantic forms of Hippasteria.

OREASTERIDAE.

There is only a single specimen in the South African collection to represent this well-known tropical family of big sea-stars. Four other species have been reported from South Africa however, so the family is better represented there than the present collection indicates. Nevertheless it must be granted that South Africa is a little too far outside the tropics for even such a ubiquitous warm-water genus as *Oreaster* to flourish, and probably south of Mozambique, the *Oreasteridae* are represented chiefly by stragglers. It is an easy matter to distinguish the few species that have been recorded hitherto.

Key to the South African Species of Oreasteridae.

Rays well developed.

One or two distal superomarginals on each side of each ray bear a very big spine, while the remaining marginal plates are merely a little tumid and carry no spines . . . . . *Oreaster linckii.*

Superomarginals without spines or with small or moderate ones on many plates, especially in interradii . . . *Oreaster mammillatus.*

Rays very short or apparently wanting, as the body is thick and cushion like, and pentangular or roughly circular.

Furrow-series of adambulacral armature with 5—7 spinelets; papulae confined to special areas above the margin.

Papular areas with little spinelets; tubercles of dorsal side rather small and more or less pointed . . . . *Culcita novaeguineae.*

Papular areas without spinelets; tubercles of dorsal side, big, scattered and blunt . . . . . *Culcita schmideliana.*

Furrow-series of adambulacral armature with only 2 or 3 spinelets; papulae all over back, clear to the margin . . . *Culcita veneris.*

* Oreaster linckii.

Asterias linkii de Blainville, 1830. Dict. Sci. Nat., vol. 60, p. 219. See also Linck, 1733, De Stell. Mar., pl. 7, no. 8.

Oreaster linckii Lütken, 1864. Vid. med., p. 156.

Linck's figure gives a very good idea of a typical specimen of this species, which is common at Zanzibar and has been reported from Mozambique by both Peters and Bell.

Oreaster mammillatus.

Asterias mammillatus Audouin, 1826. Expl. som. des pls. Echinod. de l'Egypte pub. par Savigny, p. 209: Rayonnés, pl. 5.

Oreaster mammillatus Müller and Troschel, 1842. Syst. Ast., p. 48.

This is a very variable species and the growth changes and limits of variation need very much to be worked out. In some specimens, spines and even the big tubercles are nearly or quite lacking while at the other extreme, every big dorsal or superomarginal plate carries a small or moderate spine. Peters reported the species from Mozambique and it is not recorded from south of there, but in the present collection is a specimen from Mossel Bay, Cape Colony, which thus extends the known range of the species many hundreds of miles to the south. The specimen is a small one (R = 60 mm.) and lacks one ray, which is however beginning to regenerate. There are no spines anywhere but many of the marginals, especially of the lower series, and a number of abactinal plates bear more or less elevated tubercles. The dry specimen is light yellowish-brown. Mossel Bay. C. W. Black. 1914.

* Culcita novaeguineae.

Müller and Troschel, 1842. Syst. Ast., p. 38. Döderlein, 1896. Jena Denkschr., vol. 8, pls. 19 and 20, figs. 1—9.

This widely distributed Indo-Pacific species is very variable and has been described under a number of names. It has been reported from Mozambique and there is a young individual from that place

in the Museum of Comparative Zoölogy, identified and labelled by Perrier as "*Randasia granulata* Gray. jeune *Culcita areolata* E. Per."

CULCITA SCHMIDELIANA.

Asterias schmideliana Retzius, 1805. Diss. Ast., p. ?*
Culcita schmideliana Gray, 1840 Ann. Mag. Nat. Hist, vol. 6, p. 276.
Döderlein, 1896. Jena Denkschr., vol. 8, pl. 20, figs. 10–15.

This species seems to be common at Zanzibar and has been reported from Mozambique by Bell. A specimen is in the S. A. Museum from Mozambique collected by K. H. Barnard, 1912.

*CULCITA VENERIS.

Perrier, 1879. Arch. Zool. Exp., vol. 8, p. 48; pl. 4.

This species then known only from the holotype, taken at St. Paul Island in the southern Indian Ocean, was recorded by Bell (1905, Rep. Mar. Inv. South Africa, vol. 3, pag. 248) from near the Cape of Good Hope, in 23—37 fms. In spite of the extraordinary interest attaching to the rediscovery of so remarkable an animal, Bell does not give a single bit of information in regard to his specimen and we can only surmise that it was so much like the holotype in size and appearance that he felt no doubt of their identity.

PORANIIDAE.

This family was not hitherto known from the vicinity of South Africa, and it is represented in the PIETER FAURE collection by only a single specimen. This however is of very great interest as it proves to be an undescribed species of a little-known, and hitherto monotypic genus of the North Atlantic.

CHONDRASTER ELATTOSIS**, sp. nov.

Plate VIII. Fig. 4.

R = 115 mm.; r = 75 mm.; R = 1·53r. Disk elevated, v. d. at center, 40 mm. Whole animal covered with a thick, smooth, fleshy skin. Abactinal skeleton wanting or greatly reduced; marginal plates present but very spongy and without spines or tubercles. Papulae numerous, arranged in two parallel series, 20 mm. wide and 5 mm. apart, along the median radial area; a few small groups of papulae, occur irregularly near the center of the disk. Anal opening

* Few writers have been able to consult this paper and no one has given the page reference. The paper is not accessible to me.

** ἐλαττόω = to lessen, in reference to the reduction of the skeleton.

evident. Madreporite distinct but small, 3 mm. across; rather spongy.

Actino-lateral areas with numerous parallel furrows running to margin and even over the margin onto the upper side; no spines or tubercles anywhere. Adambulacral plates with an inner series of 3 or often 4 sharp spines, 1–3 mm. long, sacculate, the saccules extending far beyond the spine-tip; and an outer series of 3, rarely 4, similar but stouter spines, enclosed in a thick, fleshy sack and forming a low, racquet-shaped appendage, 3–4 mm. high and 2·5 mm. wide. Oral plates very thick but flat with no superoral spines or tubercles; at the inner tip of each plate is a rather stout, sacculate, nearly horizontal spine; along the free margin of each plate is a series of similar but longer and stouter, vertically placed spines, united with each other and with the plate itself by skin. Feet large in two series. Colour uniformly dull, deep pink; feet brown.

P.F. 19003. South from Cape Infanta, Cape Colony, 36° 49′ S., 21° 14′ E., 560 fms. Gn. s. 1 specimen; adult.

Holotype; South African Museum No. A 6448.

This remarkable sea-star was unfortunately preserved in formalin and it is evident that some decalcification has taken place. It is however impossible to determine now how much of the sacculate appearance of the adambulacral and oral spines is due to decalcification and how much is natural. It is also uncertain how much of the absence of a dorsal skeleton, and to what degree the sponginess of the marginal plates, is artificial. There is however little doubt as to the generic position of this notable specimen, as it agrees so well in its main features with *Chondraster grandis* Verrill, which occurs in the northern Atlantic, southeast of New England, in 220–538 fms. The South African species differs from the genotype however in the wider papular bands, the greater reduction of the skeleton, the absence of marginal tubercles, and particularly in the armature of the adambulacral plates. In *grandis* there are only two spines in the inner series. The two species apparently differ also in colour, as the northern form is red above and yellow beneath, while the southern species seems to be unicolorous. This may of course be only an individual matter.

OPHIDIASTERIDAE.

This is another tropical family and its inclusion in the present report is due chiefly to the fact that four species are listed by Bell in the Alert Report (1884) as having been taken at Mozambique. One of these is represented in the South African collection before

me by two small specimens but these also are from Mozambique. The only truly South African species is the interesting *Austrofromia* from False Bay.

Key to the South African Species of Ophidiasteridae.

Papulae on actinal surface; adambulacral armature spiniform.
Papulae single; rays 3 or 4 times as long as wide at base *Austrofromia schultzei.*
Papulae in areas; rays 5 or 6 times as long as wide at base *Nardoa variolata.*
No papulae on actinal surface; adambulacral armature granuliform.
Inner (furrow) series of adambulacral spines with spines separated from each other by vertical series of little granules.
Colour blue; arms relatively short and wide, R = 5 or 6 *br* *Linckia laevigata.*
Colours orange and green; arms relatively long and slender, R = 7—12 *br* *Linckia multifora.*
Inner (furrow) series of adambulacral spines with small spines alternating with larger and no vertical series of little granules between *Linckia diplax.*

* Austrofromia schultzei.

Fromia schultzei Döderlein, 1910. Jena. Denkschr., vol. 16, p. 249; pl. 4, figs. 3–3*b*.

Austrofromia schultzei H. L. Clark, 1921. Echin. Torres Strait, p. 49.

This interesting species is based on a single specimen from False Bay, Cape of Good Hope. Its nearest ally, *A. polypora* H. L. C., occurs on the southern and western coasts of Australia. No nearly related forms are known from the African coast.

* Nardoa variolata.

Asterias variolata Retzius, 1805. Diss. Ast., p. 19. See Linck, 1733, De Stell. Mar., pl. 8, no. 10.

Nardoa variolata Gray, 1840. Ann. Mag. Nat. Hist., vol. 6, p. 286.

This well-known Indo-Pacific species is recorded by Bell from Mozambique, whence Peters also reported it half a century ago. Curiously enough, it has never been well figured, for Linck's figures while recognizable are far from good.

* Linckia laevigata.

Asterias laevigata Linné, 1758. Syst. Nat. ed. 10, p. 662. See H. L. Clark, 1921. Echin. Torres Strait, pls. 9 and 26.

Linckia laevigata Nardo, 1834. Oken's Isis, p. 717.

This handsome sea-star, notable for its colour, so unusual among echinoderms, has been reported from Mozambique by both Peters and Bell.

Linckia multifora.

Asterias multifora Lamarck, 1816. Anim. s. Vert., vol. 2, p. 565.
Linckia multiforis von Martens, 1866. Arch. f. Naturg., Jhrg. 32, Bd. 1, p. 65. See de Loriol, 1885. Mém. Soc. Phys. Hist. Nat. Genève, vol. 29, pl. 9.

This species is reported by Bell from Mozambique, and two young individuals from the same place, taken by K. H. Barnard in November, 1912, lie before me. Some years ago (1908, Bull. M. C. Z. vol. 51, p. 283) I expressed the opinion that *multifora* could only be considered a variety of *laevigata*. Since then I have collected and examined hundreds of *laevigata* near the Great Barrier Reef of Australia and I find its specific characters are very constant. I am inclined to think therefore that *multifora* is probably entitled to rank as a valid species, but its characters still need elucidation.

* Linckia diplax.

Ophidiaster diplax Müller and Troschel, 1842. Syst. Ast., p. 30.
Linckia diplax Lütken, 1871. Vid. Med., p. 269.

This species is reported by Bell from Mozambique. Its status is dubious. It is very near the species so beautifully figured by de Loriol (1885, Mem. Soc. Phys. Hist. Nat. Genève, vol. 29, pl. 10) as *L. ehrenbergii* M. & T., while Ludwig ranks it only as a variety of *L. pacifica* Gray. In my opinion, *pacifica* is identical with the West Indian species, *guildingii* Gray; at any rate, I have not been able as yet to find any tangible difference between them. The Indo-Pacific *Linckias* are badly in need of a careful revision based upon fieldwork, as the study of museum material alone proves very unsatisfactory.

GANERIIDAE.

The presence of this family in this report is due to a very young sea-star which I am unable to refer to any known genus but which seems to belong in the *Ganeriidae*. The specimen was sent to Dr. W. K. Fisher for his examination and he writes: "My guess would be *Cycethra* or a close relative. ..... If the tube-feet have true disks, I think the *Ganeriidae* will be a safe assumption." The tube-feet appear to have true sucking-disks, so I am listing the family *Ganeriidae* in the present report. Most of the members of the family occur in the vicinity of the Straits of Magellan and the Falkland Islands.

The important features of the youngster before me may be listed

as follows: Disk and rays flattened, the general form being distinctly star-shaped but with very obtuse rays. R = 5·5 mm.; *r* = 3 mm.: R = 1·8 *r*; *br* = 3 mm. Abactinal plates relatively few, tabulate, with well-spaced, short rough spines; under a magnification of 40 diameters, they thus appear paxilliform. No madreporite is visible but in each interradius is a small, bare, depressed area, covered only by thin skin. Marginal plates 5 on each side of each ray, in each series; all very much alike; they bear short, rough spinelets, well-spaced as on the abactinal plates. Terminal plate short but wide, roughly kidney-shaped, covered with little spinules, like the abactinal plates. Actinal plates small and rather numerous, each with 2–5 (usually 3) rough spinelets similar to those of the abactinal plates but rather longer; the series next to the adambulacrals runs nearly to the tip of the ray and the second runs to the fourth inferomarginal; the remaining two are very short and carry only 4 (or 3) and 2 (or 1) plates respectively. Adambulacral plates very wide and short and very characteristic; the adoral marginal corner extends inward half-way across the furrow, and at the tip curves abrubtly aborally, thus half-way encircling a large tube-foot with a fairly well-developed sucker; on this furrow-projection of the plate are three relatively long, rough spines, of which the middle one is slightly largest and stands at the bend in the plate, another is at the tip of the plate and the third is between the largest and the furrow-margin; on the actinal surface of each plate is an oblique series of 3 or 4 spines the largest being nearest the furrow and farthest from the mouth; the largest is equal to, or a trifle larger than, the one on the bend of the plate, while the smallest is about equal to the spines on the actinal plates. Oral plates of moderate size, flat but distally rather abruptly raised; on each free margin are four spines, the one at the tip of the jaw, much the largest, flat, wide and truncate, the others progressively smaller, more cylindrical and more slender; on the distal angle of each plate are two spines like those on the actinal plates and proximal to them is a single slightly larger spine.

P.F. 13240. Cove Rock, near East London, N. $^3/_4$ E., 5 miles. 43 fms. St., brk. sh. 1 specimen; very young.

I know of no sea-star with the ambulacral furrow guarded as in this specimen and I have little doubt it represents an undescribed genus. But it is conceivable that with growth the adambulacral armature would become more like that of *Cycethra*, and in any case it seems unwise to base a new genus on so obviously immature a specimen. And in this opinion, I am glad to say, Dr. Fisher fully concurs.

ASTERINIDAE.

This is the best represented in South African waters of any of families of sea-stars, although the present collection contains but seven forms. Eleven of those here listed are *Asterinas* in the wide sense of that term and several of them are very imperfectly known. The group was revised by Verrill in 1913 (Amer. Jour. Sci., vol. 35, p. 477) but owing to an unfortunate mistake one or more paragraphs of his "key" failed to be printed and as a consequence, it is quite useless. Some of his statements also are very summary and many species are not even mentioned. I have not found it practicable therefore to adopt his proposed new genera, though I have no doubt they are destined to come into use when the numerous species of *Asterinidae* are carefully revised. Meanwhile I use *Asterina* in its old broad sense. I regret to have to add two new species and a new variety to this mass of undigested material but there seems to be no other course open. Another new species is a small but interesting *Anseropoda*. Sladen (1889, CHALLENGER Ast., p. 390) records *Asterina gunnii* Gray from the Cape of Good Hope but I feel sure this is a mistake and I therefore omit that species from the present list. The fourteen forms included are separable as follows:

Key to the South African Species of Asterinidae.

Body not very flat and thin; $r = 1{\cdot}25$—2 v. d. at center of disk.
R = 1·8 *r* or more, usually more than 2 *r*.
Actinal intermediate plates, at least near mouth, each with 5 or more spines.
Abactinal plates not imbricated, covered with spines *Parasterina bellula.*
Abactinal plates more or less imbricated.
Actinal intermediate plates, each with a cluster of 8—15 spines *Asterina penicillaris.*
Actinal intermediate plates, each with 5—11 spines in a single, or rarely double, transverse series.
Abactinal plates closely covered with minute, crowded spinelets . . . . . *Asterina granifera.*
Abactinal plates relatively bare, the spinelets scattered, frequently marginal or in a single transverse series *Asterina granifera* var. *sporacantha.*
Actinal intermediate plates, each with 1—4 spines.
Abactinal plates with 5 or more spines and often in addition a tuft of 2—4 stouter spines having a common base *Asterina coronata.*
Abactinal plates not as above . . . *Asterina burtonii.*
R = 1·25—1·8 *r*, only very rarely 2 *r*.

Adambulacral spines 2 (or sometimes 3).

No big subambulacral spine; actinal intermediate plates with 3—6 spinelets . . . . . *Asterina coccinea.*

A big subambulacral spine on the surface of each adambulacral plate; actinal intermediate plates with only 1 or 2 spinelets.

Abactinal spinulation, granuliform.

Abactinal granules coarse; many actinal intermediate plates with 2 spines each; subambulacral spine very large, blunt or truncate . . . . *Asterina dyscrita.*

Abactinal granules rather fine; actinal intermediate plates nearly always with 1 spine each; subambulacral spine not disproportionately big, pointed. . *Asterina exigua.*

Abactinal spinulation spiniform, the spinelets rather long but stout and blunt; actinal intermediate plates usually with 1 spine each; subambulacral spine very large, blunt or truncate *Asterina calcarata.*

Adambulacral spines 3 or 4, with 2 or more spines on the surface of each plate.

Abactinal spinelets thick, blunt, crowded; actinal spines relatively long, blunt . . . . *Asterina lüderitziana.*

Abactinal spinelets short, delicate, sharp, well-spaced; actinal spinelets very similar . . . . *Asterina gracilispina.*

Body very flat and thin; $r = 2{\cdot}5$—5 v. d. at center of disk.

Rays 9 . . . . . *Anseropoda novemradiata.*

Rays 5 . . . . . *Anseropoda habracantha.*

* Parasterina bellula.

Patiria bellula Sladen, 1889. Challenger Ast., p. 385; pl. 63, figs. 1, 2.

The original specimens of this species were taken by the Challenger in shallow water, Simons Bay, Cape of Good Hope. So far as I know it has not been met with since except by the Scotia which took one specimen in Saldanha Bay. Fisher (1908. Smiths. Misc. Coll., vol. 52, p. 90) called attention to the error in using the generic term *Patiria* and suggested *Parasterina*, but he did not publish the combination of the latter name with *bellula*. Sladen emphasizes the non-imbrication of the abactinal plates, using that as the one distinctive character in his key. Fisher does the same in his key to the genera of *Asterinidae* (1911, Bull. 76 U. S. Nat. Mus., p. 253) and as I have never seen an authentic specimen of *Parasterina*, I can only follow in the steps of these eminent predecessors. I may add however that I am not convinced of the great importance of imbrication as a generic character; for the *degree* of imbrication is subject to individual diversity, especially in the long-rayed *Asterinas*. I think the relationship between *Parasterina* and such *Asterinas* as *granifera* and *penicillaris* needs a careful re-investigation.

* Asterina penicillaris

Asterias penicillaris Lamarck, 1816. Anim. s. Vert., vol. 2, p. 555.
Asterina penicillaris von Martens, 1866. Arch. f. Naturg., Jhrg. 32, Bd. 1, p. 74.

This species is very imperfectly known and has never been figured, so far as I can learn. Goto (1914, Mon. Jap. Ast., pt. 1, p. 651) denies its occurrence in Japan and says that the specimens, which Sladen, in the Challenger Report, recorded from Kobé represent a new species which he describes under the name *batheri*. Meissner (1892, Arch. f. Naturg., Jhrg. 58, Bd. 1, p. 187) records five specimens of *penicillaris* from Cape Town. One of these, and a similar one from the Red Sea, are now in the M. C. Z. collection, received in exchange from the Berlin Museum. They seem to me to belong to the following species (*granifera*), which has been rather fully described by Perrier from specimens from Table Bay, Cape of Good Hope. But Perrier makes no reference whatever to *penicillaris* and I am not at all sure that *granifera* and *penicillaris* are not synonymous. At any rate, if distinct, they must be very nearly related.

Asterina granifera.

Plate XVII. Figs. 1, 2.

Patiria granifera Gray, 1847. Proc. Zool. Soc. London, p. 82.
Asterina granifera Perrier, 1876. Arch. Zool. Exp., vol. 5, p. 239.

This is another little known and unfigured species of *Asterina*, recorded as yet only from the Cape of Good Hope. There are a number of *Asterinas* in the Pieter Faure collection which seem to me better referred to this species than to any other. Perrier's description is adequate and I hope the two figures given herewith may serve to make the species easily recognizable henceforth. The specimens before me range in size from R = 20 to R = 45 mm. The smallest specimen has the rays flatter and less tapering that in the larger ones, the abactinal secondary plates and the papulae are fewer in number and the abactinal spinelets are smaller and more pointed; orally there is little difference. The specimens from P.F. 3010 are so similar to the figures and description of *Parasterina bellula* given by Sladen (*l. c.*) that if they were the only ones before me, I should refer them to that species. But I fail to find any character by which they can be certainly distinguished from the others and I must therefore refer them to the older species.

One of the specimens from P.F. 15908 is remarkable for apparently

having *six* rays, but seen from below, it is obviously a 5-rayed specimen in which one ray split very early in life and has since developed as two rather widely diverging rays.

P.F. 3010. False Bay, Cape Colony; littoral. 3 specimens; adult.

P.F. 5008. Rockland Point, False Bay, N.W. 1/4 N., 2 miles. 23 fms. R. 1 specimen; adult.

P.F. 14711. Saldanha Bay, Cape Colony; low tide. 1 specimen; adult.

P.F. 15908. False Bay, Cape Colony. 11 fms. R. 2 specimens; adult.

P.F. 16151. False Bay, Cape Colony. 9 fms. Brk. sh. 2 specimens; young.

Mossel Bay, Cape Colony. 1 specimen; adult, poor.

Asterina granifera *var.* sporacantha*, var. nov.

Plate XVII. Fig. 3.

Three specimens of Asterina, which I am satisfied are but a variety of *granifera*, look so different that I at first believed them a distinct species. The alcoholic specimens are distinctly pinkish and this color is evident when dry, whereas the specimens of *granifera* are yellowish, though sometimes with a pinkish cast. The colour in life of both the type form and the variety is said to be bright orange-red, with the madreporite more or less violet. The chief character however is the spinulation of the abactinal plates; in the typical form these plates are well covered and often densely packed with minute spinelets; in the present variety these plates are more or less bare, the spinelets occurring in marginal or single, transverse series, or irregularly scattered; they are rather larger than in the typical form and are generally acute; the surface of the larger plates where the spines are lacking is more or less evidently shagreened or minutely tuberculated.

I am led to regard this form as only a variety of *granifera* because it occurs at the same stations with the typical from, and in the latter there is more or less individual diversity in the density of the spinulation of the abactinal plates.

The largest of the specimens of *sporacantha* has R = 53 mm., *br* = 23 mm. and *v.d.* = 19 mm.; the form is thus very thick and heavy. The other specimens are less stout in every way but they

* σποράς = scattered + ἄκανθα = spine, in reference to the widely scattered abactinal spinelets.

are nevertheless somewhat stouter than specimens of typical *granifera* of a corresponding size.

P.F. 1268. Cape St. Blaize, N.E. by E., 27 miles. 45 fms. Fne. s. 1 specimen; adult.

P.F. 5008. Rockland Point, False Bay, N.W. $^1/_4$ N., 2 miles. 23 fms. R. 1 specimen; adult.

P.F. 14711. Saldanha Bay, Cape Colony; low tide. 1 specimen; adult.

Holotype, South African Museum, no. A 6419, P.F. 1268.

* Asterina coronata.

Von Martens, 1866. Arch. f. Naturg. Jhrg. 32, Bd. 1, p. 73.

This species, originally recorded from the East Indies, is given by Sladen as occurring at Mozambique. But I have not been able to find his authority for the statement. The species and three varietal forms have been fully discussed by Fisher (1919, Bull. 100 U. S. Nat. Mus., pp. 411–416).

Asterina burtonii.

Gray, 1840. Ann. Mag. Nat. Hist., vol. 6, p. 289.

This widely distributed species, well-figured by Savigny (1809, Desc. l'Egypte. Rayonnés, pl. 4, figs. 2·1–2·8) but without a name, has very generally been called *cepheus*, the name given by Müller and Troschel in 1842. I can find no reason however for rejecting Gray's name. It is true no type specimen is extant but Gray's description is unusually good (*for him*) and I have no doubt as to the *Asterina* he had in hand. Perrier gives *burtonii* as a synonym of *cepheus* without question but calmly ignores its two year's priority! Verrill has recently revived the older name and I follow him therein. It may be mentioned in passing that Perrier (and others) spelled the specific name *cepheus* as *cephea* on transferring it from *Asteriscus* to *Asterina*, overlooking the fact that it is (as Bell pointed out in 1884) a proper noun (Cepheus, the father of Andromeda) and not an adjective.

This species has been known from Mozambique for a long time, and there is a very fine specimen from there in the South African Museum's collection. It was taken by Mr. K. H. Barnard in November, 1912.

Asterina coccinea.

Patiria coccinea Gray, 1840. Ann. Mag. Nat. Hist., vol. 6, p. 290.
Asterina coccinea Perrier, 1876. Arch. Zool. Exp., vol. 5, p. 234.

This is another of the unfigured and little known species of *Asterina*. Perrier's description, based on material in the British Museum, where

there are said to be many specimens, supplies some of the deficiencies of Gray's inadequate diagnosis, but is not wholly satisfactory. He says the species is pentagonal, and then that R = *r*; of course if R = *r*, the outline is approximately circular; probably R = 1·25 *r*. Of the ambulacral spines, he says they are arranged in a single series; if this were true, the species would be unique; if it means the furrow series only it is true of all *Asterinas*; if it refers only to the actinal surface of the plate it would be distinctive; but there is no way of determining just what is meant. Bell records this species in his South African Report, 1905, as occurring at three stations, but he gives no information about the material and there is reason for doubting whether he examined the specimens carefully. Some at least seem to have been the following species, ***dyscrita.***

Asterina dyscrita *, sp. nov.

Plate XVI. Figs. 5, 6.

R = 14 mm.; *r* = 11 mm.; R = 1·3 *r*; *v. d.* = 5·5 mm. General form pentagonal with slightly concave or notched sides, rather thick. Abactinal plates scarcely distinguishable under the covering of coarse, spherical granules; these are ·20–·35 mm. in diameter and occur 4–10 on each plate; the plates or at least the groups of granules, are arranged very regularly in longitudinal series, radially, and hence in diagonal series, interradially. Papulae fairly numerous but small, not so large as most of the granules.

Actinal intermediate plates numerous, in regular series parallel to ambulacral furrows, and hence forming oblique series running to the margins; each plate of the series adjoining adambulacrals carries a single, stout, bluntly pointed spinelet; in the next series, a few plates carry two spinelets but most have only one; in the following series, nearly all the plates carry two; the size of the spinelets decreases from the adambulacrals outward.

Adambulacral armature consists of two (or very rarely three) furrow spinelets, and a single large subambulacral spine, on the actinal surface of each plate; furrow spinelets slender, ·75–·80 mm. long, subequal; subambulacral spine, nearly a millimeter long, stout, slightly flattened, blunt or almost truncate.

Oral plates each with 6 or 7 marginal spines and with one large, blunt spine on the actinal surface near the middle; the innermost spine (one of the pair at tip of jaw) is a millimeter long, stout, flat

* δύσκριτος = hard to determine, in reference to its doubtful status.

and truncate; the next is rather smaller in every way; the remainder are very markedly smaller and are pointed.

Colour in life, various shades of green, mottled with specks of red, blue, yellow etc.

P.F. 10004. Between River and Sebastian Bluff, nearer the former; low tide. 2 specimens; adult?

Holotype, South African Museum, no. A 6420.

These two specimens were sent to me with the label: "*Asterias coccinea.* Bell's no. 10004. (Not seen by Bell)." There is also a note saying: "These have not been actually seen by Bell, but are taken from a bottle with the same number as given by Bell in his Reports". Of course, it is obvious from the appearance of the actinal surface that these specimens are not *coccinea.* They are closely related to both *exigua* and *calcarata* but are readily distinguished from either of those species by the armature of the oral plates, and the very coarse, nearly spherical granules of the abactinal surface. I find no species as yet described to which they are any nearer and I have therefore described them as new, but it is possible that they will prove to be only a variety of *exigua.*

* Asterina exigua.

Asterias exigua Lamarck, 1816. Anim. s. Vert., vol. 2, p. 554.
Asterina exigua Perrier, 1876. Arch. Zool. Exp., vol. 5, p. 222.

This widely distributed Indo-Pacific species was collected at the Cape of Good Hope nearly a century ago and has also been reported from Natal. There are no specimens in the South African Museum but the Museum of Comparative Zoölogy has a specimen labelled Cape of Good Hope, received many years ago from the "Huguenot Seminary, South Africa". It is reported in numbers by Döderlein from Angra Pequena Bay.

* Asterina calcarata.

Asteriscus calcaratus Gay, 1854. Hist. fis. pol. Chile. Zool., vol. 8, p. 427.
Asterina calcarata Perrier, 1876. Arch. Zool. Exp., vol. 5, p. 222.

Koehler (1908, Trans. Roy. Soc. Edinburgh, vol. 46, p. 632) records this species from two stations on the Cape Colony coast. He says he has compared the South African specimens with others from Chile and is sure they are identical. He also states that one specimen had 6 rays. Such a 6-rayed specimen is probably the basis of the record of *A. gunnii* from South Africa.

It is obvious that ***exigua***, ***dyscrita***, ***calcarata*** and ***gunnii*** are closely related forms which need much more careful comparative study than has been possible as yet. It is by no means clear how a 6-rayed individual of ***calcarata*** is to be distinguished from ***gunnii***.

ASTERINA LUDERITZIANA.

Döderlein, 1908. Jahrb. Nass. Ver. Naturk. Wiesbaden, Jhrg. 61, p. 296; pl. 2.

This well-characterized species is represented in the present collection by two specimens from Walfish Bay, some distance north of the type-locality at Angra Pequena.

ASTERINA GRACILISPINA*, sp. nov.

Plate XVI. Figs. 3, 4.

R = 6 mm.; $r = 4$ mm.; R = 1·5 r.; *v. d.* = 2·75 mm. Rays 5. Abactinal plates arranged in half a dozen distinctly imbricating series on each ray and a few additional plates at the interradial margin; secondary plates few and confined to center of disk. Each abactinal plate has the free surface covered with well-spaced minute, short, sharp spinelets. Papulae rather large, in about eight series on each ray but many series are very incomplete. Seen from above there is no evident marginal fringe of spinelets. No madreporite can be seen.

Actinal intermediate plates not very numerous, 50–60 in each interradial area, but most of these are small plates near the margin; each plate carries a single transverse series of 3–5 delicate spinelets, of which the middle ones are longest; those near mouth are ·40 mm. long but they become smaller and smaller as the disk margin is approached. In many series the spinelets appear united by a web.

Adambulacral armature in two series, as usual; the furrow series is made up of 3 or 4 slender, pointed spinelets, the middle ones half a millimeter long, united by a web; the series on the actinal surface of the plate is similar but is placed obliquely or almost directly at right angles to the furrow margin; there are rarely, if ever, more than three spinelets in this series and they are smaller than the furrow series.

Oral plates, each with five spines on the free margin and two spines on the actinal surface; of the marginal spines, the proximal two are large and flat, somewhat truncate while the other three

* *gracilis* = delicate + *spina* = spines, in reference to the delicate spinulation.

are noticeably smaller, more terete and pointed; the pair on the surface of the plate is placed transversely across the plate; each is about the size and shape of one of the larger spines of the furrow series of an adambulacral plate.

Colour (dried) dull pinkish.

P.F. 13280. Coke Rock, N. E. by E. $^1/_2$ E., 4 miles. 22 fms. R. and brk. sh. 1 specimen; young.

Holotype, South African Museum, no. A 6421.

I have been at a loss to know what to do with this little *Asterina*. I could not find a species to which it might be assigned properly, yet I hesitated to base a new species in so undigested a genus on a single small specimen. I am driven however to the latter course, as the only one which is justifiable. Moreover I do not know to what section of the genus it is most nearly related, for its spinulation is very characteristic and quite unlike any other Sonth African species of similar form. It is however not impossible (though highly improbable) that the present specimen is a very young stage of *A. granifera*. Abundant material, of early stages of that species, alone will tell. The apparent absence of a madreporite may be an indication of very early youth.

* Anseropoda novemradiata.

Palmipes novemradiatus Bell, 1905. Mar. Inv. South Africa, vol. 3, p. 248.

Although Bell was one of the first writers to point out the priority of *Anseropoda* over *Palmipes*, when he came to name his new species from South Africa, he lacked the courage of his convictions. Moreover he gives such a very inadequate description that were it not for the unusual number of rays, his species would be quite unidentifiable. His statement that "no *Palmipes* is known with more than five rays" ignores *Anseropoda rosacea* Lamk. which has 15 or 16 rays and has been known for a hundred years!

Anseropoda habracantha *, sp. nov.

Plate XVII. Figs. 4, 5.

R = 16 mm.; r = 11 mm.; R = 1·45 r; *v. d.* = 3·5; $r = 3$ *v. d.* Rays 5. Form as usual in the genus, the central portion of the disk and median area of each ray rather abruptly elevated above the thin, flat interradial regions. Abactinal plates very numerous,

* ἁβρός = delicate + ἄκανθα = spine, in reference to the delicate spinulation.

crowded, arranged in very regular longitudinal and diagonal series, their outlines hidden under the spinelets; each plate carries a tuft of 10–20, slender radiating spines about half a millimeter long; the plates of the median radial series are largest. No madreporite is visible. Of papulae, a single series can be detected on each side of the median radial series of plates.

Actinal intermediate plates in regular series; each carries a transverse series of long, very slender spinelets; on the larger plates, this series consists of 8–10 spinelets, the middle ones a trifle the longest and nearly a millimeter long; on the smaller plates, as the margin is approached the spines become fewer and shorter.

Adambulacral armature consists of a furrow series of 4 (or 3) spines and an actinal series of about 5 spines; the middle spines of the furrow series are longest, exceeding a millimeter; all are webbed on the basal half; the second spine of the actinal series, which is oblique or distinctly curved, is much the longest, as a rule, and considerably exceeds a millimeter; these actinal spines are also webbed basally. All the adambulacral spines are exceedingly delicate and most of them are more or less broken and crushed.

Oral plates, each with a marginal series of 6–8 long slender spines, the innermost longest, and a surface series of 6–8 slightly smaller spines placed longitudinally on the plate.

Colour (dried) very pale woodbrown.

P.F. 909. Off East London, Cape Colony, 33° 6′ S. × 28° 11′ E., 85 fms. 1 specimen; young.

Holotype, South African Museum, no. A 6425.

It is a pity there is only a single young specimen of this interesting species. It seems to be nearest to ***A. placenta*** (Penn.) of Europe but comparison with small specimens of that species shows it to be quite distinct. The abactinal spinelets are much longer, giving a very different appearance to that surface. Orally too the spinulation is finer and more crowded.

ECHINASTERIDAE.

This family is poorly represented in South African waters, only three species being present in the collection before me, and no others have been recorded hitherto. Bell (1905) lists ***Henricia ornata*** and a species of ***Echinaster***, concerning which he says only that the two specimens do not "link on" to any known species. He considers that they "closely resemble" a specimen from Port Natal, long in the British Museum, which he is "unable to determine". In spite then of having three available specimens, he not only does not describe

the new species, but neglects to give a single character by which it may be recognized. It is quite possible that it is the species described beyond as *E. reticulatus* but, at present, there is no means of knowing. The three members of the family represented in the collection of the South African Museum may be distinguished from each other as follows:

Key to the South African Species of Echinasteridae.

Abactinal plates with numerous very small spinelets . *Henricia ornata.*
Abactinal plates with isolated spines or tubercles.
Rays short, inflated, with very large papular areas . *Poraniopsis capensis.*
Rays long, terete, with small papular areas . *Echinaster reticulatus.*

Henricia ornata.

Echinaster* (*Cribella*) *ornatus Perrier, 1869. Ann. Sci. Nat., vol. 12, p. 251.
Henricia ornata Bell, 1905. Mar. Inv. South Africa, vol. 3, p. 250. Döderlein, 1910, Jena. Denksch., vol. 16, p. 252; pl. 4, figs. 2–2*a*.

In view of the extraordinary diversity which ***Henricia sanguinolenta*** shows in nearly every character upon which species may be based, it would be most unwise to attempt to differentiate the natural forms of ***Henricia*** occurring in the southern temperate zone, without far more material than is at present available. Bell was wise in referring all his specimens to ***ornata*** and it would be foolish for me to do otherwise with the few in the present collection. They agree with each other well and there is no doubt they represent a single species. It is not so sure whether they are really ***ornata*** or not, but there is really little reason to doubt that, since the Cape of Good Hope is the type-locality for that species.

The individuals at hand are all well-grown, R = 34–44 mm. One individual has six subequal rays which are relatively stouter and less tapering than in the others.

S.A.M. No. 3011. Cape Colony: False Bay. Littoral. Dr. Purcell. 5 specimens.

Poraniopsis capensis *, sp. nov.

Plate XV. Figs. 3, 4.

R = 27 mm.; $r = 13{\cdot}5$; R = $2r$. Disk large and inflated, Rays short, wide and inflated, about 16 mm. long and 13 mm. wide at base, triangular in outline. Abactinal skeleton rather weak, with very large papular areas; on many of these areas are minute, scat-

* *Capensis* = of the Cape, in reference to the general locality whence the type specimen came.

tered, calcareous plates, a few of which carry very small spinelets. Abactinal plates with scattered spines, 1–2 mm. long, thick and pointed; these spines do not show any serial arrangement either longitudinal or transverse. Along the sides of the ray, limiting the ventral surface is an indistinct series of inferomarginal plates, each of which carries a single spine about 2 mm. long. Actinal interradial areas rather large, traversed by about five series of more or less imbricated plates, between which is thin, naked skin. Madreporite conspicuous, 2 mm. across.

Adamulacral plates, each with two spines, of which one, usually much the smaller, is on the somewhat projecting inner margin of the plate, while the other, which may be 2·5 mm. long, is on the actinal surface of the plate; these spines are either blunt or pointed, are often flattened and are more or less irregular in both size and position. Actinal intermediate plates do not extend half the length of the arm and are usually quite bare; in no interradial area are there more than half a dozen scatterd spines. Oral plates rather large, very little swollen; each carries a large, pointed flat spine at its inner end, a larger, blunt spine on the surface posteriorly and about three much smaller, sharp spines, or spinelets, on the free margin. Colour (dried) light yellow-brown, the bare skin darker than the plates.

P.F. 2798. Vasco de Gama Peak, N. 71° E., 18 miles. 230 fms. Stones. 1 specimen.

Holotype, South African Museum, no. A 6416.

This interesting little starfish is very near the type-species of the genus, *P. echinaster*, from 53 fms. in Nassau Bay, Tierra del Fuego. It differs in the presence of only one spine on each inferomarginal plate, the lack of any serial arrangement of the abactinal spines, and the seemingly thinner skin. These differences are not important and a good series of specimens may show that the two forms are identical. But it is not desirable to list the South American species from South Africa until the identity is fully demonstrated and I have therefore given the African form a distinguishing name, for the present.

Echinaster reticulatus *, sp. nov.

Plate XV. Figs. 1, 2.

R = 75 mm.; r = 15 mm.; R = 5r; br = 17 mm.; R = 4·5br. Disk rather small; arms terete, but slightly flattened. Abactinal skeleton markedly reticulate, the papular areas quite small, and in

* *reticulatus* = netted, in reference to the network formed by the abactinal plates.

the holotype, quite depressed. The whole animal is covered with a rather thick skin, but this does not greatly obscure the abactinal skeleton. Abactinal plates carry numerous isolated spines, about a millimeter high, sharp-pointed, but with the basal half imbedded in a collar of the thick skin; when the tip is broken off or is undeveloped the spine has the appearance of a flat-topped tubercle. Madreporite small, sunken, near center of disk.

Actinal interradial areas small, with few plates, each of which carries a single spinelet, more or less imbedded in the skin. Adambulacral plates, short and numerous, as usual in the genus. Each plate bears a small furrow spine and a transverse series of three (often two) spines, which appear thick and blunt from their skin-covering; the spine on the furrow margin is longest and least blunt, the second is stoutest and bluntest, the third is distinctly the smallest. Outside the adambulacral plates, the spinulation is irregular and resembles that of the abactinal surface, but in some places there are two indistinct longitudinal series of spinelets next to the adambulacral plates; here and there a third spine accompanies these in such a way that there is a transverse comb of three spines adjoining the adambulacral series. Papulae are numerous on the actinal surface, even adjoining the adambulacral plates. Oral plates ill-defined; each bears three spines on the margin, similar to and scarcely larger than the adambulacral spines; on the surface of each plate, there is one, and frequently there are two, thick blunt spines. Colour, in alcohol, bright yellow-brown, the spinelets yellow, at least at tip.

P.F. 13509. Cape Morgan, Cape Colony, W. $^1/_2$ N., 3 miles. 17–20 fms. Rocks. 1 specimen; adult.

P.F. 15602. False Bay, Cape Colony, 18–25 fms. Sand. 1 specimen; adult.

Table Bay, Cape Colony. 1 specimen; adult.

Holotype, South African Museum no. A 6423. P.F. 15602.

The three *Echinasters* which I here list under the new name ***reticulatus*** are so unlike each other at first glance that I supposed each represented a different species, but after careful comparison I have decided it is probable the superficial differences are largely due to differences in preservation. The holotype is in fine condition and was undoubtedly living when put in alcohol but in one particular, it is imperfect, for most of the abactinal spinelets have the tips missing, so that they appear like low tubercles, and as they are quite nnmerous, they make the reticulations of the skeleton very conspicuous. In some cases, it is clear that the tip of the

spinelet was broken off but as a rule the tubercles seem never to have had a pointed tip.

The specimen from Table Bay looks very different. It was apparently not preserved until it had been dead for some time, so that the spines and spinelets are seldom erect but are appressed to the body wall; as they are whitish while the skin is deep brown, the coloration is quite different from that of the holotype. The abactinal spinelets are fewer than in that specimen while the adambulacral spines are more numerous (often 4 on a plate) and more slender. The double series of actinal spinelets just outside the adambulacrals is quite distinct. The reticulation of the skeleton is not at all distinct except on the distal halves of the rays, abactinally.

The specimen from off Cape Morgan is slightly smaller than the others and much lighter coloured. It is uniformly light wood-brown, the spines not much lighter and hence not in contrast. The reticulation is not so marked as in the type, partly because the skeletal plates are wider and the papular areas smaller, and partly because the abactinal spinelets are fewer and are well-spaced. The madreporite is very small and hard to find. Actinally the specimen is much like the holotype except that the spines are smaller and more slender; many adambulacral plates have only two spines, in addition to the furrow spine; the oral plates on the contrary, may have four marginal spines instead of three.

On the whole, *reticulatus* is no more variable than some of the other species of the genus and I think there is little doubt that these three specimens are really a single species. It is evident that if the genus *Othilia* is to be recognized because of the actinal papulae, *reticulatus* is an *Othilia*. On the other hand, it is superficially very near the Mediterranean *sepositus*, which is a typical *Echinaster*. It differs from *sepositus*, not only in the matter of the papulae but in the adambulacral armature. This latter feature also distinguishes *reticulatus* from several other *Echinasters* to which it is nearly allied.

CRYASTERIDAE.

This small family was instituted in 1906 by Koehler for some remarkable starfishes taken by the first French Antarctic Expedition. Additional specimens were secured by the second expedition in 1908–09, one of which represented a second species. The genus *Cryaster* is distinguished especially by the almost complete absence of a skeleton; only along the ambulacral furrows are connected calcareous ossicles present. This character is so unusual that Koehler

considered it necessary to institute a new family for the reception of the genus. The French expeditions took *Cryaster* far to the south of Tierra del Fuego, and the Shackleton expedition took it near South Victorialand, even further south from Australia. The occurrence of two specimens, which are certainly of the same family, in the PIETER FAURE collection, from shallow water in Algoa Bay, is thus of unusual interest. These individuals are obviously different from the Antarctic species but there seems to be no reason why they should not be placed in the same genus.

CRYASTER BRACHYACTIS *, sp. nov.

Plate XI. Figs. 1, 2.

R = 40 mm.; *r* = 25 mm.; R = 1·6 *r*; *br* = 27 mm. Disk very large, thick (*v. d.* = 18 mm.), dorsally flat, orally convex. Rays 5, short, wide, thick and bluntly pointed. Abactinal surface covered by a leathery body wall, a millimeter thick, in which are imbedded innumerable minute plates, each of which carries one (seldom two, very rarely more) sharp, rough spinelet, half a millimeter long; the entire upper surface is thus quite uniformly, minutely prickly. Papulae minute, very numerous, but not uniformly distributed. Seen from the inner side the abactinal body wall has the appearance of a decalcified wall in which there had been a well-developed reticulate skeleton, and the papulae are confined to the meshes of this leathery reticulation. There is however no evidence whatever of decalcification having occurred anywhere. Madreporite not conspicuous, 3 mm. across, situated about half way between the margin and center of disk.

Actinal intermediate areas large, without calcareous plates, spinules or papulae; the surface is somewhat wrinkled or folded in radial series but very superficially. The boundary between the actinal and abactinal surfaces is well-marked by a series of rather large plates buried in the skin, most of which carry several small sharp spinelets but some are armed with spines 1·5 mm. long and nearly ·5 mm. thick at base. Adambulacral plates numerous, short, wide and well developed; each plate bears on the furrow margin a stout, sharp, somewhat flattened spine, 1–2 mm. long; on a few plates here and there, this spine has distal to it, a smaller and more slender spine; on the surface of each plate is a second spine, equal to or larger than the first and very rarely a third spine, somewhat smaller, occurs at the outer end of the plate; none of these adambulacral spines

* *βραχύς* = short + *ἀκτίς* = ray, in reference to the very short rays.

are sufficiently clothed with skin to be called saccate. Oral plates flat, very small, each with four subequal spines (about 1·5–2 mm. long) on the free margin; occasionally a similar spine occurs on the surface of the plate. Pedicels in two series in each furrow. Ampullae large but single. Color (in alcohol) light brown, with a reddish-tinge orally; in life brilliant scarlet.

P.F. 18771. St. Croix Island, Algoa Bay, N.W. $^3/_4$ W., 8 miles. 26 fms. M. 1 specimen; adult?

P.F. 19055. Nanquas Peak, Algoa Bay, N. by E., 11 miles. 57 fms. M. 1 specimen; adult.

Holotype, South African Museum no. A 6412; P.F. 19055.

One ray of the holotype shows a curious malformation, due to the forking of the ambulacrum about 12 mm. from the tip. This is obvious in the figure.

The specimen from 18771 is remarkable for the extreme contraction of the dorsal body wall, which is evidently very muscular. The rays are drawn up into an almost vertical position, so that, although each ambulacral furrow is 38 mm. long, the disk is only 23 mm. across, and from the tip of one ray to that of the next-but-one is at most only 32 mm. In all essentials of structure however this specimen agrees very closely with the holotype.

This remarkable starfish is readily distinguished from the other two members of the genus by the very short rays and the adambulacral armature. All three species are mud dwellers in shallow water but the occurrence of what was supposed to be a distinctly Antarctic genus in Algoa Bay is certainly of unusual interest. The two Antarctic species are much larger than the African and their longer rays give them quite a different appearance.

SOLASTERIDAE.

This family is best represented in the colder waters of the northern hemisphere. Only one species is recorded from the South African region. That and an undescribed species of *Lophaster* are in the Pieter Faure collection. They may be distinguished from each other easily by the number of rays. There is also in the collection a dried, 9-rayed specimen of *Solaster endeca* with the label: "? *Palmipes novemradiatus* J. Bell. Loc.? No number. (P.F. coll.)". It is highly improbable that this particular specimen was ever taken by the Pieter Faure. The species *might* occur in South African waters but it is not known south of the equator.*

* This specimen is undoubtedly South African, it being labelled as a duplicate of specimens sent to Prof. Bell [Ed.].

Key to the South African Species of Solasteridae.

Rays 8—10	*Crossaster penicillatus.*
Rays 5	*Lophaster quadrispinus.*

Crossaster penicillatus.

Sladen, 1889. Challenger Ast., p. 446; pls. 70, fig. 5 and 72, figs. 9, 10.

Although the largest of these individuals is much larger than Sladen's types, and has the rays relatively much more slender than in his figure, there is no reason to doubt their identity. Bell (1905) lists this species from half a dozen stations but gives no data whatever about the specimens. In the present collection, only two extremes of age are represented, young ones with R = 10–15 mm. and big adults with R = 55–60 mm. It is very interesting to find that of the ten young, two have only 8 rays and eight have 9, while of the five adults, only one has 9 rays and four have 10. This suggests that 10 is the normal number of rays in the species and that smaller numbers are growth-stages.

P.F. 17965. Cape Point, N. 41° E., 38 miles. 315–400 fms. S., bl. sp. 10 specimens; young.

P.F. 18206. Cape Point, N.N.E. $^1/_4$ E., 14 miles. 100 fms. Gn. m. 5 specimens; adult.

Lophaster quadrispinus *, sp. nov.

Plate XVIII. Figs. 1, 2.

R = 70 mm.; r = 20 mm.; R = 3·5 r; br = 20 mm. Disk rather large, flat but quite high (*v. d.* = 10 mm.) Rays 5, rather flat, tapering steadily to the pointed tip. Abactinal skeleton with rather small meshes, the papular areas usually with only 3–5 papulae. Paxillae relatively few and widely spaced, the distance between two about equal to height of column; each paxilla bears a tuft of 10–12, or more, long, slender spines, about equal to the column. Madreporite large, about 3 mm. across, nearer to center of disk than to margin. Marginal plates about 23 in each series, the superomarginals above and not alternating with, the lower series. Marginal paxillae similar to the abactinal but abruptly much larger and correspondingly conspicuous.

Actinal interradial areas fairly well developed; a series of actinolateral plates adjoining the adambulacrals, 25—30 in number, extends

* *Quadrispinus* = having four spines; in reference to the furrow series of the adambulacral armature.

nearly to the tip of the ray; proximally they are close together and there is one for each adambulacral plate but distally they are more and more widely spaced and there is only one for every other adambulacral; these plates carry a central tuft of slender spinelets; remainder of the interradial area covered by 8–12 similar but smaller plates, each with a central tuft of long slender spinelets. Adambulacral plates two to each inferomarginal, as a rule, short, moderately wide, well-spaced, the spaces often wider that the length of the plates; each plate carries on its furrow-margin 4 long slender spines, the relative lengths of which it is very hard to determine as they are all more or less broken; from the middle of the ray on, there are usually only 3 spines and near the arm-tip there are only 2; on the actinal surface of each adambulacral plate is a series of 4 (or 3 or 2) similar but slightly stouter spines, arranged in an oblique series corresponding to the width of the plates; these spines are also generally broken. Oral plates large rounded, much swollen along the suture distally; the margin of each carries 8 or 9 slender spines of which the one at tip is longest and stoutest; on the sutural swelling is a series of about 4 similar but stouter spines, the *innermost* largest. Membranes cover the actinal plates and spines, but they are thin and unite the spines with each other very slightly. Tube feet large, with well developed suckers. Colour yellowish-brown (dry) with a more or less pinkish cast in alcoholic specimens.

P.F. 2798. Vasco de Gama Peak, Cape Peninsula, N. 71° E., 18 miles. 230 fms. St. 1 specimen; young.

P.F. 15060. Lion's Head, Cape Town, S.E. $^1/_4$ S., 50 miles. 230 fms. Gr. s. 2 specimens; adult.

Holotype, South African Museum no. A 6426; P.F. 15060.

The discovery of a typical *Lophaster* in South African waters is very interesting, and the interest is increased by the fact that it is much nearer to *L. furcilliger* Fisher of the eastern North Pacific ocean than it is to *L. stellans* Sladen from the western coast of Patagonia. It differs from *stellans* in the body-form, the length of the paxillar and adambulacral spinelets and the much more numerous actino-lateral plates. From *furcilliger* it is more difficult to separate it, but the actinal intermediate areas are distinctly larger, four furrow spines are more generally present and the abactinal skeleton appears to be much stouter. From *antarcticus* Koehler, it differs in the much more numerous adambulacral plates, in having only one actino-lateral plate to each inferomarginal and in the armature of the oral plates.

The young specimen from 2798 has R only a little more than 20 mm. long; the rays are flatter, blunter and less tapering; the

actinal intermediate areas are relatively smaller; but the adambulacral armature is essentially the same, and the paxillae spinelets are characteristically long. The specific characters are thus well shown even in very small specimens.

PTERASTERIDAE.

This remarkable family of starfishes is well represented in South African waters, since two species occur in shallow water and half a dozen others are found further off shore. The family is a puzzling one and the limits of the typical genus are ill-defined. So far as the South African species are concerned, *Retaster* and *Diplopteraster* are excellent genera, sharply set off from each other as well as from *Pteraster*. But when all the known species are considered the line between *Retaster* and *Pteraster* becomes exceedingly hard to draw and that between *Pteraster* and *Diplopteraster* tends to become very hazy. So far as I can see, *Retaster* and *Diplopteraster* are quite distinct from each other and easy to separate, and it is strange Sladen should have united them.

Key to the South African Species of Pterasteridae.

Armature of adambulacral plates forming transverse combs, the spinelets united by a membrane.

Adambulacral plates alike, equally prominent and equally armed; pedicels in 2 series.

Paxillar spinelets united by conspicuous, ligamentous bands, forming a heavy reticulum, each mesh of which forms a sharply defined area, containing numerous small spiracles; R much exceeds $2r$ *Retaster cribrosus.*

Paxillar spinelets united by slender fibres, often very indistinct, not forming a regular reticulum; spiracles more or less scattered; R = $2r$ or less.

R = $1{\cdot}5r$; oral spines, 5—7; adambulacral spines, 5—7 *Pteraster capensis.*

R = $2r$; oral spines, 4; adambulacral spines, 4 *Pteraster affinis.*

Adambulacral plates unlike, a more prominent regularly alternating with a less prominent; latter with fewer adambulacral spines; pedicels in 4 series *Diplopteraster multipes.*

Armature of adambulacral plates not forming webbed combs; spinelets free.

Adambulacral armature of 3 spinelets.

Supradorsal membrane not very thin; fibres connecting paxillae indistinct; 3 oral spines on free margin of each plate . *Hymenaster latebrosus.*

Supradorsal membrane very thin; fibres connecting paxillae conspicuous; 4 or 5 oral spines on sides of each plate . *Hymenaster membranaceous.*

Adambulacral armature of fewer than 3 spinelets.

Adambulacral armature of 2 spinelets . *Hymenaster lamprus.*

Adambulacral armature of a single spinelet. *Hymenaster gennaeus.*

* Retaster cribrosus.

Pteraster cribrosus von Martens, 1867. Arch. f. Naturg., Jhrg. 33, Bd. 1, p. 109; pl. 3, figs. 2–2*c*.

Retaster cribrosus Sladen, 1889. Challenger Ast., p. 477.

When Perrier instituted his genus *Retaster* in 1878, he gave a very indefinite diagnosis, mentioned no species by name and speedily forgot his own creation, ignoring it entirely in his faunal lists. Sladen revived it and added a number of species but so far as I know no type has ever been designated and all workers have found it difficult to draw a satisfactory line between *Retaster* and *Pteraster*. If however we take *cribrosus* as the type (and I herewith so designate it), the difficulty greatly diminishes, if it does not wholly disappear. For *R. cribrosus* is a well-marked form, easily distinguished from typical *Pteraster* by the nature of the supradorsal reticulum, which is made up of ligamentous bands, becoming quite hard when dry, though apparently not calcified. Each mesh of the reticulum is a sharply defined spiracular area, with numerous small spiracles. The adambulacral plates are like those of *Pteraster* and similarly armed with a transverse webbed comb but the actinolateral spines are notably short. If we accept the character of the dorsal reticulum as the real basis for generic separation from *Pteraster*, we find that *Retaster* is a small genus with few species. Sladen lists seven species but of these only *insignis* seems to me congeneric with *cribrosus*, although *gibber* may perhaps also belong with them. Aside from these, I find no representatives of the same type of structure among all the species of *Pterasteridae* known. The other so called *Retasters* should, I think, be relegated to *Pteraster*. Von Martens records *cribrosus* from Mozambique but it is not known from south of that point. It seems to be one of the characteristic sea-stars of Zanzibar.

Pteraster capensis.

Plate IX. Figs. 3, 4.

Gray, 1847. Proc. Zool. Soc. London, p. 83.

Bell (1905) records this species under the name *Retaster capensis* from seven stations on the South African coast chiefly in shallow water. But he gives no data whatever in regard to the specimens. In the collection sent me are two large *Pterasters* from False Bay (one of the stations noted by Bell) labelled "*Retaster capensis*"? With these is the note: "We have no specimens of *Retaster capensis* bearing numbers similar to those given by Bell, but two supposed specimens

of this species are sent from False Bay, 20–30 fms". Besides these two, there are nine other *Pterasters* from half a dozen stations which seem to be identical with them. As this is evidently the common pterasterid of South Africa, I should have no question about considering it Gray's species (it answers his brief description satisfactorily) were it not that Perrier, who had seen Gray's specimen, says that *capensis* and *cribrosus* agree in having "un réseau à large mailles formées de ligaments unissant les épines," etc. The specimens at hand differ from *cribrosus* strikingly in the absence of such a reticulum, except in the outer part of the actinal interradial areas. Either Perrier was mistaken, or *capensis* is very variable in the extent to which the meshwork is developed, or the specimens before me are not *capensis*.

It is an interesting and surprising fact that these South African *Pterasters* which I am here calling *capensis*, can be distinguished only with great difficulty from specimens of the same size, of *Pteraster tessellatus* Ives from Puget Sound! In fact after careful comparison, the only constant difference seems to be in the structure of the paxillae: in *capensis* each paxilla has a single central spinelet of a size about equal to the surrounding series of 6 or 7 similar spinelets, while in *tessellatus* instead of this central spinelet is a cluster of smaller and more slender spinelets. This difference is not conspicuous but it seems to be constant and is certainly important.

Some specimens of *capensis*, and of *tessellatus* also, have a well marked reticulum along the lower sides of the rays. It is possible, though I have no evidence to support the view, that there is much variation in the extent of this reticulum and the British Museum type may possibly have it developed dorsally. But if this proves to be so, it will be useless to try and maintain *Retaster* as a separate genus.

The specimens before me range from R = 53 and $r = 40$ mm. ($R = 1{\cdot}325\,r$), to R = 19 and $r = 12$ ($R = 1{\cdot}6\,r$). One specimen has R = 36 and $r = 20$ ($R = 1{\cdot}8\,r$) which is the extreme arm-length for the group in which *capensis* and *tessellatus* belong.

P.F. 2336. Lions Head, Cape Town, N. 67° E., 25 miles. 131–136 fms. Blk. spks. 1 specimen; small adult.

P.F. 2429. Lions Head N. 84° E., 38 miles. 195–204 fms. Blk. spks. 2 specimens; small adults.

P.F. 14532. Cape Point N. 50° E., 18 miles. 180 fms. Gn. s., blk. spks. 2 specimens; young.

P.F. 18154. Cape Point N.E. by E. $^3/_4$ E., 18 miles. 200 fms. Fne. s. 1 specimen; young.

P.F. 19054. Nanquas Peak, Algoa Bay, N. by E., 11 miles. 57 fms. M. 2 specimens; adult.

False Bay, Cape Colony, 20–30 fms. 2 specimens; adult.

Mossel Bay, Cape Colony. 1 specimen; adult.

Bathymetrical range, 20–204 fms.

Colour in life: dark or pale violet, either uniform or with a dark angular ring on the upper surface on a paler ground colour.

Pteraster affinis.

E. A. Smith, 1876. Ann. Mag. N. H. (4), vol. 17, p. 108.
1879, Phil. Trans., vol. 168, pl. 16, fig. 5.

The specimen before me has R = 28–30 mm., r = 15 mm., so that R = 1·8–2 r. It is thus considerably larger than Smith's type but it agrees with his description so well that I have no doubt it is the same species. The colour in alcohol is light dingy yellow.

P.F. 2798. Vasco de Gama Peak, Cape Peninsula, N. 71° E., 18 miles. 230 fms. St. 1 specimen; adult, probably.

Diplopteraster multipes.

Pteraster multipes M. Sars, 1865. Forh. Vid. Selsk. Christiana, p. 200.
Fisher, 1911. Bull. 76 U. S. Nat. Mus., pl. 107.

The occurrence of this northern species off the Cape of Good Hope is indeed remarkable. One of the specimens has R = 25 mm. and the other has R = 55 mm. I have compared them with a specimen, taken in 207 fms. off the northeastern coast of the United States, and there is no doubt, in my mind, of their identity. Fisher (*op. cit.* p. 371) has given a key to the three known species of *Diplopteraster* and these specimens run down at once to *multipes*. One would naturally expect one of the two southern species to be the South African form. Sladen can hardly have compared this species with *Retaster cribrosus* when he placed *Diplopteraster* in the synonymy of *Retaster*.

P.F. 14532. Cape Point N. 50° E., 18 miles. 180 fms. Gn. s., blk. spks. 2 specimens; 1 adult and 1 young.

Hymenaster latebrosus.

Sladen, 1882. Jour. Linn. Soc. London (Zoöl.), vol. 16, p. 230.
1889, Challenger Ast., pl. 92, figs. 4, 5.

The single specimen, which I refer to this species, has R = 27 mm. and r = 15 mm., but two of the arms seem to have been bitten or

broken off at some time and are partly regenerated; they are only 15 mm. in total length. This individual is thus somewhat larger than Sladen's type which was taken in the Antarctic Ocean, far to the south of West Australia, in 1950 fms. The South African specimen agrees well with Sladen's description and figure, except that the dorsal paxillae are fewer and they project more strikingly, and there are only two, instead of three, oral spines on the free lateral margins of the plates. These differences seem to me well within the probable range of individual diversity.

P.F. 16906. Cape Point N.E. by E. $^1/_4$ E., 40 miles. 800–900 fms. Gn. m. 1 specimen; adult.

Hymenaster membranaceus.

Sladen, 1882. Jour. Linn. Soc. (Zoöl.), vol. 16, p. 237.
1889, Challenger Ast., pl. 92, figs. 6, 7.

It is with much hesitation that I refer a number of small *Hymenasters*, in very poor condition, to this species. They are all small, R = 20–30 mm., and are so badly rubbed, orally, that it is impossible to determine what the armature of the oral plates was. The adambulacral plates certainly carried three short, slender spines. The supradorsal membrane is very thin and full of interlacing fibres. The type of *membranaceus* was from 1125 fms. in the northeastern Atlantic, and was larger (R = 35 mm.) than any of these South African specimens. The oral plates and armature were a very characteristic feature and it is to be regretted that all of the specimens before me have the oral plates badly rubbed. It is evident however that there were 5 small spines on lateral margins of each oral plate. In view of this fact and the character of the dorsal membrane, it has seemed to me best to refer these specimens to *membranaceus* though their identity is of course doubtful.

P.F. 16906. Cape Point N.E. by E. $^1/_4$ E., 40 miles. 800–900 fms. Gn. m. 7 specimens; young?

P.F. 1726. Cape Pont E. $^3/_4$ N., 42 miles. 930 fms. Gn. m. 6 specimens: young?

Hymenaster lamprus *, sp. nov.

Plate XI. Figs. 3, 4.

R = 42 mm.; r = 32 mm.; R = 1·3 r. Form almost pentagonal, as the rays are blunt and little produced and the sides are very lightly concave. Disk not very high or thick; radial paxillar areas

* λαμπρός = bright-colored, in reference to the fine colour of the actinal surface.

elevated and sharply defined, with paxillae in about half a dozen series; each paxilla has 3 or 4 rather stout spinelets, about 2 mm. long, which radiate widely and push the membrane up above themselves to such a degree that the paxilla areas look very spiny. Spiracles in small groups of 3–5, lying in widely scattered little patches of slightly thickened membrane; there are also a few straight, narrow patches of spiracles extending out onto the interradial membrane, much as in ***H. nobilis***. Interradial membrane, smooth and thick, but numerous fine, interlacing fibres can be made out on its surface.

Actinally the interradial areas are smooth, but fibrous as above; the free area, not touched by actinolateral spines, is 20–25 mm. wide and 10 mm. deep. Adambulacral plates each with two subequal, sharp, slender, slightly diverging, sacculate spines; the saccules extend far beyond the spine-tips. Aperture papillae sacculate, and not peculiar, fully occupying the areas between the bases of the actinolateral spines. The latter are remarkably short, only a little over 6 mm. long, at the best; there are 25–30 on each side of each ray, but only 4 or 5 are in contact with those of the adjoining ray; from the fifth to the thirteenth or fourteenth, they are subequal, but they then become rapidly shorter and shorter. Pedicels in two series.

Oral plates short and wide, projecting greatly at the distal end; each plate carries on the free lateral margin, which is somewhat flaring, 2 subequal, sharp, slender spines; a much longer and stouter spine stands at the middle of the anterior margin and back of it, near the middle of the plate is a second, similar spine.

Colour, in alcohol; dorsally, dull pink, abruptly darker even dull claret on the interradial membrane; whole actinal surface, except the dull brown feet, deep, dull red, nearly claret.

P.F. 16932. Cape Point N.E. by E. $^1/_4$ E., 40 miles. 800–900 fms. Gr. m. 1 specimen; adult.

Holotype, South African Museum no. A 6446.

This handsome ***Hymenaster*** belongs in the same group with *glaucus* and *giganteus*, but it differs from them both in the very short actinolateral spines, and the armature of the mouth plates. While it is not impossible that it is the young of *giganteus*, it seems to me highly improbable. The arrangement of the spiracles is peculiar, reminding one a little of *nobilis* or perhaps better of *koehleri*.

Hymenaster gennaeus *, sp. nov.

Plate X.

R = 75 mm.; r = 60 mm.; R = 1·25 r. Form almost perfectly

* γεννᾶιος = of noble brith, in reference to the close relationship to *H. nobilis*.

pentagonal, the sides being only very slightly concave. Dorsally very similar to *H. nobilis*, but the radial paxillar areas are relatively narrower, only about 23 mm. wide or less than one-third R.; in *nobilis*, they are about ·40 R. The narrow bands of spiracles running out onto the interradial membrane are numerous and well-defined and run clear to the margin. Actinally, the ambulacra are not at all petaloid but the pedicels and ambulacral plates and armature, including the aperture papillae are very much like those of *nobilis*. The actinolateral spines are very short, only about 11 mm. long, and from the sixth to the twenty-fifth are subequal; this gives a characteristic appearance to the ambulacra. Oral plates short and wide, conspicuously projecting distally and with lateral portions a little concave, so the margin projects downward (in normal position of animal) a trifle; on the free margin of each plate are 4 (rarely 3) spines of which the innermost is quite small, the others moderate and subequal; at the inner corner of each plate is a spine, conspicuously larger than the marginal spines; back of this is a similar spine, but a little larger; and back of this again is a third spine, apparently the largest of all; these three superoral spines are close together but they do not form a straight series, as the middle one of the three is nearer the median suture than are either of the others. Colour, in alcohol, very light brown with a pink tinge.

P.F. 16825. Cape Point N.E. by E. $^3/_4$ E., 38 miles. 750–800 fms. Gn. m. 1 specimen; adult.

Holotype, South African Museum no. 6447.

This fine starfish is in excellent condition except that most of the oral and adambulacral spines are broken. Apparently however they were all sharp, though sacculate as usual. The relationship to *nobilis* is evident but the armature of the oral plates is so different from that described and figured by Sladen for the CHALLENGER's fine Antarctic species that the two forms cannot be conspecific. The shorter actinolateral spines and the longer series of interradial spiracles are also characters of *gennaeus* which cannot be ignored.

ASTERIIDAE.

This large family of starfishes, so common on the coasts of the northern hemisphere, and especially on the Pacific coast of North America, is represented by but few species in South African waters. I fully concur in Verrill's decision that the group called "Stichasteridae" is not of family rank and its members really belong in the *Asteriidae*. Perhaps *Coronaster* belongs in the *Pedicellasteridae* rather

than here but as a matter of convenience, and for lack of material, I have left it in this family.

Of the 7 species hitherto known from South Africa, only 3 are in the PIETER FAURE collection; on the other hand, that vessel secured a fourth species, which seems to be new to science. Of the four species recorded from South Africa but not in the PIETER FAURE collection, two are well defined and there is no reason to doubt their occurrence as recorded, but Bell has thrown some doubt on the validity of *Asterias capensis* and there is a possibility that *A. africana* is identical with *A. rarispina.* The following key distinguishes the eight species included in this report.

Key to the South African Species of Asteriidae.

Abactinal plates small and rather uniform, arranged in very regular longitudinal (and also transverse) series, the intervals occupied by small but distinct groups of papulae; plates well covered by small blunt spinelets and numerous pedicellariae
Stichaster felipes.

Abactinal plates not as above.
Adambulacral armature of 1 spine (monacanthid).
Rays 5.
Large pedicellariae of ambulacral furrows, slender (length 3—4 × thickness) . . . . . *Marthasterias glacialis.*
Large pedicellariae of furrows, stout (length about twice thickness).
Abactinal spines on rays few, all of one kind, stout
Marthasterias rarispina.
Abactinal spines numerous, large and small
Marthasterias africana.
Rays 6—12.
Disk moderate, its diameter ·25—·30 R; rays not very long, R = 6 or 7 *br* . . . . . *Coscinasterias calamaria.*
Disk small, its diameter only ·20 R; rays long and slender, R = 10 *br*
Coronaster volsellatus.
Adambulacral armature of more than 1 spine.
Diplacanthid (with 2 adambulacral spines); rays 5 or 6 *Asterias capensis.*
Polyacanthid (with more than 2 adambulacral spines)
Perissasterias polyacantha.

STICHASTER FELIPES.

Sladen, 1889. CHALLENGER Ast., p. 433; pl. 101, figs. 1, 2.

The specimens at hand, one with R = 88 mm. and the other with R = 44 mm., are quite typical. Verrill says this species is not a member of *Stichaster* in a strict sense, indeed he intimates that *Stichaster* is monotypic, but he does not suggest in what genus he would place *felipes*, and its final disposition may be left until the co-called *Stichasteridae* are properly revised.

P.F. 2435. Lion's Head, Cape Town, N. 84° E., 38 miles. 194–204 fms. 1 specimen; adult.

P.F. 15434. Cape Point Lighthouse, N.E. by N., 7¾ miles. 85 fms. Fne. gn. s. 1 specimen; young.

Marthasterias glacialis.

Asterias glacialis Linné, 1758. Sys. Nat. ed. 10, p. 661.
Marthasterias glacialis W. K. Fisher, 1906. Ann. Mag. Nat. Hist. (7), vol. 17, p. 575.

There are three starfishes in the Pieter Faure collection which I think must be referred to this northern species. Bell has already recorded it (1905) from three South African stations. I have compared the present specimens with others from further north and find they agree very closely with those from the Azores. The species has an extraordinary range, as it is found throughout the eastern Atlantic from Iceland to the Cape of Good Hope; it occurs also on the coasts of northern Norway and yet in the Mediterranean too! The specimens in the Pieter Faure collection are not large, R equalling 33, 50 and 90 mm. The smallest has very few spines abactinally except the median series, only 3–5 spines occurring between that series and the superomarginals. The larger specimens have a complete but not very regular lateral series on each side and some additional spines. I agree with Bell that the number of series of abactinal spines is not a valid specific character in *glacialis*. The species is beautifully figured in Ludwig's great monograph "Seesterne des Mittelmeeres", 1897, pl. 3, figs. 1–3. Much more South African material must be secured before the real relation of *glacialis* to *africana, capensis* and *rarispina* can be determined and the validity of the three South African species be established.

P.F. 3009. Cape Colony; False Bay. 2 specimens; adult.

Locality unknown. 1 specimen; young.

Marthasterias rarispina.

Asterias rarispina Perrier, 1875. Arch. Zool. Exp., vol. 4, p. 246.
Marthasterias rarispina Verrill, 1914. Shallow Water Starfishes of the North Pacific Coast, p. 47.

There is a well-preserved sea-star in the present collection which seems to me undoubtedly a representative of this species. It is apparently adult, R = 85 mm., (but as Perrier gives no measurements whatever, it is impossible to show how its size compares with that of the type). The abactinal surface of the rays is extraordinarily bare; there are only 10–12 spines and these are all in the median radial

series; they are less stout and much sharper than the corresponding spines in *glacialis*; many of the superomarginal plates, more particularly on the basal half of the ray bear no spines. The colour of this specimen is deep, dull purplish-pink, in alcohol.

P.F. 13743. Great Fish Point, Cape Colony, N. by W., 7 miles. 49 fms. S., sh. 1 specimen; adult.

* Marthasterias africana.

Asteracanthion africanus Müller and Troschel, 1842, Syst. Ast., p. 15.

This species has never been figured or even fully described. The type locality is the Cape of Good Hope. A specimen of *Marthasterias* before me from Port Natal is regarded by Dr. W. K. Fisher as probably *africanus*, and it is from this specimen, and not from published descriptions, that the character emphasized in the key on p. 304 is taken.

* Coscinasterias calamaria.

Asterias calamaria Gray, 1840. Ann. Mag. Nat. Hist., vol. 6, p. 179. De Loriol, 1885. Cat. Rais. Ech. Mauritius: Stellérides, pl. 7, figs, 1, 2. *Coscinasterias calamaria* Perrier, 1894. Trav. et Talisman Stell., p. 106.

This sea-star, characteristic of the Australian and New Zealand coasts, has long been known from Mauritius and de Loriol says it is common there. Bell (1905) reports a specimen from rock pools at low tide, in Three Anchor Bay, Cape Colony, but evidently it is rare in South African waters. There are none in the present collection.

* Coronaster volsellatus.

Asterias (*Stolasterias*) *volsellata* Sladen, 1889. Challenger Ast., p. 584; pl. 107, figs. 1–4.

Coronaster volsellatus Fisher, 1917. Proc. Biol. Soc. Washington, vol. 30, p. 25.

The type-locality for this species is in the Philippine Islands but Bell (1905) ascribes "some remarkable fragments", "dredged off Great Fish Point Light House, N. by W. $^3/_4$ W., 17 miles", in 100 fms., to this species.

* Asterias capensis.

Perrier, 1875. Arch. Zool. Exp., vol. 4, p. 258.

Little is known of this species, which was based on a specimen from South Africa, in the British Museum. Bell (1905) lists a spe-

cimen; "Dredged off Cape St. Blaize, N. by E. 1/4 E., 65 miles. Depth 89–90 fms." As I have never seen a specimen, and no adequate description or figure has been published, I do not know in what genus it really belongs. But it is probably not a true *Asterias*. At one time (1882) Bell thought it identical with *glacialis*, which would indicate it is a *Marthasterias*.

PERISSASTERIAS *, gen. nov.

Abactinal skeleton made up of more or less cruciform plates, arranged in numerous (15–17) longitudinal series, united internally by strong, transversely placed supplementary ossicles; the exact position of these ossicles is more or less oblique and occasionally longitudinal. Abactinal spines small and numerous, more or less wreathed with pedicellariae or with a cluster of pedicellariae near the tip. Median radial series of spines somewhat larger than the others and united together in longitudinal or oblique pairs and trios. Papulae numerous but none below the inferomarginals. Actinolateral plates wanting. Adambulacral plates very wide and short, *each with a close-set transverse series of six, or usually seven spines*; each of these spines bears one or more pedicellariae at or near the tip. Major and minor pedicellariae numerous, but small; no very large pedicellariae anywhere. Pedicels in four very regular parallel series, extending nearly to extreme tip of ray.

This remarkable genus is sharply distinguished from the rest of the family by the adambulacral armature. The absence of actinolateral plates makes the actinal skeleton very simple but the excessive width of the adambulacral plates provides the necessary area for the attachment of the numerous crowded spines.

PERISSASTERIAS POLYACANTHA **, sp. nov.

Plate XVIII. Fig. 3.

R = not less than 310 mm.; *r* unknown; *br* = 40 mm.; R = nearly 8 *br*. Disk unknown. Ray wide at base, somewhat flattened, tapering steadily to the blunt tip; the ray is widest, not where it joins the disk but somewhat distal to that point. Abactinal skeleton made up of numerous series of plates arranged in longitudinal series of more or less regularity; the median series is largest and is more elevated

* *περισσός* = above measure, excessive + *Asterias*, in reference to the exceptional development of adambulacral spines.

** *πολυάκανθα* = having many thorns, in reference to the numerous adambulacral spines.

than the others; at the base of the arm there are *eight* series on each side between the median plates and the superomarginals. Median series with spines about 5 mm. long, and over a millimeter thick, bluntly pointed and with a wreath of minor pedicellariae; these spines are arranged in longitudinal or oblique pairs or trios which are apparently more or less fused together at base and are there enclosed in a common sheath of thick skin. The remaining abactinal spines are somewhat smaller (about 4 mm. long) and more slender and pointed; near the median series they are usually single and have a distinct wreath of minor pedicellariae but near the marginals there are often two and sometimes three spines on a plate and the wreaths of pedicellariae are reduced to irregular clusters. Superomarginal plates relatively rather large, each with a group of four or five irregularly placed spines about 4 mm. long, blunt and slightly widened and even flattened at the tip; there are several minor pedicellariae, as a rule, on each of the spines. Inferomarginals somewhat smaller than the upper series, each with three, or rarely four, spines, similar to those above them but a little smaller; as a rule these inferomarginal spines form an oblique series but they are occasionally irregularly placed; they are in close proximity to the adambulacral spines. No actinolateral plates whatever. Adambulacrals about 6 mm. wide and not quite a millimeter long; each carries a series of six or more commonly seven spines, of which the innermost are about 5 mm. long and the outer about 3·5 mm.; these spines are much more slender than those of the abactinal plates and each carries one or more pedicellariae near the tip. Papulae very numerous, in groups in every interspace above the inferomarginals. Pedicellariae, both major and minor, abundant; the latter are about ·40–·50 mm. long and not only compose the wreaths and clusters on the spines but are widely scattered on the skeletal plates and papular areas; the major pedicellariae are about ·60–·75 mm. long and occur all over the animal, even in the ambulacral furrow and attached to the adambulacral spines. Colour dull yellowish-brown.

P.F. 2105. Lion's Head, Cape Town, S.E. ½ E., 42 miles. 156 fms. Dk. gn. s. 1 arm of a large adult.

Holotype, South African Museum no. A 6445.

It is of course to be regretted that there was no complete specimen secured of this remarkable starfish, but it is a cause for gratification that the arm taken is so well preserved that both generic and specific characters are unmistakable. It is a little hard to decide with what genus *Perissasterias* is most nearly allied but probably the group which Perrier has named *Distolasterias* may be considered

its nearest relative, although the type of that genus is from Japanese waters, and no species are known from the southern oceans. Some species of *Asteriidae* are already known which occasionally have three adambulacral spines on a plate, but there are no connecting links between such forms and this remarkable South African starfish.

BRISINGIDAE.

This remarkable family, not hitherto known from South African waters, is represented in the PIETER FAURE collection by the following species.

BRISINGA CRICOPHORA.

Sladen, 1889. CHALLENGER Ast., p. 606; pl. 109, figs. 6–8.

There are two specimens of *Brisinga* in the collection from South Africa, and they seem to be representatives of this species which Sladen described from a single fragmentary individual taken in the West Indies. The specimens before me answer well to Sladen's description and figures except in two or three points. The type of *cricophora* had but 11 rays while each of the PIETER FAURE specimens had 13, though all are now detached. As the number of arms in other species of *Brisinga* shows no little diversity, it is not strange that this discrepancy occurs. On many adambulacral plates there may be on the aboral margin, well up in the furrow, one or even two very delicate spines. These would have been very easily overlooked by Sladen if he did not dry his specimen. The oral plates have three pairs of superoral spines, instead of two as in Sladen's description, and two on each margin instead of one. These differences are too trivial it seems to me, in the light of such scanty material, to warrant describing the South African Brisinga as a distinct species. The type of *cricophora* was 20 mm. across the disk; the present specimens are about 24 mm. The curious actinal spines at the base of the ray are quite well marked but rather similar spines occur in a specimen of *B. endecacnemos* in the M. C. Z. collection. This specimen was collected by the TALISMAN and identified by Perrier, by whom it was sent to the M. C. Z. If Sladen is right in stating that the basal actinal spines in *endecacnemos* are needle-like, this TALISMAN specimen ought to be referred to *cricophora*, but I have no authentic material of *endecacnemos* for comparison.

P.F. 18960. 36° 44′ S., 21° 44′ E., 250 fms. Gn. s., st. 2 specimens; adult.

Fisher (1917, Ann. Mag. Nat. Hist. (8), vol. 20, p. 426) places *cricophora* in his genus *Craterobrisinga*, a group separated from *Bri-*

singa by differences in the adambulacral armature which seem to me hardly of generic significance. For the present at least I think *cricophora* may remain in *Brisinga.*

BRITTLE-STARS. OPHIUROIDEA.

Brittle-stars form a relatively small part of the South African echinoderm fauna, there being fewer species represented than there are sea-stars and scarcely a dozen seem to be common along shore. Döderlein, in his list referred to previously (see p. 222), names 29 species as occurring in water of less than 278 fms. but one of these (*Ophiozona capensis*) is synonymous with another (*Ophiura costata*) and two others (*Ophioderma tonganum* and *Ophiothrix roseocoerulans*) are due to mistaken identifications. The collection from the South African Museum contains over 1200 specimens representing 44 species, of which 22 are in Döderlein's list. There are however 5 species hitherto known from Mozambique and one from Algoa Bay, as well as two from deep water off South Africa, and hence not listed by Döderlein, which fall within the scope of this report. There is also a species (*Ophiocnemis marmorata*) in the collection of the M. C. Z. from the Cape of Good Hope, collected by Wahlberg, of which Döderlein was necessarily ignorant. There are thus 57 species of brittle-star included in the present report, of which however only 6 are new to science; these are here described for the first time.

Of the 57 species, 30 are truly littoral occurring in water less than twenty fathoms deep, while 5 are strictly abyssal occurring only (or, at least, generally) in water beyond 600 fms. The remaining 22 species may be classed as continental.

Of the 30 littoral species, 16 seem to be endemic and as all but one have been known for some years, it is fair to say that half the littoral brittle-stars are characteristic forms. Of the remaining 14 species, 12 are East Indian or Indian Ocean forms while one (*Amphipholis squamata*) is cosmopolitan and one (*Ophiothrix fragilis*) is European. None of the littoral species are known from either South America or the southern coasts of Australia. It is noteworthy that of the 30 littoral brittle-stars here treated as South African, 8 are not known from south of Mozambique and one or two others are of very doubtful occurrence south of that point.

Of the 22 continental brittle-stars, no fewer than 14 are endemic, five of these being here described for the first time. The continental fauna is thus a very characteristic one. Of the eight species not

endemic, two are antarctic, two are known from southern South America and one is known from Australia and the East Indian region. There are therefore no fewer than 19 distinctly austral species in the 22 making up the continental fauna. The remaining three species are more or less cosmopolitan in deep water and their occurrence in South African waters is thus of uncertain significance. Two of the three are species of *Ophiactis*, a difficult genus, the distribution of whose deep water species is still a puzzle. The other cosmopolitan ophiuran is *Asteronyx loveni*, which was originally discovered in Norwegian seas, but has since been taken in the North Atlantic, North Pacific and Indian oceans, as well as among the West Indian Islands, off the Western coast of Mexico and off the southeastern coast of Australia.

Of the 5 abyssal ophiurans included in the present report, none are endemic but all are well-known and wide-spread species. Two are known from both the North Atlantic and North Pacific and two from the North Pacific and East Indian regions. One, *Ophiernus vallincola*, being previously known only from the North Atlantic and the Antarctic abysses, would naturally be expected in the deeps off South Africa.

In conclusion then, we may say, in the light of our present knowledge, that the brittle-star fauna of South Africa is quite characteristic, more than half (30) the known species being endemic and five others being distinctly austral forms. Nearly half the remaining species are not really part of the South African fauna at all, as they are not known from south of Mozambique. The affinities of the littoral species are distinctly Indo-Pacific and yet there are two notable cases of Atlantic relationship, in *Ophiothrix fragilis*, an European species, and *Ophioderma leonis*, a member of a very characteristic West Indian genus. The continental fauna is more emplatically endemic than is the littoral, and its affinities are clearly not Indo-Pacific, as only four or five of its members are certainly derived from that side of Africa, while twice as many have a more or less clearly marked relationship to the Atlantic fauna and three are distinctly austral, two being Antarctic. The impression made by the study of the sea-stars that the shallow water fauna is of Indian origin while that of the deeper water is from the west, is thus strengthened by study of the brittle-stars.

There is surprisingly little similarity between the brittle-stars of Australia, or those of southern South America, and those of South Africa. The small and specialized genera *Ophiomisidium* and *Dictenophiura* have Australian species but they are also known from the

Atlantic, while the fine *Ophiothrix aristulata*, which seems to unite the Cape deep waters with those of the southern coasts of Australia, is also known from the East Indies and Indian Ocean. As for the South American connections, the *Ophiomyxa* of Agulhas Bank may not be the South American species, so that *Gorgonocephalus chilensis* is the only species actually common to the two regions.

The 57 species included in the present report belong to 11 families. They can be most easily distinguished from one another if these families are first differentiated, which the following key attempts to do. Thanks to the brilliant work of Matsumoto, the families of brittle-stars are now beginning to take on tangible form. Under each family will be found a key to its South African representatives.

Key to the South African Families of Ophiuroidea.

Disk and arms covered with a smooth skin; upper arm plates rudimentary or wanting; side arm plates ventral or subventral in position.

Arms simple, not very long, 3—5 times disk-diameter, not capable of vertical coiling . . . . . *Ophiomyxidae*, p. 313.

Arms branching, or if simple, very long, capable of being vertically coiled.

Teeth present in a vertical series on each jaw tip; arms not annulated with bands of microscopic hook-bearing granules *Trichasteridae*, p. 314.

No true teeth; arms annulated with double series of hook-bearing granules *Gorgonocephalidae*, p. 315.

Disk and arms not covered by a smooth skin; upper arm-plates usually well-developed; side arm-plates not ventral or subventral in position (except when upper arm-plates are unusually wide).

Arm-spines moderately or quite long, more or less at right angles to long axis of arm, never minute or closely appressed.

Upper arm-plates small, more or less triangular, in contact (if at all) only at base of arm; teeth triangular or sharply pointed; oral papillae well-developed, 3 or more on each side . *Ophiacanthidae*, p. 319.

Upper arm plates well-developed, forming a more or less continuous series, or if triangular and discontinuous, then teeth broad, squarish and oral papillae only 1, 2 or 0 on each side.

Dental papillae none; two proximal oral papillae may occupy tip of jaw.

Not more than 4, often only 2 or 3, oral papillae on each side of jaw . . . . . *Amphiuridae*, p. 325.

5 oral papillae on each side of jaw *Ophiochitonidae*, p. 343.

Dental papillae present in a cluster at tip of jaw.

No oral papillae . . . *Ophiotrichidae*, p. 335.

Oral papillae several on each side of each jaw *Ophiocomidae*, p. 347.

Arm-spines small or at least slender, often minute, closely appressed to side arm-plates.

Disk closely granulated (rarely some plates are visible); arm-spines 5—10, short, subequal. . . . . *Ophiodermatidae*, p. 349.

Disk without, or with a fugaceous coat of granules; arm-spines rarely more than 3, uppermost often decidedly longest (numerous and subequal in *Ophiomusium lymani*).

Arms inserted laterally to disk; arm-spines 3 or rarely more
Ophiolepididae, p. 353.

Arms inserted ventrally to disk; ventral arm-plates small, covering only a narrow median area on lower surface of arm; arm-spines 2
Ophioleucidae, p. 365.

N.B. Statements made in the above key are not intended to apply to each family as a whole but only to its South African representatives.

OPHIOMYXIDAE.

This family seems to have but two representatives in South Africa, each representing a wide-spread genus. Each occurs in the PIETER FAURE collection but each has been recorded before at least once. They may be distinguished from each other as follows:

Key to the South African Species of Ophiomyxidae.

Second (outer) oral tentacle-pore small, opening within the mouth slit; oral papillae flat with wide somewhat serrate tips, the distalmost smallest *Ophiomyxa vivipara*.
Second oral tentacle-pore large, opening on oral surface of mouth plate; oral papillae spiniform, the 3 distal ones conspicuously longest and largest
Ophioscolex dentatus.

OPHIOMYXA VIVIPARA.

Studer, 1876. Monatsb. K.-Preus. Akad. wiss. Berlin, p. 462.
H. L. Clark, 1915, Mem. M. C. Z., vol. 25, pl. 2, figs. 1, 2.

The specimens at hand agree very well with those taken by the CHALLENGER on the Agulhas Bank, but they are not so closely similar to specimens from the Strait of Magellan. The available material is neither of sufficient quantity nor of suitable quality to determine whether the South American and South African are actually identical. The few specimens before me suggest that they are distinguishably different. The largest of the PIETER FAURE specimens is about 20 mm. across the disk (dry) and has arms 80–90 mm. long. It is of a nearly uniform pale reddish-brown, the disk somewhat darker.

Station 2528. Lion's Head, N. 63° E., 34 miles, 154 fms. Blk. spc. 5 specimens; adult.

Station 13225. Cove Rock, N.W. $^3/_4$ W., 13 miles, 80–130 fms. Crl. and r. 1 specimen; adult.

OPHIOSCOLEX DENTATUS.

Lyman, 1878. Bull. M. C. Z., vol. 5, p. 157; pl. VII, figs. 184–186.
1882, CHALLENGER Ophs., pl. XXIV, figs. 4–6.

Mr. Lyman's figures are better in his preliminary, than in his final report. In neither case do they correspond closely to his excellent description. The picture of the remarkably long outer oral papillae is particularly bad in the CHALLENGER report and even in the preliminary paper, they are not represented nearly long or slender enough. The four, long, flat, blunt arm-spines are better represented as to form, in the preliminary paper, but number, position and relative size are much better shown in the final plate. Apparently Mr. Lyman did not examine a dry specimen or he would not have called the tentacle-scale rounded, when it is conspicuously spiniform, nor would he have said "the upper arm-plates are only indicated by thin films of slightly calcified skin". The upper surface of the arms, at least the basal half, is covered by numerous small but distinct plates, similar to but rather larger than those which cover the disk.

This species was taken by the CHALLENGER only on the Agulhas Bank, but Bell (*op. cit.* p. 259) records it from "off Buffalo" in 195 fms. The specimens before me in the PIETER FAURE collection have a disk diameter, ranging from 9–18 mm.; the largest is thus somewhat larger than Lyman's type.

Station 2386. Lion's Head, N. 76° E., 28 miles, 140 fms. Blk. spc. 1 specimen; half grown.

Station 2528. Lion's Head, N. 63° E., 34 miles, 154 fms. Blk. spc. 3 specimens; adult.

TRICHASTERIDAE.

This family is poorly represented in South African waters, only the two following species having been found and these very sparingly. They are easily separated from each other as follows:

Key to the South African Species of Trichasteridae.

Arms long, 8—10 times disk-diameter or more, with 4 or 5 minute arm-spines on each side arm plate. . . . . *Asteronyx loveni.*

Arms short, scarcely twice disk-diameter, with only 2 minute arm-spines *Ophiuropsis lymani.*

ASTERONYX LOVENI.

Müller and Troschel, 1842. Sys. Ast. p. 119; pl. 10, figs. 3–5.

The discovery of this species off South Africa is interesting but not surprising. It has been known previously from almost all parts

of the world in deep, cold water. The largest of the PIETER FAURE specimens is still young, with the disk only 12 mm. across, while others are only half as large. I have compared the specimen with those of similar size from other regions and find no differences to which weight may be given. The oral papillae are shorter, flatter and more regularly arranged than in most northern specimens and in this particular, the South African specimens approach most nearly to one from off Victoria, but some northern specimens show a similar tendency and I do not think even a varietal name can be given to the southern form.

Station 17268. Cape Point, E. $^3/_4$ N., 42 miles, 930 fms. Gn. m. 2 specimens; very young.

Station 17303. Cape Point, E. $^3/_4$ N., 41 miles, 890 fms. Gn. m. 2 specimens; young.

* OPHIUROPSIS LYMANI.

Studer, 1884. Abh. K.-Preus. Akad. wiss. Berlin, p. 55; pl. V, figs. 12*a–d*.

This remarkable little ophiuran is known only from the holotype (disk-diameter, 6 mm.; arm-length, 10 mm.) which was taken by the GAZELLE off Spencer Bay, Southwest Africa, in 60 fms. The colour in life was rosy red. It is quite possible that this will prove to be the young of some other genus but we have no clue yet as to its relationships. The first spelling of the specific name was with two n's but as a subsequent spelling (in the Explanation of Pl. V) is correct, we must treat the first as a slip of the pen or a typographical error.

GORGONOCEPHALIDAE.

This interesting family is represented in the region about the Cape by only three species, of which two have the much-branched arms which have led to the fisherman's name of "basket-fish".* Both of these have long been known from South Africa but the third species, having unbranched or simple arms, is a discovery of the PIETER FAURE. The three forms are very easily distinguished from each other by obvious characters. The simple-armed species and one of the basket-fish seem to be endemic but the other basket-fish has an extraordinarily wide distribution, ranging as it does from Chili, Argentina and the Falkland Islands to Kerguelen and Heard Island.

* This is the colloquial name of an allied species, on the New England coast.

Key to the South African Species of Gorgonocephalidae.

Arms simple . . . . . *Astrothamnus papillatus.*
Arms much-branched.
Nearly all tentacle-pores before first fork of arms guarded by minute arm-spines . . . . . *Gorgonocephalus chilensis.*
No arm-spines on basal tentacle-pores* . . . *Astrocladus euryale.*

ASTROTHAMNUS PAPILLATUS **, sp. nov.

Plate XX. Figs. 5, 6.

Disk 18 mm. across; arms rather more than 100 mm. long. Disk slightly tumid, the ridges formed by the radial shields wide (3 mm. distally) and not conspicuous, though the interradial depressed groove is fairly well marked, thus defining clearly the radial wedges. Whole upper surface of disk covered by coarse granules, the largest nearly a millimeter in diameter; they are well-spaced but there are scattered among them smaller granules with which they intergrade; the larger granules usually are rough or even prickly on the top. Arms 4 mm. in diameter at base but tapering rather rapidly to the attenuate tip. From their very base the arms are encircled by alternating bands of fine and coarse granules; the former bear numerous minute hooks and hooklets while the latter are more or less nearly smooth. There are two or three (rarely more) series of granules in each band; when more than two, the marginal series are the coarsest.

Interbrachial areas below rather small and covered with a coat of very fine granules, abruptly and conspicuously smaller than those at the margin of the disk. Genital slits fully 3 mm. long. Surface of jaws and mouth frame and lower surface of arms as well, covered by a rather uniform coat of fine granules, coarsest on the interradial portions of the mouth-frame. Teeth, tooth-papillae and oral papillae present, spiniform and similar except that the teeth are much the largest and the distal oral papillae are smallest. First pair of tentacle-pores of arm naked and small, nearer together than the following; second pair with 2 short, slightly thorny arm-spines; third pair with 3 or 4; following pairs with 4 or usually 5 and very rarely 6. Colour, drled from alcohol, light yellow-brown.

P.F. 12872. East London, N. 15 miles, 310 fms. M. 9 specimens; adult and young.

* In specimens more than 15 mm. across disk. Young specimens may have minute arm-spines on all but the first pair of pores. Such specimens may be distinguished from young *G. chilensis* by the absence of granules on the disk and the generally smooth appearance of both surfaces of the body.

** *papillatus* = having papillae, in reference to the numerous oral papillae.

P.F. 14380. Cape Hangklip, N.N.E. 31 miles, 95 fms. Gn. s. 1 specimen; very young.

P.F. 18229. Cape Hangklip, N.E. $^1/_2$ E. 5 miles, 60 fms. Gn. m. 1 specimen; adult.

Holotype, South African Museum, no. A 6443. P.F. 18229.

The growth-stages as revealed by this interesting series are most interesting. The smallest individual has the disk only 3·5 mm. across, and the arms about 18 mm. long; the proportion is thus about the same as in the adult. Conspicuous radial shields about ·75 mm. long and ·40 mm. wide are present in two adjoining radii but are lacking in the other three; in one of these three the arm is noticeably smaller than in the other four radii. There is thus some indication of an earlier reproduction by fission, but none of the other specimens hint at such a possibility. The disk granules are few but relatively large. Most of the arm-segments have only 2 arm-spines and none has more than 3. The genital slits are well developed.

The next specimen in size is 7 mm. across the disk. Radial shields, 1 mm. long by ·50 mm. wide, are distinguishable; they are more or less surrounded by a series of minute granules, but as many disk granules are nearly a millimeter in diameter, they are not very distinct. Some of the basal arm-segments have 4 arm-spines, but those near middle of arm have only 3 and distally only 2. In specimens 9 mm. across the disk, there are no radial shields visible; their position is indicated by a group of minute granules; the appearance is as tho the little granules which surrounded the radical shields had closed in over the shield and buried it. The specimens from off East London are dry and are clasping coral fragments, cidarid spines, etc.; they are light brownish-white, and the arms are tightly coiled, so their general appearance is quite unlike that of the holotype, at first glance.

This species is as isolated structurally as it is geographically. The four species of *Astrothamnus* previously known are all Asiatic; one from the coast of Oman, two from the East Indies and one from Japan. The South African form is nearest to the Japanese species, *echinaceus*, so far as can be judged from descriptions and figures but it differs in the presence of numerous oral papillae, in the possession of arm-spines guarding the second tentacle-pore, in having 4–6 arm-spines on the basal arm-segments (instead of only 3) and in the finer and more even granulation of the oral surface. In the possession of oral papillae, *papillatus* resembles *bellator* from the Sulu archipelago, but the differences in the granulation of the

disk, on both surfaces, and in the tentacle-pores and arm-spines are quite evident. Matsumoto gives the absence of oral papillae as a characteristic of the genus *Astrothamnus* but Koehler's figure of *bellator* (1904, Siboga-exp. Oph. Mer Prof., pl. XXVIII, fig. 8) shows them distinctly and they are certainly well marked in the present species. All the papillae of the jaws are so similar that their extension distally along the sides of the mouth slits is hardly of sufficient importance to affect the position in the genus *Astrothamnus*, of the species so characterized.

Gorgonocephalus chilensis.

Astrophyton chilense Philippi, 1858. Arch. f. Naturg., vol. 24, p. 268.
Gorgonocephalus chilensis Lyman, 1882. Challenger Oph., p. 261.
Döderlein, 1911. Japan. Euryalae, pl. 5, fig. 5; pl. 8, figs. 1 and 1*a*.

This widespread and variable species is represented in the present collection only by small specimens. Those from 2798 resemble the Patagonian form in that the disk granules are widely scattered, low and rounded, only a few at center of disk and on the radial ribs rising into conical tubercles. The other specimens have the center of the disk and especially the ribs crowded with relatively big conical tubercles, more as in Kerguelen specimens. I have sought in vain for some character or group of characters by which the South American and Falkland Island *Gorgonocephalus* might be constantly distinguished from the South African and Kerguelen specimens. Perhaps in the future, more abundant material will make such a separation possible and desirable, which is not the case at present.

The larger individuals in the Pieter Faure collection are carrying on their backs much younger ones. This at least suggests that the species is viviparous and the young remain with the mother until well grown. In one case before me, an individual with a disk 25 mm. across carries, well-fitted into the very middle of its abactinal surface, a young one only 10 mm. in disk-diameter. In another case, the larger specimen carries two small ones, one near the center, the other near the margin of the disk. The young ones are clinging very tightly, some of the ultimate arm divisions entering into the genital slits of the carrier.

P.F. 2798. Vasco de Gama Peak, N. 71° E., 15 miles, 230 fms. Stns. 2 specimens; rather young.

P.F. 18154. Cape Point, N. E. by E. $^3/_4$ E., 28 miles, 300 fms. Fn. s. 7 specimens; small adults and young.

ASTROCLADUS EURYALE.

Asterias euryale Retzius, 1783. K. Vet. Akad. Hand., vol. 4, p. 243.
Astrocladus euryale Döderlein, 1911. Japan. Euryalae, p. 28.
Gorgonocephalus verrucosus Lyman, 1882. CHALLENGER Oph., p. 262.
L. Agassiz, 1839. Mem. Soc. Nat. Hist. Neuchatel, vol. 2, no. 8, pls. 1–3.

This very fine species, with only one exception known the longest of any member of the family, seems to have a very limited range as it has not yet been found anywhere except in the vicinity of southernmost Africa. The PIETER FAURE collection contains five specimens, of which two are fine adults, 60 and 65 mm. across the disk, and the remainder are about half as large.

P.F. 18381. Flesh Point, N. 6 miles. Depth and bottom unknown. 3 specimens; small adults.

False Bay. 2 specimens; fine adults.

OPHIACANTHIDAE.

This large and cosmopolitan family is very poorly represented in the seas about South Africa. Only three of thirty-three genera occur and each of these has but one representative. The genus *Ophiacantha* with more than 125 valid species was not hitherto known from the region but the PIETER FAURE has found a very characteristic species at a considerable number of stations. The three South African ophiacanthids are readily distinguished from each other as follows.

Key to the South African Species of Ophiacanthidae.

Radial shields small and nearly or quite separated; outermost oral papilla not wide and operculiform.

Disk closely covered with granules and a few, more spiniform grains; upper arm-plates large and in contact at base of arm *Ophiacantha nerthepsila.*

Disk scales evident, each with one rough-pointed, thick, short cylindrical spinelet; upper arm-plates small and widely separated *Ophiomitrella corynephora.*

Radial shields relatively large and broadly in contact; outermost oral papilla wide and operculiform . . . . . *Ophiothamnus remotus.*

OPHIACANTHA NERTHEPSILA *, sp. nov.
Plate XIX. Figs 3, 4.

Disk 7 mm. in diameter; arms 25 mm. long. Disk covered with scales which, except around margin, are completely concealed by a

* *νέρθε* = below + *ψιλός* = stript bare, in reference to the bare interbrachial areas below.

close coat of granules, among which are scattered irregularly a number of spiniform grains; there are 75–100 of the nearly spherical granules to each square millimeter of surface; the spiniform grains are 3–4 times as high as thick, pointed and well-spaced. Radial shields narrow, widely separated, only the distal tip visible. Upper arm-plates large, in contact basally but soon becoming slightly separated; they are broadly triangular, with slightly convex sides but the shape is variable owing to the degree of convexity of the proximal sides; some or all of the basal plates have these sides so strongly convex that they are almost bell-shaped and are nearly as long as wide. In the holotype however most of the upper arm-plates are distinctly triangular with a convex distal margin. Inter-

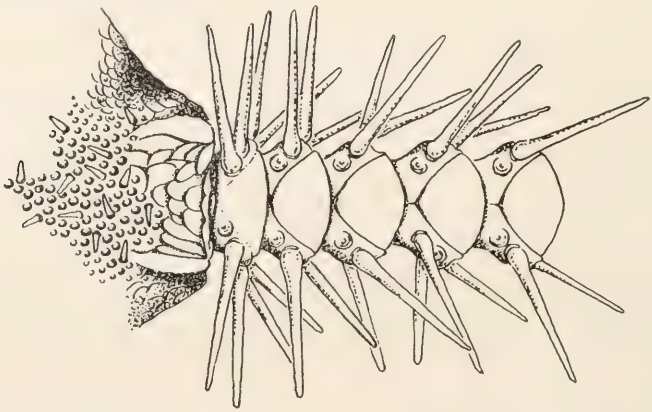

Fig. 1. Upper side of part of disk and arm of *Ophiacantha nerthepsila* sp. nov. Some of the arm-spines removed. × 10.

brachial areas below, and margin of disk both radially and interradially covered by overlapping scales, which are quite bare and entirely free from granules. Genital slits wide but short, reaching from the oral shields not quite to the second series of arm-spines. Oral shields diamond-shaped, twice as wide as long; madreporite much bigger than the others, its length and breadth more nearly equal. Adoral plates large, quadrilateral, in full contact interradially, about equally wide at the two ends, but the proximal margin longer than the distal. Oral plates small and ill-defined but each bears 4 (or 3) small, flat oral papillae; these are twice as wide as long, the outermost is distinctly the widest and bluntest; one or more of the others may be pointed. There are 6 teeth in each column, the lowest one or two pointed and somewhat triangular but

the upper ones blunt and squarish. First under arm-plate moderate, hexagonal, a trifle wider proximally than distally; second plate large rather axe-head-shaped but much wider than long; succeeding plates somewhat oblong, wider than long, but soon becoming squarish, distal corners rounded; all the under arm-plates are separated from each other more or less widely. Side arm plates not large or with prominent spine ridges, meeting both above (except at base of arm) and below; the basal plates bear 7 or 6 smooth, pointed spines, the uppermost longest and equal to at least two arm segments; on the first segment outside the disk, the rows of spines are closely approximated dorsally and on the second segment they are fairly close but the number of spines then drops to 5 and they do not approach each other dorsally; the lowest spine is smallest and bluntest and scarcely equals one arm-segment. Tentacle-scale single, blunt and spine-like. — Colour (dry): — pale brown, lightest below; disk with faint indications of white variegation and arms very faintly banded on the upper side distally.

P.F. 12983. Gonubie River, N. W. by W. $^3/_4$ W., 3 miles, 20 fms. Brk. sh. 1 specimen; small adult.

P.F. 13193. Cove Rock, N.W. by N., 6 miles, 43 fms. Brk. sh. and r. 1 specimen; small adult.

P.F. 13240. Cove Rock, N.E. $^3/_4$ E., 5 miles, 43 fms. St. and brk. sh. 4 specimens; small adults.

P.F. 13280. Cove Rock, N.E. by E., $^1/_2$ E., 4 miles, 22 fms. R. and brk. sh. 1 specimen; small adult.

P.F. 13455. Sandy Point, N.E. by N., 6 miles, 51 fms. Brk. sh. and st. 1 specimen; adult.

P.F. 13619. Great Fish Point, W. by N., 5 miles, 22 fms., R., crl., st. 1 specimen; adult.

P.F. 13801. Riet Point, N.E. by E., 2 miles, 23 fms. S. and st. 12 specimens; adult.

P.F. 15502. False Bay, 22 fms. S. and sh. 1 specimen; small adult.

P.F. 15627. False Bay, 17–27 fms. R. 2 specimens; adult and young.

P.F. 16231. False Bay, 22 fms. Brk. sh. 1 specimen; small adult.

Bathymetrical range, 17–51 fms.

Holotype, South African Museum no. A 6437. P.F. 13801.

This is a well marked species in a genus of perplexing specific lines and is not near enough to any species yet known to cause any difficulty. The long approximated spines at the base of the

arms, the bareness of the sides and lower surface of disk, the big upper arm-plates and the covering of the disk itself make a combination of characters which are quite distinctive. The species is evidently not a rare one on the southeastern coast of Cape Colony but does not seem to reach a large size. The smallest specimen is only 2 mm. across the disk while the arms are more than 8; it does not differ essentially from the adults but the side arm-plates are relatively more conspicuous and hence the arms are more „knotty", while the granulation of the disk covers the marginal plates and there are a few granules on the oral side.

There is some diversity of colour among the specimens at hand, though the adults agree well with the holotype. The arms however are sometimes quite distinctly banded. In one specimen most of the disk is occupied by a symmetrical flower-like blotch of whitish and in each interradius there is a conspicuous marginal spot of pure white. The smaller specimens are as a rule paler and the smallest are nearly white. Considerable diversity is shown in the number of "spiniform grains" on the disk. In some specimens they are few (10–15) and far between, while in other cases, they are quite numerous (75–100). There is some diversity too in their height for while they are usually only 2–4 times as high as thick they are occasionally elongated into little spinelets 5–6 times as long as their diameter.

Ophiomitrella corynephora*, sp. nov.

Plate XIX. Figs. 5, 6.

Disk 8 mm. in diameter; arms about 30 mm. long. Disk covered by a coat of thin overlapping scales, most of which bear a single, cylindrical (2–3 times as high as thick) granule with a rounded tip; there are many plates with no granules but there are very few that bear more than one. Radial shields moderate, rounded triangular, as wide as long, separated from each other by a series of scales, at least one of which is granule-bearing; the radial shields themselves bear no granules but the inner distal corner of each shield tends to project as a low tubercle. Upper arm-plates small, diamond-shaped, about as long as wide, widely separated and becoming very small distally. Interbrachial areas below like disk but there are only three or four granules in each area. Genital slits long and narrow, extending from oral shield nearly to disk-margin. Oral shields (except madreporite) diamond-shaped, wider than long, the two proximal sides lightly concave, the two distal lightly convex; madreporite more

* κορυνηφόρος = club-bearing, in reference to the lowest arm-spines.

nearly pentagonal as long as wide; the oral shields seem to be in contact with the first pair of side arm-plates. Adoral plates rather large, slightly curved, tetragonal with rounded angles, wider within, where they meet, than without. Oral plates very small, but each bears three big, club-shaped, subequal oral papillae, 2–3 times as long as thick. As usual in *Ophiomitrella* there is a distinct papilla or tentacle-scale on the inner side of the oral tentacle-pore, which seems to be borne on the first under arm-plate. Teeth about 4, the upper squarish but the lowest thick and narrow, pointed, not unlike one of the oral papillae. No tooth-papillae. First under arm-plate small, somewhat pentagonal, longer than wide; succeeding plates pentagonal a little wider than long, with distal angles rounded, all

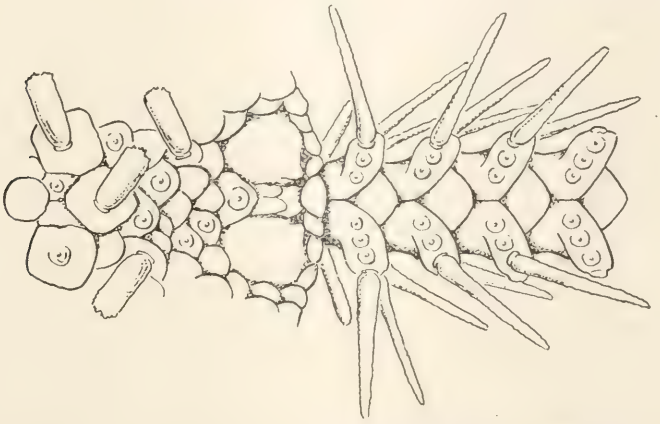

Fig. 2. Upper side of part of disk and arm of *Ophiomitrella corynephora* sp. nov. Some of the spines removed. × 10.

except first two well separated; they rapidly increase in relative length, and distally, are very small and rather narrow, scarcely three-fourths as wide as long. Side arm plates large, meeting above and below, the spine ridges becoming more and more prominent distally, where the arms are quite "knotted"; each plate carries 6 (or basally 7) spines, of which the first (uppermost) is longest and may equal two arm-segments while the sixth or seventh is shortest, little exceeding one segment; the upper spines are pointed but the lowest two or three are blunt and thickened at tip, becoming more or less club-shaped; all the spines are smooth except the lowest which may be more or less prickly at tip. Tentacle-scale large, but narrow, blunt and flattened, about half as long as under arm-plate. Colour (dry): — nearly white; specimens in alcohol have a faint pinkish tinge

and it is probable the colour in life is red or orange of some shade.

P.F. 2563. Vasco de Gama Point, S. 75° E., 13 miles, 166 fms. Blk. spc. 17 specimens; adult and young.

P.F. 2798. Vasco de Gama Peak. N. 71° E., 18 miles, 230 fms. St. 1 specimen; adult.

Holotype, South African Museum no. A 6441. P.F. 2798.

This species is near *O. ingrata* Koehler in its general features but differs in the arm-spines and in the higher and more cylindrical disk-granules. The lower arm-spines are very distinctive, no other member of the genus approaching it in this particular. The smallest specimen in the present series is only a little over 1 mm. across the disk and the arms are scarcely 3 mm. long; it is obviously very immature and shows none of the specific characters clearly. The next larger is about 2·5 mm. across the disk and shows all the specific characters more or less distinctly. These two specimens were associated with an adult in such a way as to indicate that they were its young and led me to the conviction that this species, like so many other austral echinoderms, is viviparous. On opening one of the alcoholic specimens, I found this to be the case, as there was a single young one, like the smallest described above, in each one of six bursae. The young evidently leave the bursae at this stage of development but apparently may remain on or with the mother until twice as large.

Ophiothamnus remotus.

Lyman, 1878. Bull. M. C. Z., vol. 5, p. 149; pl. VIII, figs. 201–203.

In neither the preliminary report (*op. cit.*) nor in his final Challenger Report, do Lyman's figures give an accurate idea of the close-set, operculiform oral papillae of this little brittle-star, but the earlier figures are the better in this particular. I have compared the Pieter Faure specimens with a Challenger cotype and there is no doubt of their identity. Bell (1905, Mar. Inv. South Africa, vol. 3, p. 258) reports that, of this species, "a good set was obtained from Cape Natal" and "a few from off Algoa Bay".

One of the specimens in the present collection, (13455), about 3 mm. across the disk is remarkable for the spinulation of the disk; instead of slender acicular spinelets which characterize most specimens there are just 7 stout abruptly pointed spinelets, 5 of which form a symmetrical quintet at the center of the disk; in addition there are a number of minute widely scattered granules. At first I thought this specimen might represent a second species but in view of the

facts that it is otherwise quite a typical *remotus* and that there is some individual diversity in *remotus* as to the thickness of the disk spinelets, it is better to consider this one an individual variant.

P.F. 2218. Lion's Head, E. 18 miles, 104 fms. Blk. spc. and r. 5 specimens; adult.

P.F. 2289. Lion's Head, N. 67° E., 25 miles, 131–136 fms. Blk. spc. 1 specimen; young.

P.F. 2766. Vasco de Gama Point, N. 40° E., 13 miles, 120 fms. R. 19 specimens; adult and young.

P.F. 2798. Vasco de Gama Peak, N. 71° E., 18 miles, 230 fms. Sts. 1 specimen; small adult.

P.F. 11359. Tugela River, N.W. by N. $^1/_4$ N., 24 miles, 65–80 fms. R. 10 specimens; small adult and young; 1 hexamerous.

P.F. 13227. Cove Rock, N.W. $^3/_4$ W., 13 miles, 80–130 fms. Clr.? 1 specimen; adult.

P.F. 13455. Sandy Point, N.E. by N. 6 miles, 51 fms. Brk. sh. and st. 1 specimen; young.

P.F. 13576. Stalwart Point, N.N.W., 9 miles, 53 fms. S. and sh. 1 specimen; small adult.

Bathymetrical range, 51–230 fms.

AMPHIURIDAE.

Although thirteen species of this family are now known from the South African region, they represent only four of the twenty genera, and in view of the large number and wide distribution of the species of *Amphiuridae* it must be admitted the group is not adequately represented around the Cape. A striking feature of the family's occurrence is the apparent absence of the cosmopolitan species, *Ophiactis savignyi*, although three other species of *Ophiactis* do occur. It is highly probable that a considerable number of the smaller amphiurids will be found by more intensive collecting but it is evident from the Pieter Faure collection that local conditions are not particularly favorable to the *Amphiuridae*. The thirteen species, here recorded, may be distinguished from each other as follows.

Key to the South African Species of Amphiuridae.

Tip of each jaw occupied by a pair of block-like oral papillae.
  Two oral papillae on each side of each jaw, the second being at its distal angle.
    Tentacle-scales none . . . . . *Amphiura dilatata.*
    Tentacle-scales present.
      Tentacle-scale single.

Arm-spines 6—8, short . . . *Amphiura capensis.*
Arm-spines 4 or 5, longer than arm-segment *Amphiura angularis.*
Tentacle-scales 2.
Radial shields several times as long as wide, their length exceeding one-half disk-radius; upper arm-plates not wider than long . . . . . *Amphiura candida.*
Radial shields 2—2·5 times as long as wide, not nearly one-half disk-radius; upper arm-plates much wider than long *Amphiura incana.*
More than two oral papillae on each side of each jaw.
Three oral papillae on each side, outermost wide and operculiform, equalling or exceeding the other two together in width.
Disk scales relatively coarse, especially at center of disk where some are ·25—·30 mm. across; 5—7 series of scales in each interradial area where narrowest; radial shields large . *Amphipholis minor.*
Disk scales much smaller, more numerous; radial shields smaller, less conspicuous . . . . *Amphipholis squamata.*
Four oral papillae on each side, outermost not greatly enlarged; tentacle-scales 2; arm-spines 3.
Margin of disk ornamented with round tubercles or papillae *Amphioplus gibbosus.*
No papillae or tubercles on disk margin.
Radial shields short, broadly in contact, equal to about one-third disk-radius; arms, 4—5 times disk-diameter *Amphioplus integer.*
Radial shields long, in contact, equal to half disk-radius; arms more than 7 times disk diameter . . *Amphioplus hastatus.*
Tip of each jaw without oral papillae, but occupied by the lowest tooth.
Upper arm-plates broadly oval, twice as wide as long, fully in contact *Ophiactis carnea.*
Upper arm-plates more or less triangular little or not at all in contact.
One oral papilla on each side of jaw, large scale-like *Ophiactis plana.*
Two oral papillae on each side of each jaw . *Ophiactis abyssicola.*

Amphiura dilatata.

Lyman, 1879. Bull. M. C. Z., vol. 6, p. 26; pl. XI, figs. 314–316.

There is good reason for believing that this species is identical with Ljungman's *atlantica* from St. Helena. The only difference is that *dilatata* is known to have the lower surface of the disk bare, while one *infers* from Ljungman's description that such is not the case in *atlantica*, although nothing is said one way or the other about the matter. If the St. Helena species does have the interbrachial areas below, naked, the identity of the two species would be clear and the name *atlantica* would have priority. The Challenger took *dilatata* only at her station 141, in 98 fms. but the Pieter Faure

has found it at the following places. The specimens range in size from 2 to 7 mm. across the disk, but the growth changes are relatively slight and the agreement with Lyman's description and figures is close.

P.F. 458 A. Outside False Bay, 34° 34′ S. × 18° 32′ E., 100 fms. Gn. s. 7 specimens; young.

P.F. 461 A. Outside False Bay, 34° 38′ S. × 18° 33′ E., 110 fms. Bott.? 3 specimens; young.

P.F. 2732. Vasco de Gama Point, N. 10° E., 13 miles, 85 fms. D. gn. s. 77 specimens; adult and young.

P.F. 14833. Cape Castle, W.coast, E. $^1/_2$ N., 9 miles, 89 fms. D. m. and s. 7 specimens; adult.

Amphiura capensis.

Ljungman, 1867. Öfv. Kongl. Vet.-Akad. Förh., vol. 23, p. 320.
Lyman, 1882, Challenger Oph., pl. XVIII, figs. 14–16.

These specimens range from 3·5 to 6·5 mm. across the disk; in the smallest there are as a rule but 5 arm-spines, but one or two of the basal segments have 6; in the largest, there are 7 spines on all the basal joints. Ljungman's type, 5 mm. across the disk, had 6 or 7 arm-spines but Lyman's specimen, figured in the Challenger Report, must have been about 10 mm. across and had 8 arm-spines. Döderlein reports numerous specimens of this species from Lüderitz Bay, Southwest Africa, 3·3–8 mm. across (1910, Schultze's Zool. Anth. Ergeb., vol. 4, lfg. 1, p. 253). He suggests Lyman's large specimen with 8 spines was not *capensis*, but I have examined several of the Challenger specimens and can vouch for their identity. Lyman's figures are, as Döderlein suggests, rather "schematic". The species seems to be distinctly a littoral one, in spite of the fact that the Challenger specimens were taken at 98 fms.

S.A.M. No. 3015. False Bay. Littoral. Dr. Purcell coll. 5 specimens; adult.

Rocks at Sea Point, Feb. 2, 1904. 1 specimen; young.

Amphiura angularis

Lyman, 1879. Bull. M. C. Z., vol. 6, p. 25; pl. XI, figs. 311–313.

It is very interesting to find a fine adult individual of this Antarctic species in the collection. It is one of four specimens labelled "*Ophiothrix triglochis* Bell no. 15110 (not seen by Bell)". The others are *Ophiactis abyssicola* and are listed below. The *Amphiura* is

about 7 mm. across the disk and has arms 50–60 mm. long. It agrees well with CHALLENGER cotypes.

P.F. 15110. South Head, Table Mountain, E. by S. $^1/_2$ S., 25 miles, 190 fms. Gn. s. and blk. spc. 1 specimen; adult.

* AMPHIURA CANDIDA.

Ljungman, 1867. Öft. Kongl. Vet.-Akad. Förh., vol. 23, p. 318.
Koehler, 1904, Mem. Soc. Zool. France, vol. 17, p. 67, figs. 18, 19.

Koehler has examined the holotype of this species and reports it in such poor condition that he wrote his description and made his figures from a specimen from Japan, now in the Vienna Museum and identified by Marktanner-Turneretscher. It does not seem to have occured to Koehler that the Japanese specimen was not identical with Ljungman's lone specimen from Mozambique, but it seems to me more material must be collected and studied before we can feel sure of it. No specimen has been taken south of Mozambique, and referred to *candida*, since Ljungman's type was collected.

AMPHIURA INCANA.

Lyman, 1879. Bull. M. C. Z., vol. 6, p. 20; pl. XI, figs. 285–287.

This species is very near the preceding and I am inclined to think that Ljungman's type of *candida* was a specimen of *incana*, while Marktanner-Turneretscher's specimen of *candida* from which Koehler's figures were made represents another species. But since Ljungman's holotype is no longer identifiable (according to Koehler), it might be just as well to let the name *candida* stand for the present for the Japanese species. Matsumoto (1917, Mon. Japan. Oph., p. 201) however asserts, without comment, that *candida* Mark. Turn. is not *candida* Ljungman, and treats it as a synonym of *euopla* H. L. C. Until more material is available from the vicinity of Mozambique, it will be impossible to definitely settle the matter. Meanwhile the name *incana* may be used for the South African species.

Lyman's types of *incana* came from Simon's Bay, 10–20 fms. Bell lists the species from "off the South Head, Tugela River, N. by W.", 4·75 miles, 25 fms., blk. m. but says he is not very confident of the accuracy of his determination. This is odd, for the species is unusually well characterized and Lyman's type is in the British Museum! I have compared the PIETER FAURE material with

some of the CHALLENGER specimens and have no doubt of their identity. They come from eight stations and as there are 77 of them, the species is evidently common in suitable localities. The disk-diameter ranges from 2 to 7·5 mm. The growth changes are very trivial; in the smallest specimen there are only 5 arm-spines, even at base of arm, and they are pointed, the radial shields are relatively larger, the disk scales are fewer and the arm-plates are relatively longer than in the adult.

P.F. 545. Near Port Elizabeth, 33° 54′ S. × 25° 53′ E., 31 fms. Fne. s. 10 specimens; adult and young.

P.F. 3068. False Bay, 18 fms. S. and sh. 2 specimens; adult, very fine.

P.F. 3099. False Bay, 22 fms. R. and sh. 34 specimens; adult and young.

P.F. 13280. Cove Rock, N. E. by E. ½ E., 4 miles, 22 fms. R. and brk. sh. 1 specimen; young.

P.F. 15502. False Bay, 22 fms. S. and sh. 15 specimens; adult and young.

P.F. 16231. False Bay, 22 fms. Brk. sh. 9 specimens; adult and young.

P.F. 17451. False Bay, 12 fms. S. and sh. 4 specimens; adult.

P.F. 18282. False Bay, 8–10 fms. R. 2 specimens; adult.

Bathymetrical range, 8–31 fms.

AMPHIPHOLIS MINOR.

Ophiactis minor Döderlein, 1910. Schultze's Zool. Anth. Ergeb. vol. 4, lfg. 1, p. 253; pl. V, figs. 3, 3*a*.

Amphipholis minor H. L. Clark, 1915. Mem. M. C. Z., vol. 25, p. 243.

It is very curious that Döderlein did not recognize this species as an *Amphipholis* when it is so similar to the cosmopolitan ***A. squamata***, with which he is unquestionably familiar. There is a single specimen (3·5 mm. across disk), of this species, in the PIETER FAURE collection. It agrees well with Döderlein's description but differs from the figures in having an elevated disk and sharper arm-spines. The species was previously known only from Angra Pequena Bay where it occurs with *Amphiura capensis*.

P.F. 13732. Great Fish Point, N. by W., 7 miles, 49 fms. S. and sh. 1 specimen; adult.

AMPHIPHOLIS SQUAMATA.

Asterias squamata Delle Chiaje, 1828. Mem. Anim. sans Vert. Napoli, vol. 3, p. 74.

Amphipholis squamata Verrill, 1899. Trans. Conn. Acad., vol. 10, p. 312. H. L. Clark, 1904, Bull. U. S. F. C. for 1902, pl. 6, figs. 33, 34; pl. 7, figs. 43, 44.

This remarkably cosmopolitan species was first recorded from South Africa by Ljungman in 1871 under the name *A. kinbergi*. One of Ljungman's types is now in the M. C. Z. collection and is figured in the Mem. M. C. Z., vol. 25, pl. 6, figs. 9, 10. In 1882, Mr. Lyman decided that *kinbergi* was not distinguishable from *squamata* and hence the CHALLENGER specimens from South Africa are listed under the latter name. A specimen in the PIETER FAURE collection is apparently identical with the cotype of *kinbergi* now before me, but it is clear that to separate it from specimens of *squamata* from the east coast of the United States requires a most unscientific use of the imagination, and I must therefore agree with Mr. Lyman and call the South African specimens *squamata*. The PIETER FAURE specimen is quite different from the specimen of *A. minor* but large series of *squamata* from other regions show intermediate forms and I am not fully satisfied that the two species are distinct.

S.A.M. no. 3015. False Bay. Littoral. Dr. Purcell coll. 1 specimen; adult.

* AMPHIOPLUS GIBBOSUS.

Ophiophragmus gibbosus Ljungman, 1867. Öfv. Kongl. Vet.-Akad. Förh., vol. 23, p. 316.

Amphioplus gibbosus H. L. Clark, 1915. Mem. M. C. Z., vol. 25, p. 257.

This species has not been recorded since its original description from a specimen taken near Port Natal. Even its generic position is by no means certain.

AMPHIOPLUS INTEGER.

Amphipholis integra Ljungman, 1867. Öfv. Kongl. Vet.-Akad. Förh. vol. 23, p. 313.

Amphiura integra Koehler, 1904. Mem. Soc. Zool. France, vol. 17, p. 65, figs. 16, 17.

Amphioplus integer H. L. Clark, 1915. Mem. M. C. Z., vol. 23, p. 258.

This species, like the preceding, was originally described from a specimen taken near Port Natal. Koehler has given a more detailed

description and figures, based on one of Ljungman's types. There are in the PIETER FAURE collection two amphiurids which agree so nearly with Koehler's figures and description that it seems to me best to refer them to this species. The larger and better preserved is 5 mm. across the disk and has arms about 20 mm. long. The one particular in which these specimens do not agree with the type is in the shape of the upper arm-spines. Koehler naturally lays great stress on this feature for such flattened biscuit-shaped arm-spines, as are shown in his figure, would certainly be a diagnostic character of great value, if it were constant. But Ljungman does not refer to it; which indicates that it was either wanting in some of his specimens (if he had more than one) or was not conspicuous enough to attract his attention. In the two specimens before me there is only a hint of this character; in the larger specimen a few of the uppermost spines near the base of the arm are flattened and widened and one or two even show the biscuit-shape of Koehler's figure 16 to a trifling degree. The radial shields in the specimens before me are not quite so wide in proportion to their length as in Koehler's figure, and the six primary plates of the disk are more distinct. Under the circumstances however, in spite of these differences, it seems to me better to refer these specimens to Ljungman's species than to give them a new name.

P.F. 13598. Great Fish Point, W. by N., 5 miles, 22 fms. R., crl., and st. 1 specimen; adult.

Rocks at Sea Point, Feb. 2, 1904. 1 specimen; adult.

* AMPHIOPLUS HASTATUS.

Amphipholis hastata Ljungman, 1867. Öfv. Kongl. Vet.-Akad. Förh., vol. 23, p. 313.

Amphioplus hastatus H. L. Clark, 1915. Mem. M. C. Z., vol. 25, p. 257.

This is another of Ljungman's species which has not been met with since its original description from a specimen, 4 mm. in disk-diameter, from Mozambique. Verrill (1899) puts this species in *Amphipholis* (although he says frankly that it has four oral papillae) while *gibbosus* and *integer* he puts in *Amphiodia*. Ljungman however distinctly says in each description, "Papillae orales quaternae", so that until further material proves them to be otherwise unlike *Amphioplus*, the three species must rest in that genus.

Ophiactis carnea.

Plate XX. Figs. 3, 4.

Ljungman, 1867. Öfv. Kongl. Vet.-Akad. Förh., vol. 23, p. 324.

There is an excellent series of this characteristic species, which has previously been something of a rarity. The smallest is barely 2 mm. across the disk and the arms are scarcely 10 mm. long; the disk is covered by a central rosette of 16 primary plates with about ten additional plates in each interradial area, and two small plates between the proximal ends of each pair of radial shields; there are small sharp spinelets scattered over the disk more especially near the margin; the upper arm-plates are broadly in contact and might be called transversely oval, but the proximal half is distinctly narrower than the distal and the plates are not much wider than long; the under arm-plates are squarish with rounded corners, nearly or quite in contact; there are only 4 arm-spines, even at base of arm, and they are relatively short and thick; there is a single, relatively large oral papilla at the distal angle of each jaw, on each side. In a specimen 2·5 mm. across the disk and with arms about 13 mm. long, the disk scales are much more numerous and the primary plates (except the central) are no longer distinct; the upper arm plates are broadly oval, much wider than long and there are 5 arm-spines. The largest specimen, 6 mm. across the disk and with arms nearly 35 mm. long, differs from this very little indeed; the under arm-plates are wider than long and have the distal margin convex and the arm-spines seem to be relatively a trifle longer. Most of the specimens are very light, nearly white, or more or less pinkish, but the larger ones are light brown, with the arms more or less distinctly banded with darker. One specimen, from Sea Point, is variegated gray-green, olive-green, and greenish-white, but it is not otherwise peculiar. It will be interesting to learn the colour in life.

P.F. 106 A. Between Cape St. Blaize and Mossel Bay, 4 fms. S. 14 specimens; adult and young.

P.F. 215 A. Cape St. Blaize. S.W. by W. $^1/_4$ W., 6 miles, 15–18 fms. Stns. 46 specimens; adult and young.

P.F. 769. Off East London, 32° 52′ S. × 28° 12′ E. Depth and bottom? 1 specimen; young.

P.F. 859. Off East London, 32° 45′ S. × 28° 26′ E. 36 fms. Stns. 2 specimens; young.

S.A.M. No. 3015. False Bay, Cape Colony. Littoral. Dr. Purcell coll. 1 specimen; small adult.

P.F. 10975. Tongaat River, N.W. by N. 1/4 N., 5 miles, 36 fms. S. and sh. 1 specimen; very young.

P.F. 12459. Umtwalumi River, N. by W., 2 miles, 25 fms. Brk. sh. 1 specimen; young.

P.F. 13280. Cove Rock, N.E. by E. 1/2 E., 4 miles, 22 fms. S. and brk. sh. 2 specimens; young.

P.F. 13520. East London, N.W. by W. 1/2 W., 2 miles. Depth? R. and brk. sh. 2 specimens; adult, fine.

P.F. 13598. Great Fish Point, W. by N., 5 miles, 22 fms. R., crl., and st. 3 specimens; young.

P.F. 13619. Great Fish Point, W. by N., 5 miles, 22 fms. R., crl., and st. 8 specimens; adult and young; fine.

P.F. 15627. False Bay, Cape Colony, 17–27 fms. R. 1 specimen; young.

P.F. 18282. False Bay, Cape Colony, 8–10 fms. R. 2 specimens; adult, fine.

Rocks at Sea Point, Feb. 2, 1904. 1 specimen; young.

Bathymetrical range from shore to 36 fms.

Ophiactis plana.

Lyman, 1869. Bull. M. C. Z., vol. 1, p. 330.
H. L. Clark, 1915. Mem. M. C. Z., vol. 25, pl. 10, figs. 1, 2.

In the Challenger Report, Lyman, after describing *Ophiactis flexuosa* (p. 116), records ten, small, six-armed specimens of *Ophiactis* from St. 142 (Agulhas Bank) as possibly young *flexuosa* but says they can scarcely be distinguished from *plana*. A recent critical study of the species of *Ophiactis* has led to the conclusion that *plana* and *flexuosa* are identical, the former name being the earlier though based as Lyman suggests, on young specimens. There are two very young six-armed specimens of *Ophiactis*, 2–3 mm. across the disk, in the Pieter Faure collection which are certainly not either *carnea* or *abyssicola*. They agree fairly well with *plana*, except that the radial shields are not so large and the disk scales not so few and large as in that species. But in both specimens, the disk is being regenerated at least in part, and hence I think there is little reason to doubt that these youngsters are identical with those taken by the Challenger on Agulhas Bank, and all may properly be referred to *plana*.

P.F. 13227. Cove Rock, N.W. 3/4 W., 13 miles, 80–130 fms. Crl. 1 specimen; young.

P.F. 13859. Glendower Beacon, N. 1/4 W., 21 miles, 100 fms. Sh. and r. 1 specimen; very young.

Ophiactis abyssicola.

Amphiura abyssicola Sars, 1861. Ov. Norges Ech., p. 18; pl. 2, figs. 7–12.
Ophiactis abyssicola Ljungman, 1867. Öfv. Kongl. Vet.-Akad. Förh., vol. 23, p. 324.

A recent critical study of the genus *Ophiactis* has shown that *O. poa*, described by Lyman (1882, Challenger Rep., p. 119; pl. XX, figs. 13–15) from near Tristan d'Acunha in 500–1000 fms. is not to be distinguished from Sars' species *abyssicola* of the North Atlantic. The Pieter Faure has extended the range of the species far to the southeastward by collecting a good series of specimens, as listed below. They range in disk-diameter from 3 to 8·5 mm. While they agree well in most details and are with little doubt all to be referred to one species, they show an extraordinary and most interesting diversity in the disk covering; the radial shields, while always large, vary from broadly triangular to a curved pear-seed shape with concave sides towards each other; the disk scales may be few, large and thick, or more numerous and thinner, and in two specimens (from very deep water) they are very numerous with many secondary plates intercalated around and among the larger ones; the disk spines may be numerous, all over the disk or confined to the margin, or there may be only two or three widely scattered ones; these spines are usually long and fairly stout, but they may be very slender and pointed, and in one or two specimens (from very deep water) they are very small. All the specimens are pale gray, pale brown or whitish; some have a pinkish tinge.

P.F. 2134. Lion's Head, S.E. $^1/_2$ E., 42 miles, 156 fms. D. gn. s. 1 specimen; adult.

P.F. 2798. Vasco de Gama Peak, N. 71° E., 18 miles, 230 fms. Stns. 19 specimens; adult.

P.F. 14984. Lion's Head, 55$^1/_2$° E., 47 miles, 175 fms. Bottom? 1 specimen; adult.

P.F. 15110. South Head, Table Mountain, E. by S. $^1/_2$ S., 25 miles, 190 fms. Gn. s. and blk. spc. 3 specimens; adult.

P.F. 16758. Cape Point, N.E. by E. $^1/_4$ E., 38 miles, 755 fms. Gn. m. 1 specimen; adult.

P.F. 17330. Cape Point, N. 86° E., 43 miles, 900–1000 fms. Grey m. 1 specimen; adult.

P.F. 17541. Cape Point, N.E. by E. $^3/_4$ E., 8 miles, 91 fms. S. and spc. 1 specimen; adult.

P.F. 18154. Cape Point, N.E. by E. $^3/_4$ E., 28 miles, 300 fms. Fne. s. 1 specimen; young.

P.F. 18933. Southeast from Cape Agulhas, 36° 40′ S. × 21° 26′ E., 200 fms. Gn. s. 15 specimens; adult.

Bathymetrical range, 91–1000 fms.

OPHIOTRICHIDAE.

This large, tropical family is fairly well represented around the Cape, in view of the extratropical character of the region. There are ten species now known, representing four genera. The six species of *Ophiothrix* are more or less perplexing owing to the variability of several of the species, and to the fact that specific limits in the genus are not well worked out as yet. In some species, the colour pattern seems to be the most reliable character while in other cases it seems to be perfectly worthless. So too with the character of the spinelets or thorny stumps on the disk; these may give reliable specific characters but as a rule they are not to be trusted. The arm-spines are usually dependable but their characters are not easily expressed in words and they are not often distinctive. The following key shows how the South African species of *Ophiotrichidae* may be distinguished from each other, but in this family in particular such keys must be used with caution.

Key to the South African Species of Ophiotrichidae.

Under arm-plates well developed.

Disk plates with thorny stumps or spinelets or both; these are often very numerous, concealing the plates, but they may be few and scattered.

Disk plates with numerous thorny stumps or rough spinelets or both.

Arm-spines, glassy, slender and sharp, though thorny *Ophiothrix aristulata.*

Arm-spines more or less opaque, the longest ones at least, flattened dorso-ventrally more or less, and truncate or blunt.

Radial shields big and bare; rest of disk covered chiefly with rough spinelets; arm-spines little flattened *Ophiothrix fragilis.*

Radial shields smaller and usually more or less covered by the small thorny stumps which occupy all the rest of the disk surface; larger arm-spines much flattened.

Arms moderately long, 4–6 times disk-diameter; upper arm-plates fan-shaped, rhombic or pentagonal, not much wider than long, if any . . *Ophiothrix triglochis.*

Arms very long, 9–18 times disk-diameter; upper arm-plates very much wider than long *Ophiothrix longipeda.*

Disk plates with scattered acicular spinelets.

Upper and under arm-plates obscured by skin; five distinct radiating black lines on disk, one extending onto base of each arm *Ophiothrix capensis.*

Upper and under arm-plates distinct; no radiating black lines on disk.
Upper surface of arms marked with narrow transverse lines of deep red . . . . *Ophiothrix poecilodisca.*
Upper surface of arms, at least near tip, with a narrow median stripe made up of three white lines separated from each other by distinct black ones . . . *Ophiothrix trilineata.*
Disk plates flat, smoothly covered by a uniform coat of granules; radial shields bare and very large . . . *Ophiocnemis marmorata.*
Under arm-plates wanting or apparently so.
Side arm-plates projecting as spine-bearing ridges occupying the whole height of the arm or nearly so; upper surface of arms in adults (except distally) covered by a coat of granules and not showing any upper arm-plates . . . . . *Ophiopsammium nudum.*
Side arm-plates low, squarish, projecting as wing-like plates on lower half of arm; upper surface of arms with irregular granules among which the upper arm-plates can often be distinguished *Ophiothela dividua.*

Ophiothrix aristulata.

Lyman, 1879. Bull. M. C. Z., vol. 6, p. 50; pl. XV, figs. 421—424.

In Mr. Lyman's description, he says the arm-spines are "scarcely tapering" and "slightly flattened". If this were so, it would be exceedingly difficult to distinguish this species from *triglochis* and *fragilis* (see below, under *fragilis*) but the many specimens I have seen from South Africa, the East Indies and Australia, including two of Lyman's cotypes from the Agulhas Bank, have tapering, acuminate spines which are seldom appreciably flattened. They show some diversity in length, relative thickness and thorniness but they are seldom stout and often very thorny. Bell (1905, Mar. Inv. S. Afr., vol. 3, p. 258) records this species from two stations, one in 35 fms. and one in 22 fms. Specimens of *Ophiothrix* from the latter station are before me and are here listed as *triglochis*, the common South African species, which Bell records from only one station. As *aristulata* is normally a deep water species, I suspect all of Bell's specimens were *triglochis*.

The Pieter Faure collection contains only seven specimens of this fine species. They range in disk diameter from 6 to 14 mm. and all are nearly white, with more or less of a pinkish tinge still left on the arms; on the upper arm plates, there are faint indications of a more or less broken median longitudinal, white stripe.

P.F. 2529. Lion's Head, N. 63° E., 34 miles, 154 fms. Blk. spcs. 3 specimens; adult.

P.F. 2798. Vasco de Gama Peak N. 71° E, 18 miles, 230 fms. Stn. 2 specimens; adult.

P.F. 13225. Cove Rock, N. W. $^3/_4$ W., 13 miles, 80—130 fms. Crl. and r. 2 specimens; adult.

Ophiothrix fragilis.

Asterias fragilis Abildgaard, 1789. In Müller's Zool. Dan., vol. 3, p. 28; pl. XCVIII.
Ophiothrix fragilis Düben and Koren, 1846. Kongl. Vet.-Akad. Handl. f. 1844, p. 238.

Some specimens of a coarse *Ophiothrix* from Saldanha Bay perplexed me greatly until I found that Koehler had recorded this European species from that very place. Comparison of these specimens with some of equal size of *fragilis* from Heligoland shows that they may without impropriety be referred to that species, although they do not agree in all details. They approach so nearly to some specimens of *triglochis*, indeed, that one wonders whether *fragilis* and *triglochis* are really distinct. The only difference between the two species is that in typical *triglochis* there are no disk-spinelets among the stumps and the radial shields are more or less well covered by the latter. But as will be pointed out below, the present collection shows that *triglochis* is a very variable species and it may be that it will be best to treat it merely as a southern variety of *fragilis*.

As pointed out in the key above, the *Ophiothrix* from Saldanha Bay has very large, bare radial shields and the rest of the disk is rather densely covered with long, stout, thorny spinelets. The general colour is dingy white on the disk, with both disk-spinelets and arm-spines pale brown; the radial shields have narrow dull red margins and the upper arm-plates are a mixture of dull reddish and dingy white.

P.F. 14905. Saldanha Bay, Cape Colony, 10 fms. S. and mussel-beds. 6 specimens; adult.

Ophiothrix triglochis.

Müller and Troschel, 1842. Sys. Ast., p. 114. Koehler, 1904. Mem. Soc. Zool. France, vol. 17, p. 81, figs. 41—45.

The Pieter Faure collection shows clearly that this is the common *Ophiothrix* of South Africa. There are 170 specimens from 23 stations, and while they show great diversity I feel no hesitation in referring them all to *triglochis*. The smallest is only 2·5 mm. across the disk and shows the primordial central plate very plainly.

The largest specimen is 13 mm. across the disk. In colour, the diversity is very great, ranging from almost pure white (dry specimens) to deep, dull indigo, on the disk. The arms range from white to pink, dull red or various shades of brown; often there are indications of alternating red and blue bands; sometimes there is a distinct median white stripe and usually the distal tip of the upper arm-plates is white; not uncommonly the whole distal margin of each plate is whitish. The variation in the disk covering is nearly as great as in the coloration. Typically, the whole upper surface of the disk including the radial shields is covered by low, thorny stumps as shown in Koehler's fig. 41, but the stumps themselves show no little diversity, for they may be low and crowned with short thorns (see Koehler's fig. 43) or slender and more cylindrical (Koehler's fig. 44) or they may, whether low or high, be crowned with three long, slender spinelets; all sorts of intergradations between the extremes occur. Moreover in some specimens from False Bay, we find among the stumps, disk spinelets over a millimeter long and more or less thorny; in the largest specimen, these are so numerous as to replace most of the stumps and the radial shields are bare. This individual, if by itself and labelled "Saldanha Bay", would probably be considered *fragilis*. Compared directly with Saldanha Bay specimens however, several differences are obvious; the radial shields are much smaller in *triglochis*, the disk spines, much less thorny, the upper arm-plates wider and smoother and the under arm-plates shorter and wider and more widely separated. These differences hold so well in all the material at hand that I feel justified in not uniting the two species as one.

I am inclined to think *O. roseocoerulans* Grube of St. Helena is not to be separated from *triglochis* but until more is known of the colour varieties of the Cape species, they may be kept apart. I have no doubt however that the specimens from False Bay, identified by Bell as *roseocoerulans* (*op. cit.* p. 258) are better referred to *triglochis*.

The Pieter Faure collected *triglochis* at the following points:

P.F. 106 A. Between Cape St. Blaize and Mossel Bay, 4 fms. S. 2 specimens; young.

P.F. 507. Algoa Bay, 33° 58′ S. × 25° 51′ E., 25 fms. R., blk. spcs. 1 specimen; adult.

P.F. 590. Algoa Bay, 33° 50′ S. × 25° 54′ E., depth and bottom not recorded. 1 specimen; young.

P.F. 769. Near East London, 32° 52′ S. × 28° 12′ E., depth and bottom not recorded. 30 specimens; adult.

P.F. 859. Off Great Kei River, 32° 45′ S. × 28° 26′ E., 36 fms. Stns. 7 specimens; adult and young.

S.A.M. 3014. False Bay, Cape Colony. Littoral. Dr. Purcell coll. 12 specimens; adult.

P.F. 3028. Cape Point, N.W. by W. 1/4 W., 11 3/4 miles, 45 fms. M. and r. 1 specimen; adult.

P.F. 10354. Gericke Point, N. 3/4 E., Knysna E. 3/4 N., 46 fms. S., sh., and r. 6 specimens; adult.

P.F. 10975. Tongaat River, N.W. by N. 1/4 N., 5 miles, 36 fms. S. and sh. 13 specimens; young.

P.F. 11556. Tugela River, N.W. by N., 22 miles, 47 fms. Brk. sh. 1 specimen; very young.

P.F. 12360. Umhlangakulu River, N.W. by N., 7 miles, 50 fms. S. and sh. 1 specimen; young.

P.F. 12983. Gonubie River, N.W. by W. 3/4 W., 3 miles, 20 fms. Brk. shs. 8 specimens; adult.

P.F. 13068. Hood Point, N. by W. 1/2 W., 11 miles, 49 fms. Brk. sh. 1 specimen; adult.

P.F. 13193. Cove Rock, N.W. by N., 6 miles, 43 fms. Brk. sh. and r. 4 specimens; young.

P.F. 13240. Cove Rock, N. 3/4 E., 5 miles, 43 fms. St. and brk. sh. 14 specimens; adult and young.

P.F. 13280. Cove Rock, N.E. by E. 1/2 E., 4 miles, 22 fms. R. and brk. sh. 11 specimens; adult.

P.F. 13455. Sandy Point, N.E. by N., 6 miles, 51 fms. Brk. sh. and st. 4 specimens; small adults.

P.F. 13519. East London, N.W. by W. 1/2 W., 2 miles. Depth? R. and brk. sh. 5 specimens; adult.

P.F. 13619. Great Fish Point, W. by N., 5 miles, 22 fms. R., crl. and stns. 20 specimens; adult and young.

P.F. 15502. False Bay, Cape Colony, 22 fms. S. and sh. 2 specimens; young.

P.F. 16231. False Bay, Cape Colony, 22 fms. Brk. sh. 1 specimen; very young.

P.F. 17468. False Bay, Cape Colony, 9 fms. S. and sh. 11 specimens; adult and young.

P.F. 18282. False Bay, Cape Colony, 8—10 fms. R. 15 specimens; adult and young.

Bathymetrical range, shore to 51 fms.

Ophiothrix longipeda.

Ophiura longipeda Lamarck, 1816. Anim. s. Vert., vol. 2, p. 544.
Ophiothrix longipeda Müller and Troschel, 1842. Syst. Ast., p. 113.

It is rather odd that this big, common and long known species has never been properly figured. The colored figure by Herklots (1869, Ech. p. d'apres Nature, pl. 7) is unlike any specimen I have ever seen, and I have examined scores of living individuals as well as large numbers of museum specimens.

The collection from the South African Museum extends the known range of this tropical species far to the southward. This collection contains six fragmentary specimens, of which the two larger (20–22 mm.) are unquestionably *longipeda*, while the four smaller (6–13 mm.) seem to be identical and are, with little doubt, the young. Their only peculiarities are the lack of blue in the coloration and the relatively short arms, which were apparently less than ten times the disk diameter. They are poorly preserved however and all the arms are more or less broken. There is reason to believe they were much more brightly coloured in life. It is probable too that in this species the relative length of the arms increases with age until maturity. The largest specimen I have measured, alive, was 37 mm. across the disk and had arms 625 mm. long, or 17 times the disk diameter.

P.F. 12359. Umklangakulu River, N.W. by W., 7 miles, 50 fms. S. and sh. 1 specimen; small adult.

P.F. 12405. Itongazi River, N.W., $^3/_4$ W., 3 miles, 25 fms. R. and st. 4 specimens; adult and young.

Delagoa Bay, P.E.A. K. H. Barnard, Oct. 1912. 1 specimen.

* Ophiothrix cápensis.

Lütken, 1869. Add. ad Hist. Oph., pt. 3, pp. 59 and 100.

This species does not seem to have been met with since its original description, based on a specimen from the Cape of Good Hope. It has never been figured but is apparently nearly related to *O. suensonii* of the West Indies. The concealment of the arm-plates in skin is a very remarkable character in this species and the radiating black lines on the disk would also seem to be distinctive.

Ophiothrix poecilodisca.

H. L. Clark, 1915. Mem. M. C. Z., vol. 25, p. 276; pl. 13, fig. 5.

This well-marked species, known hitherto only from Zanzibar, is represented in the present collection by a small and badly damaged specimen from Delagoa Bay. It is about 5 mm. across the disk and was collected by K. H. Barnard in October, 1912. The transverse, deep red lines across the arms are very distinctive. The lower arm plates however lack the red markings altogether. The disk carries only 7 or 8 spines.

* Ophiothrix trilineata.

Lütken, 1869. Add. ad Hist. Oph., pt. 3, pp. 58 and 100.

This wide-spread and handsome Indo-Pacific species has long been known from Mozambique, whence specimens came to the M. C. Z. many years ago, but it has not yet been found south of that point, and it is not represented in the collections of the South African Museum.

* Ophiocnemis marmorata.

Ophiura marmorata Lamarck, 1816. Anim. s. Vert., vol. 2, p. 543.
Opiocnemis marmorata Müller and Troschel, 1842. Sys. Ast., p. 87.
Döderlein, 1888. Zool. Jahrb., vol. 3, pl. XXXII, figs. 6*a–c*.

The inclusion of this species in the South African fauna seems to rest wholly on a specimen in the M. C. Z. collection, collected by Wahlberg and said to have come from the Cape of Good Hope. It occurs commonly at Zanzibar but has not been recorded from Mozambique and its occurrence on the coasts of Natal and Cape Colony seems to me very unlikely.

Ophiopsammium nudum *, sp. nov.

Disk 6 mm. in diameter; arms five, 25–30 mm. long. Disk covered by a thin naked skin, through which the five pairs of large radial shields are plainly visible; scattered sparsely over this skin are plates and granules; at the center of the disk are about a dozen, flat, nearly circular plates irregularly scattered, and others form a single discontinuous series in each of the narrow interradial areas; these plates are from ·10 to ·25 mm. across and some of them bear spherical or

* *nudum* = naked, in reference to the absence of plates at center of disk and on interbrachial areas below.

conical granules; all over the radial shields, which are about 2·5 mm. long and distally 1·5 mm. wide, and also on the interradial margin between the distal ends of the pairs of radial shields, are numerous granules about ·10 mm. in diameter; these are well spaced, and even irregularly scattered except at distal ends of the radial shields where they become somewhat crowded to form the uniform granular coat which covers the upper surface of the arms; in each interbrachial area are scattered a dozen or more granules, of which about half are conical and pointed, ·25–·50 mm. high. No upper arm-plates; distally the granular covering of the arms becomes less and less continuous, until there is only bare skin with a few scattered granules on each segment. Interbrachial areas below, perfectly naked except for a very few conical granules. Oral shields, adoral plates and under arm-plates wanting or apparently so, for if present they are completely obscured by the thin skin. Oral plates large and dental papillae numerous. No oral papillae, of course. Base of each jaw perforated as in Ophiothrix. Side arm plates short, about as high as arm, compressed into a spine-bearing ridge, which carries 6 or 7 short, blunt, not very thorny spines; uppermost and three lowest spines smallest, third longest and equal to an arm-segment; the lowest does not become hook-like until near tip of arm. No tentacle scales but the tentacles are protected by the basal part of each side arm-plate. Colour of dry specimen, pale salmon, the bare skin browner and the granules whiter.

P.F. 10975. Tongaat River, N.W. by N. $^1/_4$ N., 5 miles, 36 fms. S. and sh. 1 specimen; very young.

P.F. 10976. Same locality as 10975. 1 specimen; adult.

Holotype, South African Museum no. A 6440, P.F. 10976.

This species differs very noticeably from *O. semperi* in the much coarser granulation of the dorsal surface, the large areas of naked skin and the conspicuous radial shields. The last two characters serve to distinguish it also from *O. rugosum*, the only other member of the genus.

The specimen from P.F. 10975 has obviously undergone fission as it has six arms, three of which, with their associated radial shields, are much smaller than the others. At first glance it resembles an *Ophiothela* but more careful examination shows that the side arm-plates are not like those of that genus. In colouration it is very similar to the adult. The upper surface of the arms, however, even at the base, is not uniformly granular but has few, irregular, unequal scattered granules on each segment, much as in *Ophiothela*, and just as on the terminal segments of the arms of the adult.

* Ophiothela dividua.

Von Martens, 1879. Sitzb. Berlin Ges. Nat. Fr., p. 127, figs. 1–4.

Three of von Marten's cotypes are in the M. C. Z. collection. They were taken at Algoa Bay on alcyonarian coral. There is nothing for me to add to the original description, but it may be worth while to note that these dry specimens have retained their pretty colouration very well. The general effect is dull blue, of an indigo tint, variegated with whitish; the deep blue lines across the outer ends of the radial shields, and at intervals across the arm, are conspicuous.

OPHIOCHITONIDAE.

This small family was not previously known from South Africa but the Pieter Faure has detected three species, representing the two most characteristic genera. They may be distinguished from each other as follows:

Key to the South African Species of Ophiochitonidae.

Supplementary plates present on each side of each upper arm-plate.

Disk scales exceedingly numerous and minute, 150—200 or more per sq. mm. near center of disk where they are scarcely distinguishable with a magnifying glass. . . . . *Ophionereis dubia.*

Disk scales fine or rather coarse, 25—100 per sq. mm. at center of disk *Ophionereis porrecta.*

No supplementary plates present on the upper surface of arms *Ophiochiton australis.*

Ophionereis dubia.

Ophiolepis dubia Müller and Troschel, 1842. Sys. Ast., p. 94. Savigny, 1809. Descr. de l'Egypte (Audouin): Rayonnes, pl. 1, figs. 3^{1}–3^{10}.
Ophionereis dubia Lyman, 1865. Illus. Cat. M. C. Z., no. 1, p. 149.

This species was not previously known from south of Zanzibar but the Pieter Faure collection shows it is a regular inhabitant of the coast of Natal and eastern Cape Colony. None of the specimens are full grown, the disk-diameters ranging from 2·5 to 6·5 mm. No two are coloured alike; the disk is usually light, white or whitish, with or without a dark spot or line, between or across the radial shields; the arms are usually some light shade of brown or olive, with or without indefinite whitish variegation, but in all cases with transverse rings of brown at intervals of 3–10 (usually 4–6) segments; these rings are usually very distinct on the dorsal surface but they may be faint even there and wanting orally. Savigny's beautiful

figures show the general colour pattern well but very wisely do not attempt to indicate the disk-scales.

P.F. 859. Off Great Kei River, 32° 45′ S. × 28° 26′ E., 36 fms. St. 2 specimens; young.

P.F. 11556. Tugela River, N.W. by N., 22 miles, 47 fms. Brk. sh. 1 specimen; young.

P.F. 12360. Umhlangakulu River, N.W. by N., 7 miles, 50 fms. S. and sh. 1 specimen; small adult.

P.F. 13455. Sandy Point, N.E. by N., 61 miles, 51 fms. Brk. sh., and st. 1 specimen; small adult, diskless.

P.F. 13520. East London, N.W. by W. ½ W., 2 miles. Depth? S. and brk. sh. 1 specimen; small adult.

Ophionereis porrecta.

Lyman, 1860. Proc. Boston Soc. Nat. Hist., vol. 7, p. 260.
1865, Illus. Cat. M. C. Z., no. 1, p. 147, figs. 14 and 15.

The Pieter Faure found this species even more common than the preceding and in the same localities, although it has not been previously reported from the coast of Africa. I have compared these South African specimens with Lyman's types and find that they agree in all essentials. But whereas, in Lyman's original material from an unknown locality and in the other material at hand from various Indo-Pacific localities, the scaling of the disk becomes increasingly finer with growth, so that in large specimens it is, at center of disk at least, very fine, in these South African specimens the disk is always covered with relatively coarse scales; in the largest specimen (15 mm. disk-diameter) even at center of disk, there are not more than 20–25 scales to each sq. mm. and there may not be so many. This retention of a youthful character is of no little interest and it may be desirable ultimately to recognize this form as a subspecies or variety. But the decision on that point must await further investigations along the East African coast and accumulation of more material.

The Pieter Faure specimens range from 5·5 to 15 mm. in disk-diameter, but show little diversity in coloration. No two are exactly alike but all are more or less variegated with dull shades of brown, purplish and whitish; the arms are more or less distinctly annulated with a darker shade than the ground colour. The specimen from 13280 is peculair in the very smooth, tessellated plating of the disk; the primary plates are quite distinct and with other large plates are surrounded by circles of smaller ones in an indistinct but rather

ornate pattern; the dorsal side of the arms is very prettily marbled with dull purplish and whitish; the under surface is white but on each arm is a broad, dull purple, longitudinal stripe which does not decrease in width distally and hence comes to occupy the entire under surface of the arm. Such a stripe is faintly indicated on some other specimens.

P.F. 507 A. Algoa Bay, 33° 58′ S. × 25° 51′ E., 25 fms. R., blk. sp. 2 specimens; adult.

P.F. 859. Off Great Kei River, 32° 45′ S. × 28° 26′ E., 36 fms. St. 3 specimens; young.

P.F. 12361. Umhlangakulu River, N.W. by W., 7 miles, 50 fms. S. and sh. 3 specimens; adult and young.

P.F. 12405. Itongazi River, N.W. ¾ W., 3 miles, 25 fms. S. and st. 5 specimens; adult and young.

P.F. 13068. Hood Point, N.W. by W. ½ W., 11 miles, 49 fms. Brk. sh. 1 specimen; young.

P.F. 13280. Cove Rock, N.E. by E. ½ E., 4 miles, 22 fms. R. and brk. sh. 1 specimen; small adult.

P.F. 13520. East London, N.W. by W. ½ W., 2 miles. Depth? S. and brk. sh. 1 specimen; small adult.

Bathymetrical range, 22–50 fms.

Ophiochiton australis *, sp. nov.

Plate XX. Figs. 1, 2.

Disk 8 mm. in diameter; arms 55–60 mm. long. Disk covered by a coat of thick, irregular, overlapping scales, many of which are ·50–·75 mm. across and among which the six primary plates can hardly be distinguished. (They are evident in the smaller specimen, which is 6 mm. across the disk.) Radial shields small and widely separated; not much larger than the largest disk scales, in the smaller specimen; in the holotype they are about 1·5 mm. long, ·80–1 mm. wide just distal to the middle and about ·75 mm. apart. Upper arm-plates broadly hexagonal, 1·5–1·8 times as wide as long, the distal side slightly convex and occupying the full width of plate, the proximal margin only a little more than half as much; the disto-lateral angles are often a little rounded; the plates are in contact for the full width of the proximal margin. Interbrachial areas below covered by coarse, overlapping scales, no one of which is large or conspicuous. Oral shields, rhomboidal or spear-head-shaped, decidedly longer than wide, with all angles, except possibly the

* *australis* = southern, in reference to the locality where found.

proximal, rounded; proximal sides longer than distal; madreporite of holotype, larger and much longer than the other shields, its *distal* sides nearly twice as long as *proximal*. (On the other specimen, the madreporite is a trifle larger than the other shields but is not otherwise peculiar). Adoral plates curved pentagonal, pointed within where they barely meet, if at all, widest near middle and extending down between oral shields and side arm-plates. Oral plates small. Oral papillae, 5 on a side, of which the penultimate is much the largest; it is tetragonal and much wider than long, its width equalling the second and third together or even exceeding them; the distalmost papilla is partly concealed, as it passes inward

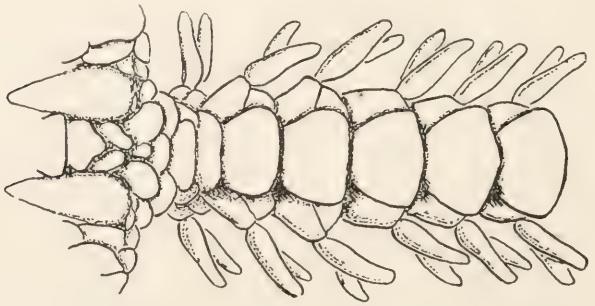

Fig. 3. Upper side of part of disk and arm of *Ophiochiton australis* sp. nov. × 10.

above the big one; the distal papilla and a part of each of the big papillae are borne on the adoral plates, while the oral plates bear the rest. No dental papillae. Teeth 5 or 6 in a column, tetragonal, except the lowest which may be somewhat triangular. First under arm-plates rather small, distally rounded and proximally prolonged, decidedly longer than wide; following plates axe-head-shaped, at first wider than long but soon becoming longer than wide, broadly in contact; the distal margin is slightly convex and the lateral margins markedly concave. Side arm-plates rather small, projecting but little and not meeting either above or below; each carries three short, thick, blunt spines, of which the uppermost equals one arm-segment, the middle one is a trifle longer, and the lowest nearly equals the middle one. Tentacle-scale, single, large, oval, nearly equal to the under arm-plate in length. Colour (dry) above light dull brown, with a purplish-shade, more or less variegated, especially on the upper arm-plates, with yellowish-white; each radial shield is whitish with a brown margin; beneath, yellowish-white.

P.F. 11556. Tugela River, N.W. by N., 22 miles, 47 fms. Brk. sh. 2 specimens; small adults.

Holotype, South African Museum no. A 6439.

This species so closely resembles *Ophionereis porrecta* in form, colour and all details, except the complete absence of supplementary upper arm-plates, that it might easily be mistaken for that species in life. It is interesting to note that it occured at the same station with *Ophionereis dubia*, while *O. dubia* and *O. porrecta* occurred together at least three times. The known species of *Ophiochiton* fall readily into two groups, of which the larger has 2 or more tentacle-scales, at least on the basal arm-pores, while the smaller has only a single, large scale. The present species belongs in the smaller group but is easily distinguished from its other members by the short, thick arm-spines, the form of the oral papillae, the oral shields, and the upper arm-plates. It seems to be nearer to the Atlantic species, *ternispinus* and *grandis*, than to any of the Pacific species. Excepting *O. lentus*, from deep water near the Kermadec Islands, this is the only *Ophiochiton* known from south of the equator.

OPHIOCOMIDAE.

No representative of this tropical family has been taken at any time by the Pieter Faure and I frankly question its right to a place in this report. It is true that several species are known from Mozambique and more probably occur there, but south of that point, there is not a single record except that of *Ophiocoma scolopendrina* which Lyman reports was taken at Simon's Bay, Cape of Good Hope, in 10–20 fms. He does not say how many specimens there were, but evidently there were very few and probably only one, as the M. C. Z. collection contains but half of the disk of a large individual from this station. While this specimen is unquestionably correctly identified, I suspect there was some mistake about the locality label, and I shall not believe that *Ophiocoma* occurs on the coasts of Cape Colony until further specimens are secured. Koehler has described an *Ophiopsila* (*O. paucispina*) from Fernão Veloso Bay, but the genus has not yet been found at Mozambique.

The species of this family now known from Mozambique are distinguished from each other as follows.

Key to the South African Species of Ophiocomidae.

Disk covered with a uniform coat of granules, except on the interbrachial areas below, where the scales are more or less bare.

Tentacle-scales 2, often 1 distally.

Colour variegated; more or less whitish on under side of arms; arms 5 – 8 times disk-diameter . . . *Ophiocoma scolopendrina.*

Colour very dark, nearly or quite black; no light colour anywhere; arms short, 4—5 times disk-diameter . . . *Ophiocoma erinaceus.*

Tentacle-scales 1, sometimes 2 on the first few basal joints.

Colour very dark as in *erinaceus* . . *Ophiocoma schoenleinii.*

Colour more or less light and variegated . . *Ophiocoma valenciae.*

Disk free from granules, but usually with a few scattered, blunt spines *Ophiomastix venosa.*

Ophiocoma scolopendrina.

Ophiura scolopendrina Lamarck, 1816. Anim. s. Vert., vol. 2, p. 544. *Ophiocoma scolopendrina* Müller and Troschel, 1842. Syst. Ast., p. 101. H. L. Clark, 1915. Mem. M. C. Z., vol. 25, pl. 14, figs. 10, 11.

This common and wide-ranging brittle-star is known from Mozambique to Tahiti and from Torres Strait to southern Japan. As stated above, I do not accept the record of its occurrence at the Cape of Good Hope. Matsumoto, in his recent admirable monograph on Japanese ophiurans (1917, Jour. Coll. Sci. Imp. Univ. Tokyo, vol. 38, art. 2) considers the two following species as merely varieties of this one. While he may be right in this, I prefer not to discuss the matter here, as a revision of the family *Ophiocomidae* has appeared in my recently published (1921) account of the Echinoderms of Torres Strait. There is no difficulty in distinguishing the three forms from each other. A specimen in the South African Museum collection, taken at Mozambique, in November, 1912, by K. H. Barnard, is undoubtedly *scolopendrina.*

* Ophiocoma erinaceus.

Müller and Troschel, 1842. Syst. Ast., p. 98. H. L. Clark, 1915. Mem. M. C. Z., vol. 25, pl. 15, figs. 5, 6.

This species has been the source of much dispute for there are many museum specimens which are intermediate between typical *erinaceus* and *scolopendrina.* After studying the two forms alive in Torres Strait, I became convinced that, at least in that region, they do not interbreed, or even mingle. I therefore consider them distinct species. The occurrence of *erinaceus* at Mozambique seems to be established.

* Ophiocoma schoenleinii.

Müller and Troschel, 1842. Syst. Ast., p. 99. H. L. Clark, 1915. Mem. M. C. Z., vol. 25, pl. 15, figs. 1, 2.

Bell (1884, Alert Rep. p. 510) records this species, without comment, from Mozambique. As it is not otherwise known from west of the East Indies, the record must be regarded as dubious, to say the least.

* Ophiocoma valenciae.

Müller and Troschel, 1842. Syst. Ast., p. 102. H. L. Clark, 1915. Mem. M. C. Z., vol. 25, pl. 16, figs. 7, 8.

This species is well known from Mozambique and northward.

Ophiomastix venosa.

Peters, 1851. Monatsb. K. Preus. Akad. Wiss. Berlin, p. 464. Koehler, 1904, Mem. Soc. Zool. France, vol. 17, p. 73, figs. 28, 29.

This handsome species is well known from Zanzibar but has not hitherto been recorded from Mozambique. A specimen from the latter place, collected by K. H. Barnard, in November, 1912, is in the present collection. It is of more than usual interest because, although it is about 20 mm. across the disk, and shows the specific characters clearly, there are no spines or granules whatever on the disk, and hence the specimen would properly be assigned to the genus *Ophiarthrum*. Koehler's figure shows no disk spines, but I have not previously noted a specimen, in which they were wholly wanting.

OPHIODERMATIDAE.

This is another family, like the preceding, characteristic of tropical shores and represented by few species outside of the tropics. In South African waters, four species have been found and three of these are in the present collection. It is very interesting to note that three and perhaps all of these species are peculiar to South Africa. They are distinguished from each other as follows:

Key to the South African Species of Ophiodermatidae.

Two long genital slits in each interbrachial area.

Granulation of lower surface of disk completely covers oral shields and face of jaws . . . . . *Cryptopelta aster.*

Oral shields large and bare, generally with an accessory shield on distal side *Ophiarachnella capensis.*

Four short genital slits in each interbrachial area.

No conspicuous bare plates on disk, except that the radial shields may be either bare or concealed . . . . . *Ophioderma leonis.*

Many conspicuously bare plates on disk; upper arm-plates often fragmented *Ophioderma wahlbergii.*

Cryptopelta aster.

Ophiopeza aster Lyman, 1879. Bull. M. C. Z., vol. 6, p. 50; pl. XIV, figs. 395–397.

Cryptopelta aster H. L. Clark, 1909. Bull. M. C. Z., vol. 52, p. 131.

The rediscovery of this interesting species, and the collecting of a good series of specimens, is one of the noteworthy results of the Pieter Faure's work. In disk-diameter, the specimens range from 2·5 to 13 mm.; the largest is thus somewhat larger than Lyman's type. The growth changes are very trivial and consist of an increase in the relative length of arm, in the number of arm-spines and in the widening and coming into broad contact of the upper and under arm-plates. The smallest specimen has arms less than 5 mm. long; one with disk 4·5 mm. has arms 9 mm.; one with disk 6·5, has arms 17; one with disk about 9 mm. has arms 27 mm. long; and the largest has arms nearly 45 mm. The proportion therefore increases from "arms 2 × disk" to "arms 3·5 × disk". The number of arm-spines is 4 on the basal arm-segments of the smallest specimen, 5 in one somewhat larger, 6 in the specimen 6·5 mm. across the disk, 7 in the one 9 mm. across, and even in the largest specimen it is very rarely 8.

Koehler has reported this species from two shallow water stations in the East Indies (7–13 fms.). But his specimens have decidedly longer arms and more arm-spines and I am inclined to think a comparison of specimens would show that the South African and East Indian species of *Cryptopelta* are not identical. The Pieter Faure specimens are all unicolorous, nearly white. They were taken at the following places.

P.F. 2798. Vasco de Gama Peak, N. 71° E., 18 miles, 230 fms. St. 2 specimens; adult.

P.F. 11359. Tugela River, N.W. by N. 1/4 N., 24 miles, 65–80 fms. R. 1 specimen; very young.

P.F. 13194. Cove Rock, N.W. by N., 6 miles, 43 fms. Brk. sh. and r. 4 specimens; young.

P.F. 13240. Cove Rock, N. 3/4 E., 5 miles, 43 fms. St. and brk. sh. 7 specimens; adult and young.

P.F. 14365. Cape St. Blaize, N.E. by N. $^1/_4$ N., 94 miles, 116 fms. S., sh., and r. 1 specimen; adult.

Bathymetrical range, 43–230 fms.

Ophiarachnella capensis.

Pectinura capensis Bell, 1888. Proc. Zool. Soc. London, p. 282; pl. XVI, figs. 3, 4.

Ophiarachnella capensis H. L. Clark, 1915. Mem. M. C. Z., vol. 25, p. 306.

It is a matter of no little interest that this little-known species has been found by the Pieter Faure. It was originally described from specimens in the British Museum labelled "Cape of Good Hope", and has not since been met with. The three specimens at hand agree well with Bell's description, but there are often 6, and rarely 7, arm-spines. In the largest specimen (15 mm.) the colored bands on the arms are so faintly indicated as to be practically wanting, while in the smallest (9·5 mm.), they are very marked; dull olive-brown, conspicuously darker on both the proximal and distal margins; in this specimen, the ground colour of which is pinkish-white, there is a large blotch of pale brown on the disk. In the largest specimen, one of the oral shields entirely lacks the supplementary plate, and in one interradius of the smallest specimen, it is very small.

P.F. 507. Algoa Bay, 33° 58′ S. × 25° 51′ E., 25 fms. R., blk. spks. 1 specimen; small adult.

S.A.M. No. 3013. False Bay, Cape Colony. Littoral. Dr. Purcell coll. 1 specimen; large adult.

P.F. 12359. Umhlangakulu River, N.W. by N., 7 miles, 50 fms. S. and sh. 1 specimen; adult.

Ophioderma leonis.

Döderlein, 1910. Schultze's Zool. Anthr. Ergeb., vol. 4, lfg. 1, p. 252; pl. V, figs. 1, 1*a*.

The species of *Ophioderma* described by Lütken in 1872 as *tonganum* under the supposition that it was from the Tonga Islands has been recorded but once since, when in 1882, Lyman reported that the Challenger had taken it at the Cape of Good Hope, in Simon's Bay, in 10–20 fms. As Lütken had but a single small specimen, and its specific characters, were far from clear, it seems strange that Mr. Lyman gives no information whatever about his specimen or specimens. It is to be inferred however from his "Table of Species of *Ophiura*" that he had several specimens and that they

differed among themselves as to the nakedness of the radial shields. I think there can be little doubt that Döderlein is right in suspecting that Lyman's specimens were not *tonganum* but were identical with the species, *leonis*, from Lüderitzbucht, S.W. Africa. Döderlein's description and figures are quite sufficient but as there are several specimens before me in the Pieter Faure collection, I shall add a few notes. As for *tonganum*, I do not believe that Lütken's specimen came from Tonga, and I think it is probably to be referred to one of the West Indian species. Only one other *Ophioderma* has been described or even recorded from the Indo-Pacific region; this is the holotype of Koehler's species *propinquum*. Here again however I am sceptical that the specimen ever came from the East Indies; but the species itself seems to be valid.

The specimens from South Africa, now at hand, range from 17 to 25 mm. in disk-diameter; the arms are about three times as much. In the smallest specimen, the radial shields are all visible and similar; in another, 9 are visible but unequal and irregular; in the other specimens they are completely concealed as in Döderlein's specimens. This accounts for Mr. Lyman's statement (apropos *tonganum*) "occasionally radial shields naked". I am inclined to think that in the young the radial shields are naked but become covered at full maturity (Döderlein's specimens were all 17 mm. or more in disk-diameter) but it may be purely a matter of individual diversity. A large specimen, with gaping mouth slits reveals the interesting fact that the tentacle-scale of the first oral pore is a long, thick and very conspicuous papilla. The adoral plates are very small and naked, as is well-shown in Döderlein's figure; his description, saying they are for the most part granulated, does not seem to me accurate. Curiously enough, one of the Pieter Faure specimens, shows exactly the same fusion of an oral shield (apparently the madreporite) with an adoral plate which is so well shown in Döderlein's figure. The colouration of the present specimens is somewhat diversified; only two are gray, like Döderlein's, while three are very dark olive-brown, nearly black, above, and yellow or whitish beneath; in one of these, the transition from dark to light is very abrupt but in the others it is gradual; one specimen is uniformly rather bright yellow-brown.

S.A.M. No. 3013. False Bay, Cape Colony; littoral. Dr. Purcell coll. 3 specimens; adult.

P.F. 14714. Saldanha Bay, Cape Colony; littoral. 2 specimens; adult.

P.F. 18282. False Bay, Cape Colony; 8–10 fms. R. 1 specimen; adult.

* Ophioderma wahlbergii.

Müller and Troschel, 1842. Sys. Ast., p. 87.

This species, described originally from Port Natal, has not been met with since, nor has it ever been figured. Bell (1905, Mar. Inv. South Afr., vol. 3, p. 255) says it "appears to be widely distributed as there are examples in the Museum from the Red Sea and from Puerto Cabello." The occurrence of an *Ophioderma* in the Red Sea, whether identical with one from Natal or not, would seem to be worthy of more than this scant, passing notice, and surely we might have been informed a little more particularly as to the grounds on which specimens from Venezuela, the Red Sea and Natal are regarded as identical. It is certainly a unique distribution. According to Müller and Troschel, the Natal species is very well characterized, and it is much to my regret that I find no specimens in the Pieter Faure collection.

OPHIOLEPIDIDAE.

This large, cosmopolitan family is well represented in South African waters, by a small but diversified group of species, belonging to seven genera, three of which are of worldwide distribution, one is a distinctly Indo-Pacific littoral group, and the others are deep water genera of whose actual range our knowledge is still incomplete. Only one of the species here included is new to science, but the occurrence of two specimens of the extraordinary genus *Astrophiura* is of no less interest, though the genus had already been reported from the Agulhas Bank. The following key shows the diagnostic characters of the eleven species here listed.

Key to the South African Species of Ophiolepididae.

Side arm-plates of one or more basal arm-segments greatly extended laterally so as to meet corresponding plates of adjoining arms, or prevented from that only by the genital plates.

Basal arm-segments with their side-plates in contact all around the true disk area . . . . . *Astrophiura cavellae.*

Basal segments of adjoining arms separated by genital plates *Ophiomisidium pulchellum.*

Side arm-plates of basal arm-segmeuts not extraordinarily widened.

Tentacle-scales on second oral and first arm-pores numerous (5—15).

Radial shields at margin of disk, in contact with basal upper arm-plates; upper ends of genital plates not extending above dorsal surface of arms.

Arm-spines minute, peg-like.

Arm-spines 2 or 3, close together near middle or on lower half of side arm-plate; upper arm-plates pentagonal, in contact, becoming rhombic and finally triangular and distally well separated *Ophiura costata.*

Arm spines 3, the uppermost near top of side arm-plate, widely separated from the other two; upper arm-plates tetragonal, broadly in contact, distally elongated and finally somewhat separated . . . . . *Ophiura irrorata.*

Arm-spines 3, moderately long, the uppermost longest and equalling or exceeding an arm-segment.

Arm-spines wide and flat; radial shields small; upper arm-plates, tetragonal, broadly in contact . *Ophiura flagellata.*

Arm-spines acicular; radial shields large; upper arm-plates (except basal) oval. becoming elongated, little or not at all in contact . . . . . *Ophiura trimeni.*

Radial shields pushed back from margin of disk and separated from basal upper arm-plates by two closely united, small, swollen plates, which lie between the considerably elevated upper ends of the genital plates; a secondary arm-comb of minute papillae lies on the outer side of each of these swollen plates . . . *Dictenophiura anoidea.*

Tentacle-scales on second oral and basal arm-pores few, usually 1 or 2 but in Ophioplocus sometimes 4 or 5.

Upper arm-plates single and unbroken.

Upper arm-plates large and broadly in contact.

Oral shields distinctly longer than wide; primary plates of disk and two similarly large plates in each interradius conspicuous, each surrounded by a distinct belt of smaller scales *Ophiocten amitinum.*

Oral shields distinctly wider than long; disk plates thin, and rather indistinct, tho the primary plates are often quite evident *Ophiocten pacificum.*

Upper arm-plates very small and widely separated *Ophiomusium lymani.*

Upper arm-plates broken into half a dozen or more pieces, more or less symmetrically arranged . . . *Ophioplocus imbricatus.*

Astrophiura cavellae.

Koehler, 1915. Bull. Inst. Ocean., no. 311, p. 1, figs. 1–6.

It was with great pleasure that I found in the Pieter Faure collection, two specimens of *Astrophiura* in very fine condition. The first example of this remarkable genus was collected on the shores of Madagascar and was described by Sladen in 1879, as *A. permira.* (This date has been published by Koehler as 1870 and by Matsumoto as 1878; the former is probably a typographical error while the latter is due to a preliminary notice of Sladen's not sufficient to establish the species). In 1898, the Valdivia collected a species

of *Astrophiura* on the Agulhas Bank, off the coast of Cape Colony in 175 fms.; 5 specimens were taken, one of which was figured, but not named or described, by Chun (1900, Aus den Tiefen des Weltmeeres, p. 488). In 1913, Matsumoto was so fortunate as to be able to describe as a new species, a fine specimen of *Astrophiura* from Okinose, a submarine bank in the Sagami Sea, Japan. Finally Koehler in 1915 (*l. c.*) gave full descriptions of the five specimens taken by the VALDIVIA, which he considered different from both the Madagascar species and the Japanese. Matsumoto (1917, Mon. Jap. Oph., pp. 245–246) fails to realize that it is Chun's specimens upon which Koehler's species is based and hence he writes as though there were four species of *Astrophiura* known.

There is no doubt that the Japanese species (*A. kawamurai*) is a well-marked form; it needs no further discussion here. But when one begins to compare the South African and Madagascar species, difficulties arise. In the first place, there is but one specimen known of the latter (*permira*) and it is obvious from Sladen's figures that it is either an aberrant individual or the dorsal surface has been injured and more or less regenerated. In the second place, no two of the five specimens of *cavellae* are exactly alike in the arrangement of their dorsal plates. It is true that no one of them agrees with *permira* but it is hard to see that they differ more from that species than they do from each other. In the third place, the two specimens in the PIETER FAURE collection, measuring 9 and 10 mm. in diameter of entire body, agree closely with each other but differ from both *permira* and *cavellae* in certain particulars, although they were taken very near the type-locality of *cavellae*. Both specimens have large tubercles on the five largest radial plates, and a central cluster of five erect, peg-like spinelets or tubercles crowded at the center of the centrodorsal plate; the height of these is about one-half the radius of the centrodorsal. No such cluster is recorded for any specimen of *Astrophiura* as yet described. Again the first circle of plates surrounding the centrodorsal is made up, not of *five* plates as in typical *cavellae*, but of *ten* nearly equal plates, arranged in five radial pairs; there is a minute tubercle, at the center of more than half these plates. One of Koehler's specimens had ten plates in this first series but these were very unequal and so arranged as to give three large plates in each interradial series, besides the extramarginal triangle. In one of the PIETER FAURE specimens, there are three such plates in one interradins but this is due to the horizontal division of what is typically the uppermost interradial. There is no trace of a tubercle on the

extramarginal triangle, but the other interradials may have a tubercle more or less well developed or may entirely lack it. The same is true of the upper arm-plates.

In view of this diversity in the arrangement, form and appearance of the dorsal plates, I am very sceptical as to there being any true specific distinction between *cavellae* and *permira*. It would be perfectly possible to consider the PIETER FAURE specimens representatives of an undescribed species, marked by the central cluster of spinelets and the circle of ten equal plates around the centrodorsal, but in view of the locality where they were taken and the diversity shown by the VALDIVIA specimens, I think they must be considered *cavellae*. I have compared them carefully with Sladen's description and figures and should have called them *permira* without hesitation had *cavellae* never been described. Koehler lays stress on the absence of oral shields in *permira* but, after examination of these specimens before me, I think this is only a matter of interpretation of the plate present in each adoral angle of each oral interbrachial area. One of these is fairly well marked and we are all agreed in calling it the madreporite, while the other four, as shown by Koehler's own figures, are more or less ill-defined. In the type of *permira*, they were so ill-defined that Sladen (1879, Ann. Mag. Nat. Hist. (5), vol. 4, p. 405) did not recognize their homology; if the lowest one in his fig. 5 were treated by the artist as the madreporite is, the homology would be obvious! I therefore believe *cavellae* and *permira* will prove to be synonyms, but until more material is available, I prefer to let the South African *Astrophiura* continue to bear the honoured name, *cavellae*.

As regards the position of *Astrophiura* in the system, I agree with Matsumoto in considering it only a highly specialized member of the *Ophiolepididae*, and not in any sense a primitive or annectent form. Sladen was carried away by the novelty of that original specimen!

P.F. 1909. Cape St. Blaize, N. by E. $^1/_4$ E., 67 miles, 90–100 fms. Rough bottom. 2 specimens; adult.

OPHIOMISIDIUM PULCHELLUM.

Ophiomusium pulchellum Wyville Thomson; 1877, The Atlantic, vol. 2, p. 67. Lyman, 1882. CHALLENGER Oph., pl. III, figs. 1–3.
Ophiomisidium pulchellum Koehler, 1914. Bull. 84 U. S. N. M., p. 32.

It is quite natural to find this interesting little brittle-star in the collection, but it is particularly noteworthy that it was taken with

Astrophiura and at no other station. The specimens are 3 to 4·5 mm. in disk diameter and show no trace of genital slits.

P.F. 1909. Cape St. Blaize, N. by E. $^1/_4$ E., 67 miles, 90–100 fms. Rough bottom. 4 specimens; adult and young.

Ophiura costata.

Ophioglypha costata Lyman, 1878. Bull. M. C. Z., vol. 5, p. 76; pl. IV, figs. 92–94.

Ophiura costata Meissner, 1901. Bronn's Thierreichs, vol. 2, pt. 3, p. 925.

Ophiozona capensis Bell, 1905. Mar. Inv. South Africa, vol. 3, p. 256; pl. I, figs. 1, 2.

Matsumoto (1915, Proc. Philadelphia Acad. Nat. Sci., p. 81) first called attention to the fact that Bell's *Ophiozona capensis* was an *Ophiura*. The M. C. Z. contains two cotypes of Bell's species received from the British Museum in exchange. On examining them in connection with the Pieter Faure collection, I was struck by their resemblance to *Ophiura costata* and comparison with a cotype of that species proves them to be identical. Bell's figure does not show the arm-comb well and Matsumoto was misled into supposing it was made up of spiniform papillae, whereas the comb-papillae are really blunt, flat and very closely crowded together. It is curious that Bell should have considered the species an *Ophiozona*, for it is a very typical example of the *irrorata*-group of *Ophiura*. It seems to be fairly common in the vicinity of the Cape of Good Hope but is not as yet known from anywhere else. The Pieter Faure specimens range from 5 to 22 mm. in disk-diameter and show some interesting growth changes. The smallest has the disk covered by 51 plates, of which the radial shields, which are in contact at their middle, are largest, and the centrodorsal and 5 primary radials are conspicuous; a second radial and two interradials, one of which is marginal, are the only other large plates. The first two upper arm-plates lie between the distal ends of the radial shields; the third is the largest and widest of all, more than twice as wide as long; the fourth is pentagonal, as wide as long, in contact with the third; the fifth is triangular and barely touches the fourth while the remaining plates, all small and triangular, are widely separated. The comb-papillae are not essentially different from those of the adult but they are relatively thicker and rather less truncate. The oral surface shows only very slight differences from what is to be seen in adults; the under arm-plates are all well separated and the greater part of each interbrachial area outside of the oral shield is occupied by a single

large plate; the proximal end of the jaws is not at all elevated or swollen as it is so noticeably in adults. There are only 2 arm-spines on each side of three or four basal arm segments. A specimen 7 mm. across the disk differs from this one chiefly in the complete separation of the radial shields, between which the distal radial plate and the first upper arm-plate are in broad contact. One may now count more than 75 disk plates but the additional ones are small triangular scales, intercalated between the angles of the larger plates. Later growth changes consist chiefly in the multiplication of these secondary disk plates and in the increased size, especially width, of the basal upper arm-plates, of which as many as 25 are in contact in large adults.

P.F. 461 A. Off Cape of Good Hope, 34° 38′ S. × 18° 33′ E., 110 fms. Bottom? 1 specimen; young.

P.F. 2216. Lion's Head, E. 18 miles, 104 fms. Blk. spcs. and r. 5 specimens; adult and young.

P.F. 2714. Vasco de Gama Peak, N. 10° E., 13 miles, 85 fms. Dk. gn. s. 9 specimens; adult and young.

P.F. 2766. Vasco de Gama Peak, N. 40° E., 13 miles, 120 fms. R. 1 specimen; young.

P.F. 2798. Vasco de Gama Peak, N. 71° E., 18 miles, 230 fms. Stns. 1 specimen; adult.

Bathymetrical range, 85–230 fms.

Ophiura irrorata.

Ophioglypha irrorata Lyman, 1878. Bull. M. C. Z., vol. 5, p. 73; pl. IV, figs. 106–108.

Ophiura irrorata Meissner, 1901. Bronn's Thierreichs, vol. 2, pt. 3, p. 925.

This characteristic species from the abyssal fauna is represented in the Pieter Faure collection by a good series of 21 specimens, ranging from 6 to 27 mm. in disk-diameter; the arms are broken in every case, usually proximal to the middle. The only growth-changes of importance shown are in the upper and under arm-plates, for in the smallest, as in the largest specimen, the primary disk-plates are obvious but separated by numerous, less well-defined, more or less overlapping plates, and the upper arm-spine is near the top of the side arm-plate widely spaced from the other two. This arrangement of the little peg-like arm-spines is one of the best and most invariable specific characters at any age. In the smallest specimen, only a few basal upper arm-plates are in contact, and only the first two are tetragonal and wider than long. In older specimens, more of the basal upper arm-plates are wider than long

and are broadly in contact. until we reach the condition of the largest adult at hand where all the arm-plates present (every arm is broken) are broadly tetragonal and very fully in contact, tho the more distal are markedly wider distally than proximally. The first under arm-plate of the smallest specimen is relatively large, much wider than long, somewhat heptagonal, in contact with the adoral plate on either side and with the second under arm-plate distally; the latter is considerably larger still, tetragonal with the convex distal side longest and the straight proximal side much the shortest; it is about as wide as long and is separated from the third under arm-plate by the side arm-plates; the third plate is similar to the first in size and shape: the fourth is similar but smaller; the fifth and subsequent plates are small, much wider than long, with a straight proximal side, strongly convex distally and with the lateral angles more or less truncated; the under arm-plates, except the first two or three, are broadly separated from each other. With increasing size, the basal under arm-plates become bigger and tend to be more and more in contact with each other, until the condition shown by the largest adult is reached where the first eight plates are in contact, and plates 2 and 3 are particularly large and conspicuous.

P.F. 16905. Cape Point, N.E. by E. $^1/_4$ E., 40 miles, 800–900 fms. Gn. m. 4 specimens; young.

P.F. 16991. Cape Point, N.E. by E. $^1/_2$ E., 43 miles, 900 fms. Gn. m. 4 specimens; adult and young.

P.F. 17268. Cape Point, E. $^3/_4$ N., 42 miles, 930 fms. Gn. m. 1 specimen; young.

P.F. 17330. Cape Point, N. 86° E., 43 miles, 900–1000 fms. Grey m. 11 specimens; young.

P.F. 17351. Cape Point, N. 86° E., 43 miles, 900–1000 fms. Grey m. 1 specimen; young.

Ophiura flagellata.

Ophioglypha flagellata Lyman, 1878. Bull. M. C. Z., vol. 5, p. 69; pl. II, figs. 49–51.

Ophiura flagellata Meissner, 1901. Bronn's Thierreichs, vol. 2, pt. 3, p. 925.

The specimens in the Pieter Faure collection are all young (7·5–14 mm. in disk-diameter) and all have the disk fully covered with scales. As most of the arm-spines are broken, the correct identification of the specimens was not at first suspected. They agree well however with specimens of similar size from Japan. The species has been reported from both the southern Atlantic and the Indian

Ocean as well as the Pacific and has a very wide bathymetrical, as well as geographical, range.

P.F. 17182. Cape Point, E. 3/4 N., 38 miles, 630 fms. Gn. m. 1 specimen; young.

P.F. 17330. Cape Point, N. 86° E., 43 miles, 900–1000 fms. Grey m. 7 specimens; young.

P.F. 17631. Cape Point, N. 81° E., 32 miles, 460 fms. Gn. m. 1 specimen; young.

Ophiura trimeni.

Bell, 1905. Mar. Inv. South Africa, vol. 3, p. 257; pl. I, figs. 3, 4.

Bell's description is obviously quite inadequate but his figures show the specific characters very well. The elongated oval, widely separated upper arm-plates is the best specific character, taken in connection with the large radial shields and long, slender arm-spines. The series in the present collection is a very fine one, consisting of 265 specimens, ranging from 2·75 mm. to 10 mm. in disk diameter, and taken at eleven different places. They have been compared with two of Bell's cotypes so there is no doubt of the identification.

P.F. 2146. Lion's Head, S. 72° E., 47 miles, 190 fms. Gn. s., blk. sps. 9 specimens; adult.

P.F. 2289. Lion's Head, N. 67° E., 25 miles, 131–136 fms. Blk. sps. 39 specimens; adult.

P.F. 2302 A. Lion's Head, N. 67° E., 25 miles, 131–136 fms. Blk. sps. 4 specimens; adult.

P.F. 2386. Lion's Head, N. 76° E., 28 miles, 140 fms. Blk. sps. 3 specimens; adult.

P.F. 2530. Lion's Head, N. 63° E., 34 miles, 154 fms. Blk. sps. 6 specimens; adult.

P.F. 6015. Cape Point, S. 83° E., 35 miles, 360 fms. Blk. sps. 5 specimens; adult and young.

P.F. 14559. Cape Point, N. 50° E., 18 miles, 180 fms. Gn. s., blk. sps. 2 specimens; adult.

P.F. 14566. Cape Point, N. 50° E., 18 miles, 180 fms. Gn. s., blk. sps. 2 specimens; adult.

P.F. 15038. Lion's Head, S.E. 1/4 E., 50 miles, 230 fms. Gn. s. 175 specimens; adult and young.

P.F. 16905. Cape Point, N.E. by E. 1/4 E., 40 miles, 800–900 fms. Gn. m. 1 specimen; adult.

P.F. 18933. Southeast from Cape Agulhas, 36° 40′ S. × 21° 26′ E., 200 fms. Gn. s. 19 specimens; adult and young.

Bathymetrical range, 131–900 fms.

Dictenophiura * anoidea **, gen. et sp. nov.

Plate XIX. Figs. 1, 2.

Disk 6·25 mm. in diameter; arms, 15 mm. long; arms about two and a half times disk-diameter. Disk flat, but thick and elevated above arm-bases, its thickness one-fourth to one third of its diameter; there is an indistinct line between the scaling of its top and that of the interbrachial sides; the latter are each covered by about eight scales while the former is occupied by the six primary plates, a radial plate between the proximal ends of each pair of radial shields a proximal and a distal plate in each interradius, rather numerous small triangular plates intercalated among the larger ones, and the five pairs of large radial shields, the distal halves of which are in full contact; these plates are all, thick, smooth, and often shining. Genital plates large and conspicuous, the curved rounded upper end abutting on the outer corner of each radial shield, its breadth about one-third that of the shield. Between the upper ends of the genital plates of any one radius are a pair of closely united, almost soldered, thick, high plates, which effectively separate the radial shields from the armplates, as well as the genital plates from each other. On the outer side of each of these thickened plates is a secondary arm-comb of very fine papillae, lying just underneath and within the true armcomb. Papillae of latter, 15–20, spiniform and well-spaced, but short and blunt.

Arms more than a millimeter broad at base, where they are a little flattened, but only half as wide at the twelfth segment where they are nearly cylindrical. Upper arm-plates not at all swollen, the distal ones quite flat; first plate very short and wide; second much larger, 3 or 4 times as wide as long, extending across the full width of the arm; third, narrower and longer; each succeeding plate becomes narrower, especially proximally so that the sixth and subsequent plates are quite triangular; basal plates in contact but beyond the sixth or seventh plate, they are well separated.

* *Δίς* = *double* + *κτείς* (root, *κτεν-*) = *comb* + *ophiura*, in reference to the double arm-comb between the elevated ends of the genital plates. The type of the genus is *Ophiura carnea* Lütken. The only other species are *Ophioglypha stellata* Studer and the new South African one about to be described.

** *Ἀ* privative + *οἰδέος* = *swollen*, in reference to the upper arm plates, which are flat and not swollen as in *D. carnea*.

Interbrachial areas below covered by the very large, elongated oral shields and about ten small plates like those on the sides of the areas; each oral shield is about 1·5–1·75 mm. long by 1 mm. wide; the distal margin is well rounded, the lateral margins are more or less indented by the genital slits and the inner angle is quite acute. Adoral plates narrow, meeting within, distinctly longer than inner margins of oral shield. Oral plates distinct, proximally elevated or swollen. Oral papillae, 3 on a side and one at apex of jaw, the distalmost very wide but low. Second oral tentacle pores opening entirely outside mouth slit, guarded by about 5 scales on one side and 4 on the other. First under arm-plate very large, tetragonal but much wider without than within, in contact with distal end of adoral plate on each side; second plate widely separated from it, small, triangular; succeeding plates small and widely separated, much wider than long, somewhat pentagonal with a proximal angle and a convex distal margin. Side arm-plates very large, broadly in contact below, and, beyond the basal seven or eight segments, above; each carries 3 well-spaced, blunt cylindrical arm-spines; these are subequal or the uppermost is longest and at base of arm are nearly equal to a segment but distally they barely equal half a segment. Basal tentacle-pores large but rapidly decreasing in size; the first has 3 (or 2) scales on one side and 2 on the other; the second and third have one on each side, but after that there is only a single tentacle-scale to each pore. — Colour, nearly or quite white; colour in life unknown.

P.F. 545. Algoa Bay, 33° 54′ S. × 25° 53′ E., 31 fms. Fne. s. 12 specimens; young.

P.F. 599. Algoa Bay, 33° 49′ S. × 25° 56′ E., depth and bottom? 4 specimens; young.

P.F. 3076. False Bay, Cape Colony, 22 fms. S., sh. 7 specimens; adult.

P.F. 7099. Cape Infanta, N.E. by N. $^1/_2$ N., 13 miles, 43 fms. Cal. s., few blk. sps. 7 specimens; adult and young.

P.F. 13194. Cove Rock, N.W. by N., 6 miles, 43 fms. Brk. sh., r. 1 specimen; young.

P.F. 13240. Cove Rock, N. $^3/_4$ E., 5 miles, 43 fms. St., brk. sh. 20 specimens; adult.

P.F. 13576. Stalwart Point, N.N.W., 9 miles, 53 fms. S., sh. 10 specimens; adult and young.

P.F. 13732. Great Fish Point, N. by W., 7 miles, 49 fms. S., sh. 40 specimens; adult and young.

P.F. 16231. False Bay, Cape Colony, 22 fms. Brk. sh. 2 specimens; adult.

Bathymetrical range, 22–43 fms.

Holotype, South African Museum no. A 6438. P.F. 16231.

This pretty little brittle-star is nearer to *carnea* of Northern European seas than it is to *stellata* of the East Indian region. All three species agree, as Koehler many years ago pointed out in respect to *carnea* and *stellata* (1898, Bull. Sci., vol. 31, p. 62), in the possession of the pair of peculiar swollen plates between the upper ends of the genital plates, and this is so characteristic and so obvious a feature, that it seems to be worthy of generic recognition, especially associated as it is, with a flat, elevated disk and short, stout flattened arms with small upper and under arm-plates. The differences between *carnea* and *anoidea* are not very important but are perfectly obvious. In the first place, the upper arm-plates of *carnea* are distinctly swollen, while those of *anoidea* are flat; the disk-plates of the European species are much more numerous (comparing specimens of the same size) than in the South African form; in the latter the arm-spines of the basal arm-segments are about twice as long as those of *carnea*; and finally the under arm-plates of *anoidea* are smaller and less conspicuous than those of the northern species. In a certain sense these differences show that *anoidea* is intermediate between *carnea* and *stellata* in structure, as it is geographically.

Ophiocten amitinum.

Lyman, 1878. Bull. M. C. Z., vol. 5, p. 100; pl. V, figs. 129, 130.

The specimens in the Pieter Faure collection resemble closely those taken by the Challenger, with which I have compared them, except that there is little or no indication of papillae on the distal margins of the basal upper arm-plates. These papillae however are not so well marked in all the Challenger specimens as Lyman's figure suggests and I do not think their absence in the specimens before me is due to anything more than individual diversity. The disk-diameter of these specimens ranges from 3 to 7 mm.

Several of the specimens from off the Glendower Beacon were parasitized by a nematode worm several centimeters in length, lying coiled within the disk. These worms have been sent to Professor H. B. Ward of the University of Illinois for study.

P.F. 13721. Great Fish Point, N. by W. $^3/_4$ W., 17 miles, 100 fms. S., sh., st. 11 specimens; adult and young.

P.F. 13859. Glendower Beacon, N. 1/4 W., 21 miles, 100 fms. Sh., st. 37 specimens; adult and young.

P.F. 13884. Nanquas Peak, N.W. 1/4 N., 15 miles, 49 fms. S., blk. sps. 1 specimen; adult.

Ophiocten pacificum.

Lütken and Mortensen, 1899. Mem. M. C. Z., vol. 23, p. 131; pl. III, figs. 5–7.

These specimens agree well not only with the description and figures of Lütken and Mortensen, but with numerous specimens of *pacificum* from the eastern Pacific and from Japan. They are peculiar in the complete absence of spinelets on the basal upper arm-plates and in the great reduction of the arm-comb. But as none are really in good condition, too much stress must not be laid on such negative characters. The specimens measure 6–12 mm. across the disk, and the arms are all broken, usually quite near the disk. The species seems to be abyssal only, in this region, as elsewhere.

P.F. 16905. Cape Point, N.E. by E. 1/4 E., 40 miles, 800–900 fms. Gn. m. 9 specimens; adult.

P.F. 17330. Cape Point, N. 86° E., 43 miles, 900–1000 fms. Grey m. 7 specimens; adult.

P.F. 17351. Cape Point, N. 86° E., 43 miles, 900–1000 fms. Grey m. 4 specimens; adult and young.

Ophiomusium lymani.

Wyville Thomson, 1873. Depths of the Sea, p. 172; figs. 32, 33.

This is another deep water species, of very wide distribution. The specimens at hand range from 5 to 24 mm. in disk-diameter. The large specimens are very closely tuberculated, even on the radial shields, while the young specimens are much smoother.

P.F. 16758. Cape Point, N.E. by E. 1/4 E., 38 miles, 755 fms. Gn. m. 1 specimen; young.

P.F. 16905. Cape Point, N.E. by E. 1/4 E., 40 miles, 800–900 fms. Gn. m. 2 specimens; young.

P.F. 16928 B. Cape Point, N.E. by E. 1/4 E., 40 miles, 800–900 fms. Gn. m. 3 specimens; adult and young.

P.F. 17268. Cape Point, E. 3/4 N., 42 miles, 930 fms. Gn. m. 2 specimens; young.

* Ophioplocus imbricatus.

Ophiolepis imbricata Müller and Troschel, 1842. Syst. Ast., p. 93.
Ophioplocus imbricatus Lyman, 1861. Proc. Boston Soc. Nat. Hist., vol. 8, p. 76, footnote. Herklots, 1869. Echinod. peintes d'apres Nature, pl. V, fig. 1.

This tropical littoral brittle-star is recorded from Mozambique by Bell, but is not in the present collection.

OPHIOLEUCIDAE.

So far as we as yet know, this small family is represented in South African waters only by a single species, and that an abyssal form.

Ophiernus vallincola.

Lyman, 1878. Bull. M. C. Z., vol. 5, p. 122; pl. VI, figs. 170–172.

There is a fine series of this species in the present collection, ranging from 5·5 to 16 mm. across the disk, with arms 6–7 times as much. They show little diversity, among themselves, all having the small nearly circular radial shields and the naked disk skin characteristic of the species.

P.F. 16730. Cape Point, N.E. by E. 1/4 E., 38 miles, 755 fms. Gn. m. 1 specimen; adult.

P.F. 16781. Cape Point, N.E. by E., 36 miles, 650–700 fms. Gn. m. 4 specimens; adult and young.

P.F. 17183. Cape Point, E. 3/4 N., 38 miles, 630 fms. Gn. m. 17 specimens; adult and young.

P.F. 17303. Cape Point, E. 3/4 N., 41 miles, 890 fms. Gn. m. 1 specimen; adult.

P.F. 17411. Cape Point, E. 1/2 N., 34 miles, 500–550 fms. Gn. m. 3 specimens; adult.

P.F. 17433. Cape Point, N. 89° E., 36 miles, 700 fms. Bottom? 4 specimens; adult and young.

P.F. 17440. Cape Point, N. 89° E., 36 miles, 700 fms. Bottom? 2 specimens; adult.

P.F. 17631. Cape Point, N. 81° E., 32 miles, 460 fms. Gn. m. 9 specimens; adult.

Bathymetrical range, 460–890 fms.

SEA-URCHINS. ECHINOIDEA.

Sea-urchins form a proportionately large part of the South African echinoderm fauna, for while the brittle-stars of the region are only about four per cent of the known species, the echini are nearly ten per cent of the known forms. This is in keeping with the results from the THETIS and ENDEAVOUR collections, about southern Australia, which show that Echini form a relatively large proportion of the echinoderms of that region. The fact as regards South Africa may be expressed in this way: that, whereas echini make up only about eleven per cent of the echinoderm fauna of the world, in South African waters, they make up more than twenty per cent of the echinoderm fauna as now known. And yet, curiously enough, south of Mozambique, not more than two or three sea-urchins are known to occur along shore, and only *Parechinus angulosus* is at all common on the Cape Colony coast.

Döderlein, in his list mentioned previously (see p. 222), gives 25 species of Echini as occuring in water under 278 fms., but one of these (*Protocentrotus annulatus*) is synonymous with another (*Parechinus angulatus*) and one (*Temnopleurus reevesi*) is not accepted for this report (see p.). The collection from the South African Museum contains 240 specimens of 30 species, (3 apparently new to science) of which only 13 are in Döderlein's list. There are however 2 species hitherto known from Mozambique and 1 from Natal, and a deep water species from 46 miles off Cape Point, which were not included by Döderlein in his list and are not in the collection before me, so that 44 species are included in the present report.

Of these 44 species, 23 are truly littoral, occurring in water less than 20 fms. deep, while only 4 are strictly abyssal, living normally beyond the 600 fms. mark. Of the remaining species 16 are continental and one (*Spatagobrissus*) is either littoral or continental but its exact habitat is unknown.

Of the 23 species known to be littoral, only 2 are endemic, a surprisingly small proportion. Of the remaining 21 species, 6 are characteristic of the western Indian Ocean, while 13 are widely distributed Indo-Pacific forms; one of the remaining two has been known hitherto only from Liberia, while the other is cosmopolitan. None of the littoral species is known from either South America or the southern coasts of Australia. It is noteworthy that 8 of the 23 littoral echini are not known from south of Mozambique and there

are three or four others, which are possibly only stragglers south of that point.

Of the 17 continental echini, we find that there are 11 which are endemic. This includes *Spatagobrissus* and one other species hitherto undescribed. Of the 6 species not endemic, only two are Indo-Pacific, one is distinctly southern, occurring off the coasts of both southern South America and southeastern Australia, one is West Indian and two are well-known North Atlantic forms. It ought to be added further that of the 11 endemic species, no fewer than 7 are nearly allied to north Atlantic or West Indian species. It is quite clear then that a very large proportion of the continental Echini of South Africa came from the west rather than from the east.

Of the 4 abyssal echini, one is endemic, one is distinctly antarctic (in deep water), one is North Atlantic and one is cosmopolitan.

We may conclude then that the South African echinoid fauna contains three distinct elements at least. First, an important Indian and Indo-Pacific element which makes up most of the littoral group. Many of these species do not occur south of Durban and a considerable number are only stragglers south of the vicinity of Mozambique. Only two are endemic and one of these is a persistent relict of a group, geologically very old. A second element in the South African fauna is from the North Atlantic and the West Indian region. This makes up nearly the whole of the continental fauna, and has one representative in the littoral and one in the abyssal group. Many of the continental forms have become sufficiently differentiated to be specifically distinguishable from their nearest allies but there is little doubt of their original stock. The third element in the fauna is austral and is relatively insignificant, being represented by only one abyssal and one continental species. The echini therefore add to the weight of evidence that the South African echinoderm fauna has received its littoral element from the east and its continental element from the west.

The 44 species of sea-urchins here listed belong to no fewer than 21 families. The *Palaeopneustidae* is the only one of the other eight families of Echini large enough to make its absence worthy of comment. The 21 families are distinguishable from each other as indicated in the following key. Under each family will be found a key to its South African species, when more than one occurs in the area covered by this report.

Key to the South African Families of Echini.

Mouth and periproct central and opposite.
- Primary tubercles perforate.
  - Ambulacral plates simple.
    - Peristome covered with numerous small plates. . *Cidaridae.*
    - Peristome with only ten large, buccal plates . *Aspidodiadematidae.*
  - Ambulacral plates compound, at least orally.
    - Test more or less flexible, or at least not very rigid; periproct more or less leathery; spines slender, hollow.
      - Peristome not covered by ambulacral plates *Centrechinidae.*
      - Peristome covered by five double columns of perforated ambulacral plates . . . . . *Echinothuridae.*
    - Test rigid; periproct well plated; spines stout, solid . *Pedinidae.*
- Primary tubercles imperforate.
  - Large, permanent, suranal plate, similar to those of oculo-genital ring, present . . . . . *Saleniidae.*
  - Suranal plate, if present, small, or if large, not at all like those of oculo-genital ring.
    - In midzone, every four or five ambulacral plates fused together and grown over by one large primary tubercle . *Stomopneustidae.*
    - Ambulacral plates in midzone, not thus fused together.
      - Ambitus circular.
        - Periproct covered by 4 (rarely 3,5 or more) similar, triangular plates . . . . . *Arbaciidae.*
        - Periproct covered by several or many dissimilar, and usually, irregularly arranged plates.
          - Ambulacral plates made up of 3 elements; ambitus at or below equator.
            - Test, at least abactinally or in midzone, more or less sculptured or ornamented with deep pits or furrows . . . *Temnopleuridae.*
            - Test not sculptured, pitted or furrowed *Echinidae.*
          - Ambulacral plates made up of 4 or more elements; or if only 3 are present, ambitus *above* equator *Strongylocentrotidae.*
      - Ambitus elliptical . . . . *Echinometridae.*

Mouth central or anterior; periproct posterior, often on oral surface.
- Mouth central, with jaws.
  - Auricles (of perignathic girdle) separate; test not discoidal; genital pores 5. . . . . *Clypeastridae.*
  - Auricles fused into a single piece.
    - Test not discoidal and with no lunules or marginal slits.
      - Petals more or less perfect; madreporic pores numerous; test flattened, moderate or large. . . . *Laganidae.*
      - Petals reduced, often rudimentary; only one madreporic pore; test small, 5—8 mm. long, rarely up to 15 mm., but often relatively high . . . . . *Fibulariidae.*

Test discoidal, with lunules or marginal slits, at least in posterior half (South African species). . . . *Scutellidae.*

Mouth anterior without jaws.

Interambulacrum 5 not essentially different orally from the other interambulacra . . . . . *Nucleolitidae.*

Interambulacrum 5 modified orally to form a sternum.

Labrum (i. e. primordial plate, adjoining mouth, in interambulacrum 5) followed by a single plate.

Mouth horizontally placed on oral surface of test *Urechinidae.*

Mouth vertical at the end of an oral invagination or furrow *Pourtalesiidae.*

Labrum followed by a pair of nearly, or quite, equal large plates.

Subanal fasciole wanting . . . . *Hemiasteridae.*

Subanal fasciole present . . . . *Spatangidae.*

CIDARIDAE.

This interesting family is poorly represented in South African waters, only one species, and that not a littoral one, being known certainly from south of Mozambique. Two widespread Indo-Pacific species occur at that point and perhaps somewhat further down the coast. The three forms may be distinguished from each other as follows. *

Key to the South African Species of Cidaridae.

Primary spines short, cylindrical and stout, barely equal to, or shorter than, test-diameter, truncate or at least very blunt, with no purple spots or lines at base *Eucidaris metularia.*

* It is difficult to determine whether any other species of *Cidaridae* occurs at Mozambique. Peters (1855, Seeigel von Mossambique, p. 118) lists *Cidaris verticillata* without comment and it is impossible to say whether he met with the species at Mozambique or at the Kerimba Islands. That the latter is the locality to which he referred is indicated by the fact that Mr. J. J. Simpson collected a small specimen of *verticillata* there some ten years ago. In his report on Simpson's collection, Rudmose Brown (1910, Proc. Roy. Phys. Soc. Edinburgh, vol. XVIII, p. 36) misspells the specific name, so that it reads *verticulata.* In this same report Brown records ten specimens of *Goniocidaris canaliculata* from the Kerimba Islands; he also lists Natal and Zanzibar as localities for this South American species. Obviously his locality records are taken from the "Revision". Mortensen's most important review of the cidarids in 1903 and my paper on the group in 1907 were evidently unknown to Mr. Brown. It is practically certain that *canaliculata* does not occur in South African waters. In view of the fact that Brown does not list *Eucidaris metularia,* which is common at Mozambique, there is good reason to believe his ten specimens called *canaliculata* are that species. This idea is confirmed by his remarks about the spines.

Primary spines decidedly longer than test-diameter, or if shorter, with purple spots or lines at base.

Primary spines with purple spots or longitudinal lines, conspicuous on the base or "neck" . . . . . *Prionocidaris baculosa.*

Primary spines with light-colored, unspotted neck *Stereocidaris capensis.*

Eucidaris metularia.

Cidarites metularia Lamarck, 1816. Anim. s. Vert., vol. 3, p. 56.
Eucidaris metularia Döderlein, 1887. Japan. Seeigel, p. 42.
Cidaris metularia A. Agassiz, 1873. Rev. Ech., pl. 1*g*, fig. 1.

Although Mr. Agassiz lists this species from the Cape of Good Hope, on the strength of specimens in the British Museum, there is little doubt that the locality label for these old specimens is not to be trusted. Neither the Challenger nor any of the other expeditions which have collected at the Cape have met with this species there, nor has it been taken by the Pieter Faure. There are five specimens in the collection of the South African Museum but they were taken at Mozambique, by K. H. Barnard, along shore. There is no evidence to warrant the belief that this sea-urchin occurs very much to the south of that point.

Prionocidaris baculosa.

Cidarites baculosa Lamarck, 1816. Anim. s. Vert., vol. 3, p. 55.
Prionocidaris baculosa Mortensen, 1909. Gauss Ech., p. 50.
Phyllacanthus baculosa A. Agassiz, 1873. Rev. Ech., pl. 1*f*, figs. 4, 5.

There is in the collection a small specimen of this well known Indo-Pacific species, which was taken by Mr. Barnard at Mozambique, the most southerly point on the African coast, whence *baculosa* is known. This specimen is only 23 mm. in diameter, with the longest primaries a trifle more. The "necks" of the primaries show clearly the longitudinal purple lines.

It is of great interest to find in the Pieter Faure collection two large primary spines (50–55 mm. long and 4–6·5 mm. in diameter) which show the characteristic purple lines of this species. They are undoubtedly from an individual identical with the small specimen from Mozambique. They are more or less water-worn or at least have that appearance and have undoubtedly been transported a long distance by some agency; for they were dredged in 25 fms. on a bottom of broken shells, two miles off the Umtwalumi River, Natal, hundreds of miles south of the known range of *baculosa*. They bear the reference no. 12466. It is possible they were carried by a fish.

Stereocidaris capensis.

Stereocidaris indica var. *capensis* Döderlein, 1901. Zool. Anz., vol. 23, p. 19.
Stereocidaris capensis Döderlein, 1906. Valdivia Ech., p. 110; pl. X, figs. 3–6.

This specimen, 62 mm. in diameter and 50 mm. high, with primary spines 75 mm. long, and only 4 mm. in diameter, does not answer to the description of any known species, but I have no doubt that both it, and the two specimens of *Cidaris* reported by Bell (1904, Mar. Inv. South Africa, vol. 3, p. 168) are to be referred to the same species as the specimens taken by the Valdivia on Agulhas Bank. None of the Valdivia specimens was nearly so large as the present individual, which is also peculiar in the relatively large peristome, 28 mm. across. I am more and more inclined to think that *capensis* and *indica* are identical and possibly one or more of the Japanese species of this perplexing genus, is also to be referred to *indica*. But more abundant material must be available before the matter can be decided. The present specimen has the abactinal system 31 mm. across and the ambulacra are, in width, ·23 of the interambulacra. There are, in each column, 7 or 8 coronal plates, 6 or 7 of which bore primary spines.

P.F. 14259. Cape St. Francis, N.E. by E., 32 miles. 74 fms. R. 1 specimen; adult.

ASPIDODIADEMATIDAE.

This small family of cosmopolitan, but abyssal, distribution was not previously known from South Africa or from any of the neighboring deeps. It is a matter of great interest therefore to find it in the Pieter Faure collection, where it is represented by the following species.

Aspidodiadema nicobaricum.

Döderlein, 1906. Valdivia Ech., p. 163; pl. XX, figs. 1–1*b*.

The specimens at hand are 11–17 mm. in horizontal diameter, and are therefore scarcely half as large as the original Valdivia specimens. They resemble closely specimens in the M. C. Z. collection from the Hawaiian Islands. The primary spines are only faintly purplish but the test, especially actinally, is quite purple. The slender tridentate pedicellariae of the abactinal region are very conspicuous with straight, narrow valves about 2 mm. long. The species was formerly known

from near the Nicobar Islands, near the Kei Islands and from the Hawaiian Islands.

P.F. 12793. East London, N.W. $^1/_2$ N., 20 miles. 400–450 fms. S., st. 4 specimens; small adults and young.

CENTRECHINIDAE.

This distinctly tropical, shallow-water family, is scarcely entitled to a place in this report for it occurs only at Mozambique or as a straggler southward to Natal. The three species, long known from Mozambique, and two of which have been reported from as far south as the Cape of Good Hope, are easily distinguished from each other as follows.

Key to the South African Species of Centrechinidae.

Test and spines black or blackish; primary spines sometimes banded, black and white.

Ambulacral primary spines not essentially different from those of interambulacra; ambulacra with few or no secondary spines abactinally and narrower there than at ambitus; a conspicuous abactinal white spot in life, in each interambulacrum . . . . . *Centrechinus setosus.*

Ambulacral spines filiform, smooth, except near tip; ambulacra with numerous secondary tubercles abactinally, and distinctly wider there than at ambitus; interambulacral primary spines fragile, diameter of their central cavity more than half diameter of spine; minute teeth on spine in distinctly separated whorls . . . . . *Echinothrix calamaris.*

Test and and spines with no black; greenish and red or red-brown, the prevailing tints; test very flat . . . . . *Astropyga radiata.*

Centrechinus setosus.

Echinometra setosa Leske, 1778. Add. ad Klein, p. 36; pl. XXXVII, figs. 1, 2.

Diadema setosa Gray, 1825. Ann. Phil., vol. 26, p. 426. (*Auct. omnes*).

Centrechinus setosus Jackson, 1912. Phyl. Ech., p. 28.

This well-known Indo-Pacific sea-urchin is represented in the collection at hand, by a single specimen collected along shore at Mozambique by K. H. Barnard. The test is about 35 mm. in diameter and the primary spines are 65-70 mms. long. The characteristic white spots in the interambulacra, abactinally, can still be detected, which is unusual in dry specimens. The species has long been known from Mozambique and Mr. Agassiz list's it in the "Revision" from Simon's Bay, Cape of Good Hope. Bell (1904, Mar. Inv. S. Africa, vol. 3, p. 168) lists a young specimen from off Cape Morgan, in

77 fms. These records from the coast of Cape Colony do not seem to me trustworthy though it cannot be denied that stragglers from the Mozambique region may occur far down the coast.

Echinothrix calamaris.

Echinus calamaris Pallas, 1774. Spic. Zool., vol. 1, fasc. 10, p. 31.
Echinothrix calamaris Peters, 1853. Monatsb. Berlin Akad., p. 484.

A fine, though small, specimen of this beautiful sea-urchin lies before me, taken at Mozambique by Mr. Barnard. No satisfactory figure has as yet been published of this remarkable echinoid. Leske, (1778, Add. ad Klein, pl. XLV, figs. 1, 2) gives two recognizable views and also (fig. 1 B) shows well one of the extraordinary primary spines, much enlarged. But a colored figure, taken from a living specimen, is really necessary to give any fair idea of this, perhaps the most lovely of sea-urchins. It has never been reported from south of Mozambique but it is well-known throughout the Indo-Pacific region.

Dr. Rudmose Brown (1910, Proc. Roy. Phys. Soc. Edinburgh, vol. XVIII, p. 38) records a small specimen of this species from the Kerimba Islands as *E. turcarum*. The differences between the two species of *Echinothrix* are by no means great and are evidently not clear in Dr. Brown's mind.

Astropyga radiata.

Cidaris radiata Leske, 1778. Add. ad Klein, p. 52.
Astropyga radiata Gray, 1825. Ann. Phil., vol. 26, p. 426. Peters, 1855. Seeigel von Mossambique, fig. 1 (as *A. mossambica*).

Although Bell says (1904, Mar. Inv. S. Afr., vol. 3, p. 169) that Krauss long since collected this species at the Cape, I have no doubt that the record is unreliable. Bell records young specimens from four stations on the coast of Natal, north of 30° S. lat. and two of these, about 15 mm. in diameter, from the South African Museum are before me. There is no reason to question the identification, but the fact that they were taken six and a half miles off shore at a depth of 48 fms. seems to warrant the opinion that they are only stragglers from the north. The species is not in the Pieter Faure collection. It is well known however from Mozambique and Zanzibar.

ECHINOTHURIDAE.

This remarkable family is sparingly represented in South African seas. Two species are in the PIETER FAURE collection and there is little doubt that the same two species are mentioned by Bell [1904, Mar. Inv. S. Afr., vol. 3, p. 169) as being in the collection he examined. He did not trouble to identify his specimens but simply says they are "allied respectively to *P. tenue* A. Ag. and *P. bursarium* A. Ag." The specimens before me are indeed allied to these Pacific species but they are nevertheless North Atlantic forms. They are easily distinguished from each other as follows.

Key to the South African Species of Echinothuridae.

Many actinal primary spines enclosed in skin bags, none with "hoofs"; abactinal and actinal surfaces abruptly and strikingly unlike . *Phormosoma placenta.*

Actinal primary spines not enclosed in skin bags, some at least ending in "hoofs"; abactinal and actinal surfaces not abruptly and strikingly unlike *Echinosoma petersii.*

PHORMOSOMA PLACENTA.

Wyville Thomson, 1872. Proc. Roy. Soc. Edinburgh, vol. VII, no. 84, p. 617. 1874, PORCUPINE Ech., pls. LXII and LXIII, figs. 1–8.

This well-known North Atlantic species is represented in the PIETER FAURE collection by a good series of specimens ranging from 7 to 120 mm. in diameter. The last is the largest specimen yet recorded for this species. Bell (*l. c.*) says that the *Phormosoma* from the Cape received by him was allied to *P. bursarium* but I am satisfied that the PIETER FAURE specimens are all *placenta*. I have compared them with specimens of *placenta*, *sigsbei*, *bursarium* and *indicum* and feel quite sure of the identification. They were taken at the following stations:

P.F. 16702. Cape Point, N.E. by E. 1/4 E., 38 miles, 755 fms. Gn. m. 2 specimens; adult.

P.F. 16741. Cape Point, N.E. by E. 1/4 E., 38 miles, 755 fms. Gn. m. 2 specimens; adult.

P.F. 16790. Cape Point, N.E. by E., 36 miles, 650–700 fms. Gn. m. 3 specimens; adult.

P.F. 16902. Cape Point, N.E. by E. 1/4 E., 40 miles, 800–900 fms. Gn. m. 5 specimens; very young and young.

P.F. 16944. Cape Point, N.E. by E. 1/4 E., 40 miles, 800–900 fms. Gn. m. 1 specimen; young.

P.F. 17351. Cape Point, N. 83° E., 43 miles, 900–1000 fms. Grey m. 6 specimens; young.

P.F. 17376. Cape Point, N. 81° E., 32 miles, 460 fms. Bottom? 1 specimen; very large adult.

P.F. 17440. Cape Point, N. 89° E., 36 miles, 700 fms. Bottom? 1 specimen; young.

Bathymetrical range, 460–1000 fms.

ECHINOSOMA PETERSII.

Phormosoma petersii A. Agassiz, 1880. Bull. M. C. Z., vol. 8, p. 76. 1883, BLAKE Ech., pls. X and XI.

Echinosoma petersii A. Agassiz and Clark, 1909. Mem. M. C. Z., vol. 34, p. 169.

I see no reason to doubt that the echinothurid to which Bell refers (*l. c.*) as allied to *Phormosoma tenue* is identical with one in the PIETER FAURE collection, which I believe to be the Caribbean species *E. petersii*. The only difference noticeable is that the primary tubercles appear to be somewhat larger on the abactinal surface, than they are in a Caribbean specimen of slightly larger size. The PIETER FAURE specimen is only about 125 mm. in diameter and is in poor condition. The surface is so badly rubbed I could find no tridentate pedicellariae and there are very few unbroken spines. There is a small vial with hoofed spines in it accompanying the specimen but there is no direct evidence to show that they actually came from this specimen. They probably did however.

P.F. 12580. Cape Natal, N. by E., 24 miles, 440 fms. M. 1 specimen; small adult.

PEDINIDAE.

This family, containing but one Recent genus, has not hitherto been found in southern seas. One species is known from near the Kei Islands but all the others are from north of the equator. The occurrence therefore of a *Coenopedina* from deep water off the Cape is a matter of very great interest. It appears to be an undescribed form and may be named for the locality where it occurs, as two of the other species have been.

COENOPEDINA CAPENSIS, sp. nov.

Plate XXI. Figs. 1, 2.

Test 16 mm. in diameter and only 7 mm. high; height therefore is about ·44 h. d. Coronal plates 9 or 10 in a column, all, or all but the uppermost, with primary tubercles and spines; interambu-

lacral areas in midzone, about 5·5 mm. wide. Ambulacral plates only 9, the uppermost and sometimes the two uppermost without primary tubercles; ambulacra about 4·5 mm. wide in midzone; poriferous areas very narrow, the pore-pairs in almost vertical arcs of three near the outer margin of plate. Primary tubercles relatively large, without crenulation, but conspicuously perforate. Abactinal system 8·5 mm. across; oculars moderately large, pentagonal, with pore distal to center, and several small tubercles; all decidedly exsert; genitals large, wider than high, heptagonal, well covered, except along lateral and distal margins, with secondary and miliary tubercles; genital pore small, situated about half way between center of plate and the distal tip; with the latter it is connected by a shallow furrow; anal system 4·25 mm. across, covered by numerous, small, thin,

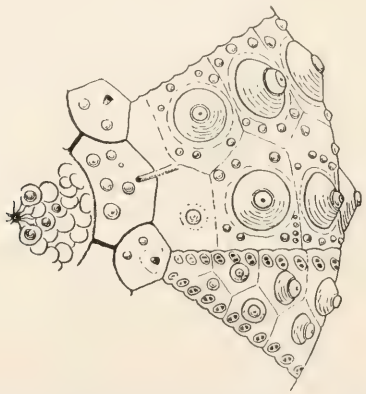

Fig. 4. Abactinal view of portion of test of *Coenopedina capensis* sp. nov. × 5.

somewhat overlapping plates, a dozen or more of which carry secondary tubercles and spines, Peristome 7·5 mm. across, covered by the five pairs of large buccal plates and numerous thin peristomal plates; a few of the largest of the latter carry pedicellariae while the buccal plates in addition to numerous small tridentate and ophicephalous pedicellariae, carry a very few secondary spines; gill cuts so shallow as to be barely perceptible.

Primary spines all broken, so it is impossible to state their length definitely, but the largest were ·75–·80 mm. in diameter at base and were thus probably 15–20 mm. long; they are not at all hollow and the surface is covered with 25–30 very delicate, parallel, longitudinal ridges, which are microscopically serrate; secondary spines similar but conspicuously smaller.

Pedicellariae fairly abundant, but only two kinds were noted, *ophicephalous* and *tridentate*. The former are characteristic having the markedly constricted valves found in *cubensis*, *mirabilis* and *pulchella*, but different from those of any of these species in the wider blades and the more abrupt contraction between blade and base; a typical valve is about ·27 mm. long, with the loop ·10 mm. more; the expanded part of blade is about ·17 mm. wide and ·11 long, while the base of the valve is ·19–·20 mm. wide. The tridentate pedicellariae are not abundant nor do they seem to reach a large size; the valves are always straight and narrow and are more or less expanded, as well as in contact, at the tip; the largest ones noted were ·80 mm. long. The ophicephalous pedicellariae are most common abactinally while the tridentate occur chiefly on the coronal and buccal plates. The calcareous plates of the tube-feet are very numerous, coarsely reticulated, often narrow with drawn-out, rod-like ends.

Colour of test, dried from alcohol; dingy whitish, but whole genito-ocular ring and the coronal plates immediately adjoining rich bright purple in abrupt contrast; periproct very pale violet or at center, whitish. Secondary spines whitish but the primaries above the ambitus are more or less markedly purple, though the basal portion may be dull flesh-color or reddish.

P.F. 16902. Cape Point, N.E. by E. $^1/_4$ E., 40 miles, 800–900 fms. Gn. m. 1 specimen; young.

P.F. 17215. Cape Point, N. 77° E., distant? miles, 660–700 fms. Gn. m. 2 specimens; small adult and young.

Holotype, South African Museum no. A 6432. P.F. 17215.

This very interesting sea-urchin is closely allied to *C. hawaiiensis* from the Hawaiian Islands, but careful comparison shows a number of differences of more or less value. Perhaps the most important of these are in the ambulacra, which are composed of fewer and wider plates; thus, in a specimen of *hawaiiensis* of the same size as the holotype of *capensis*, there are 10 or 11 ambulacral plates and 8 interambulacral, as against 9 of each in the African species; moreover the ambulacra are only about half as wide as the interambulacra, while in *capensis* they may be four-fifths as wide. Another difference is in the position of the genital pores, which are much further from the distal angle of the plate in *capensis* than in *hawaiiensis*. The periproctal plates in *capensis* are very thin and overlapping, while in *hawaiiensis* they are much more like granules. The ophicephalous pedicellariae in the two species are quite unlike. Although both species are conspicuously purple abactinally, the contrast between the purple and the dingy white of the greater part of the test is quite

marked in *capensis* whereas in the Hawaiian species, the purple fades out more gradually in the midzone. In view of all these differences, even though each is trivial in itself, it seems to me the two forms must be regarded as distinct species. Both are abyssal forms, while the other Recent species of the genus are inhabitants of the continental slope. The African species cannot be confused with the Atlantic species, *cubensis*, the conspicuous purple of the abactinal surface distinguishing it at a glance. But it agrees with that species in having the peristome distinctly smaller than the abactinal system, and in the general character of the ophicephalous pedicellariae.

SALENIIDAE.

This small, but old and interesting, family of little, deepwater sea-urchins is represented on the Agulhas Bank by the following species. No other saleniid is known nearer than Tristan d'Acunha.

*Salenia phoinissa.

A. Agassiz and Clark, 1908. Mem. M. C. Z., vol. 34, p. 54. See Döderlein, 1906, Valdivia Ech., pl. XXI, figs. 2, 2*a* (as *S. pattersoni*).

This is one of the characteristic species of the Agulhas Bank, where it was taken by the Valdivia in 56 fms.; but it must be rare, as it has not been met with by the Pieter Faure. The only other living members of the genus are found in the West Indies and near Japan.

STOMOPNEUSTIDAE.

This family contains but a single genus and probably the following widely distributed Indo-Pacific form is the only species.

Stomopneustes variolaris.

Echinus variolaris Lamarck, 1816. Anim. s. Vert., vol. 3, p. 47. *Stomopneustes variolaris* Agassiz, 1841. Mon. d'Ech.: Obs. Prog. Rec. Hist. Nat. Ech., p. 7. A. Agassiz, 1873. Rev. Ech. pl. IV*b*, figs. 1–3.

There are two specimens in the collection before me, taken at Mozambique by Mr. K. H. Barnard in November, 1912. The species has long been known from this place but its occurrence south of there is doubtful. Mr. Agassiz, in the "Revision", lists a specimen from Natal, as occurring in the Stuttgart Museum, but there is a strong probability of a mistake in the label.

ARBACIIDAE.

The discovery of a representative of this family in South African seas was one of the interesting results of the VALDIVIA's collecting on the Agulhas Banks. Döderlein, at first, considered it identical with the West Indian representative of the same genus but later decided it was a distinguishable variety. In the PIETER FAURE collection is a magnificient specimen of what is apparently the same species, which convinces me that the form may well be recognized as a valid species, under the following name.

COELOPLEURUS INTERRUPTUS.

Plate XXI. Fig. 3.

Coelopleurus floridanus Döderlein, 1906. VALDIVIA Ech., p. 181 (*non* A. Agassiz, 1872).

Coelopleurus floridanus var. *interrupta* Döderlein, 1910. Jena. Denkschr., vol. 16, p. 257.

Döderlein had but a single small example (18 mm. in diameter) of this interesting species and as he had no specimen of *floridanus* at hand for comparison, it is not strange that he referred it to the West Indian species, and gave no detailed description. The PIETER FAURE specimen is 43 mm. in diameter, somewhat larger than the largest specimen of *floridanus* in the M. C. Z. collection. On comparing the two specimens one finds the following differences of taxonomic importance.

In the first place the colouration of the Cape specimen is totally different from that of *floridanus*. In the latter the bare interambulacral area is prevailingly blue-violet, clearest on the distal half of the genital plate and fading out rapidly towards the ambitus; there are small blotches of pale brown proximally which increase rapidly in size so that the brown occupies a much larger area than the blue-violet; the sides of the interambulacra are bright scarlet-red, the prevailing tint of the ambulacra. This general pattern of coloration is shown in all (16) of the specimens of *floridanus* in the M. C. Z. collection, the only diversity being in the brightness of the shades and their relative extent; in some young individuals, the brown is wanting and there remains the blue-violet and scarlet in vivid contrast; more commonly the shades are paler or duller and the brown is replaced by greenish-white or dirty whitish; some dry specimens are quite dingy but this is usually due to superficial foreign matter. Now in the fine specimen of *interruptus* before me,

the bare interambulacral area, including the distal half of the genital plate is brown, with 9 or 10 transverse, irregular bars of violet (with little indication of blue), of which the lowest are brightest and those near the genital plate are faintest; along each margin of the area is a rather broad vertical white stripe, not at all sharply defined but quite evident; the ambulacra are red, as in *floridanus*. The abactinal, and even some of the actinal, secondaries of *interruptus* are bright scarlet, but in *floridanus* they are commonly dirty white, though a few may be more or less red.

The primary spines of *floridanus*, when full grown and uninjured are pale greenish at base, particularly the collar; on the actinal side beyond the collar they are shining, pure white; abactinally the greenish passes more or less rapidly but not abruptly into brilliant scarlet-red; if the spines are very long, the red becomes discontinuous distally so that the extreme terminal part of the spine abactinally is pale greenish with well-separated scarlet cross-bands or spots. In some specimens, there is little red and it is nearly all confined to the abactinal surface of the middle third of the spine. More commonly however the red extends even to the collar and sometimes the collar itself is more or less red. But in any case the red is a more or less vivid scarlet. In *interruptus* on the other hand, the collar of the full-grown spines is usually greenish proximally and underneath but distally, at least on the abactinal ridge, it becomes dull purplish-red and this colour occupies the upper surface of most of the spine; distally it becomes redder and less purple and at the tip of certain spines, especially those that are regenerating, we find red spots on a greenish-ground, very similar to those found in *floridanus*. The under surface of the primaries is always more or less shining white. The amount of red on the spines shows considerably diversity but in any case, it is (except for occasional distal spots as noted) a very purplish red quite unlike the fine scarlet of *floridanus*. As a result of the colour differences *interruptus*, viewed as a whole, looks quite unlike any specimen of *floridanus* I have ever seen, and is even more different from the other Recent species of the genus.

Aside from the colour differences, *interruptus* differs from *floridanus* in the greater stoutness of the primary spines and in the ophicephalous pedicellariae. While the thickness of the basal part of the largest primaries in the West Indian species is about 2 mm. or, say, about 2 percent of the whole length, in the African form it is 3·5 mm. or about 4·5 per cent of the length. The ophicephalous pedicellariae in both species have stalks about 4 mm. long and

valves ·40–·50 mm., not including the loops, but in *floridanus*, the stalks are at base about ·20 mm. thick and the blades of the valves are in width ·60 of the valve-length, while in *interruptus*, the stalks are ·30 mm. or more in thickness at base and the width of the blades is only about ·45 of the valve-length.

The Pieter Faure specimen of *interruptus* agrees well with the Valdivia specimen in all the proportions of the test; the primary spines seem however to have been relatively much shorter, for, though all are now broken, it is practically certain none of them were ever 100 mm. long.

Koehler (1908, Trans. Roy. Soc. Edinburgh, vol. 46, p. 641) records a specimen of *Coelopleurus* from Ascension, which he says had ophicephalous pedicellariae like those of the Valdivia specimen. As the pedicellariae of *floridanus* had not then been figured, Koehler could not have told whether the Ascension specimen is really nearer to *interruptus* than to *floridanus*, and he very naturally noted the resemblance to the form, of which the pedicellariae had been figured. It is very desirable to secure more material from near Ascension and see whether the *Coelopleurus* living there is the West Indian, the South African or an undescribed species.

P.F. 18707. Algoa Bay, Cape Colony, 30 fms. 1 specimen; fine adult.

TEMNOPLEURIDAE.

The occurence of this family along the southern shore of Africa is only that of a straggling interloper. It is not represented in the Pieter Faure collections and there are but three specimens in the series sent me from the S. A. Museum. One of these represents a well-known species of *Salmacis*, which has hitherto been recorded from China and the Philippines in the east to the Red Sea and Mozambique on the west, while the other two belong to an equally well-known *Temnopleurus* with a similar range. Three other species of Temnopleurids are recorded from South Africa, all by Döderlein (1906) in his Valdivia Report; one is a second species of Temnopleurus (*reevesii*) but the other two represent a deep-water section of the family. As regards the *Temnopleurus*, I am inclined to think there is some mistake, for there was only a single small specimen, and it was labelled as taken in 57 fms. about 70 miles southeast of Cape Agulhas. As Döderlein certainly knows the species of *Temnopleurus*, it seems unlikely that this can be a case of mistaken identification. And yet, since *reevesii* is not otherwise known from east of Ceylon, I am loth to include it among South African

echini. Until further evidence is forthcoming therefore I must consider the young echinoid taken by the VALDIVIA and recorded as *reevesii*, as a young *toreumaticus*, a species whose occurrence at Delagoa Bay no longer admits of doubt.

The four temnopleurids, whose occurrence, in the region covered by this report, is indisputable, may be distinguished from each other as follows:

Key to the South African Species of Temnopleuridae.

Size large, diameter 20 mm. or more; color not white; test more or less deeply sculptured.

Spines more or less bright red . . . . . *Salmacis bicolor.*

Spines not at all red or reddish . . . . *Temnopleurus toreumaticus.*

Size small, diameter usually much less than 20 mm.; color more or less white; test only superficially sculptured.

Peristome with few plates proximal to buccal circle . *Orechinus monolini.*

Peristome with membrane proximal to buccal circle, well-plated *Lamprechinus nitidus.*

SALMACIS BICOLOR.

L. Agassiz, 1841. Pref. Val. Anat. Ech., p. VIII. A. Agassiz, 1873, Rev. Ech., pl. VIII*a*, figs. 11, 12.

This is a well-known sea-urchin of the western Indian Ocean and has long been known from Mozambique. A very good specimen in the South African Museum collection is labelled: "Durban. Jan. 1913. Low tide. K. H. Barnard." This is a notable extension of the known range of the species, which is one of the most beautifully coloured of sea-urchins. The bright red secondary spines form a good back-ground for the primaries banded with purple and green. The Durban specimen is somewhat subdued in colour as the secondaries are brown-red and the test a dull light green, while most of the primaries are broken.

In the Revision (Pt. 1, p. 156), *Salmacis sulcata* (= *S. sphaeroides* L.) is listed from Mozambique but it is probable that there is a mistake somewhere for the species is not otherwise known from the western part of the Indian Ocean.

TEMNOPLEURUS TOREUMATICUS.

Cidaris toreumatica Leske, 1778. Add. ad Klein, p. 155.
Temnopleurus toreumaticus L. Agassiz, 1841. Int. Mon. Scut., p. 7.

The occurrence of this characteristically Asiastic species at Delagoa Bay seemed to me so highly improbable that I have never credited

the published record from that place (See Junod, 1899. Bull. Soc. Vaudoise, vol. 35, p. 281, footnote to an appendix to a list of insects!). But there are two specimens before me from Delagoa Bay which were sent to the South African Museum for identification. There is no room for doubt that they are *toreumaticus*; hence Junod's identification and record are vindicated. The larger is 38 mm. in diameter and is notable for the long, slender primary spines, those at the ambitus being 24–26 mm. in length; they are distinctly banded on the distal half. The other specimen is only 26 mm. in diameter and the longest primary spines are only 10–12 mm. long; moreover very few of the spines show any indication of banding, and those only very faintly; one might well say the spines were unbanded. In this particular the specimen is very near *reevesii* but the abactinal system proves beyond question that it is *toreumaticus*. On the whole these two specimens are very similar to specimens of the same size from Japan. They are much less like those from the Persian Gulf.

Whether this species is confined to Delagoa Bay remains to be seen. If such is the case, it may have been accidentally introduced in some way, possibly on a foul ship-bottom.

* Orechinus monolini.

Trigonocidaris monolini A. Agassiz, 1879. Proc. Amer. Acad., vol. 14, p. 203.

Orechinus monolini Döderlein, 1905. Zool. Anz., vol. 28, p. 622. 1906, Valdivia Ech., p. 196; pls. XXV, fig, 1; XXXV, fig. 6.

The Valdivia took a single specimen of this East Indian species, with the following, southeast of Mossel Bay, in 276 fms.

* Lamprechinus nitidus.

Döderlein, 1905. Zool. Anz., vol. 28, p. 622. 1906, Valdivia Ech., p. 190; pls. XXXIII, figs. 1, 2, XXXV, fig. 11.

This little sea-urchin is known only from a single station, about a hundred miles southeast of Mossel Bay, Cape Colony in 276 fms. Two specimens were taken. I have little doubt it is identical with the preceeding species, the differences given by Döderlein seeming to be trivial and unreliable.

ECHINIDAE.

This large and widely distributed family is not extensively represented in South Africa, for of the five species here listed two occur

only in deep water and two of the others are tropical stragglers. The five species may be distinguished from each other as follows.

Key to the South African Species of Echinidae.

Ambulacral pores in regular arcs of 3 which may however be nearly horizontal.
Height of test two-thirds of diameter or more, and may even greatly exceed it; peristome very small, only ·15—·25 h. d.; color reddish, with slender red primaries . . . . . *Echinus horridus.*
Height of test rarely three-fourths of diameter and usually little, if any, more than half; peristome moderate or large, ·29—·50 of test diameter.
Gill cuts shallow and not very sharply defined; size moderate or small.
Oculars all exsert; primary spines relatively few and conspicuously longer than the small, rather crowded secondaries; coronal plates of specimens over 32 mm. h. d., only 15—17; color (of preserved specimens) whitish for both test and spines; deep water species *Echinus gilchristi.*
Ocular I often insert; primary spines numerous, not much longer than the larger secondaries, which are not small and crowded; coronal plates of specimens over 32 mm. h. d., 18—25; color very diversified but test at least never whitish; littoral species *Parechinus angulosus.*
Gill cuts deep and sharply defined; size large *Toxopneustes pileolus.*
Ambulacral pores in 3 vertical series, forming very broad poriferous areas *Tripneustes gratilla.*

* Echinus horridus.

A. Agassiz, 1879. Proc. Amer. Acad., vol. 14, p. 203. Döderlein, 1906, Valdivia Ech., p. 220; pl. XXVIII, figs. 1–1*c*. H. L. Clark, 1916, Endeavour Ech., p. 109; pls. XXXIX and XL.

The Valdivia took what seems to be a half-grown specimen of this remarkable urchin in 276 fms. about one hundred miles southeast of Mossel Bay. The species is particularly notable for occurring on the continental slopes of South Africa, southern South America and southeastern Australia. The extra-ordinary vertical height which the adult may attain makes the species doubly remarkable.

* Echinus gilchristi.

Bell, 1904. Mar. Inv. S. Afr., vol. 3, p. 170. Döderlein, 1906, Valdivia Ech., p. 213; pl. XXVI.

It seems a little strange that the Pieter Faure met with no further specimens of this species, as there is no specimen in the collection sent me. The full account and numerous figures given by Döderlein make the recognition of the species easy. It was listed

by Bell from half a dozen stations of which five were in 85 fms. or less while one was at 660–700 fms. The VALDIVIA specimens came from three stations at 40–276 fms. The numerous and rather crowded secondary spines seem to be the main distinguishing feature of this *Echinus*, when compared with the northern *acutus*, which seems to be its nearest relative. As in the northern species, the proportional height of the test varies greatly.

PARECHINUS ANGULOSUS.

Cidaris angulosa Leske, 1778. Add. ad Klein, p. XVII, 28.
Parechinus angulosus Mortensen, 1903. INGOLF Ech., pt. 1, p. 108.
1909, GAUSS Ech., pls. VIII, figs. 7, 8; IX, figs. 8 and 10.
Protocentrotus annulatus Mortensen, 1909. GAUSS Ech., p. 61; pl. VIII, figs. 9–13.

The series sent me from the South African Museum is of the greatest interest and value, for it shows that this characteristic South African urchin does occur as far north as Mozambique, that Mortensen's proposed species *annulatus* is only a phase of this variable species, and that another phase seems to be isolated as a recognizable variety in Saldanha Bay.

Ludwig (1899, Ech. Sansibar., p. 555) suggested that the specimens of *angulosus* recorded by Agassiz, in the Revision, from Mozambique were probably *Lytechinus verruculatus* and he accordingly lists them under that specific name. But the three specimens in the present collection, taken at Mozambique, although small, are almost certainly *angulosus* and it is therefore likely Mr. Agassiz's record should stand, and the name *verruculatus* must then be stricken from the Zanzibar list.

I am fortunate in having at hand three of Mortensen's original specimens (cotypes) of *annulatus* and have therefore been able to compare them directly with the young *angulosus* in the PIETER FAURE collection. The lot from 17486 is particularly instructive, as they range from 10 to 18 mm. in diameter and show great diversity of colour (see J. S. Thomson. A. M. N. H. (8). 12. p. 190. 1913); one has all the spines orange-red except those around the peristome where the red fades to white; another has all the spines light violet; but in most, the spines are more or less annulated usually with dusky but sometimes with white. Examination of the ambulacra of these, and other young specimens shows that the characters supposed to distinguish *annulatus* are not regularly correlated with banded spines, but many specimens with unicolorous spines have numerous ambulacral plates and small tubercles. The only conclusion I can

reach is that *annulatus* is simply based on young specimens of *angulatus* which have banded spines, and unless adult specimens are found retaining this feature I do not see how we can use the name even in a varietal sense.

All of the specimens in the present collection from Saldanha Bay, on the west coast of Cape Colony are conspicuous for having *white* spines; the white is often tinged with green or rarely with purple, but the pale, unicolourous spines are in striking contrast to the greenish or reddish test. In view of the constancy of the character and the geographical isolation of the locality, I think this form may well be designated as variety PALLIDUS. The test is noticeably flattened and the buccal membrane has very few calcareous plates outside the circle of buccal plates. None of the specimens (the largest is 25 mm. h. d. and 11·5 mm. high) has an insert ocular. In some particulars this variety reminds one of the Marion Island form of *magellanicus* but when placed side by side, the differences between the two forms are obvious.

Among the specimens sent me from Capetown are half a dozen young ones, two each from the lots 180, 182 and 183 of Bell's report (1904, Mar. Inv. S. Afr., vol. 3, p. 171) and which he listed as "*Echinus* juv." Although Bell has not seen these particular specimens there is no doubt they are identical with his. I see no reason for considering them anything but young *angulosus*. Aside from these half dozen specimens, the localities for which are given in Bell's report, the material of *angulosus* in the collection sent me is from only the three following stations. There are however in the M. C. Z. collection more than a hundred additional specimens, all of which I have examined.

P.F. 14642. Off Saldanha Bay, west coast of Cape Colony, 20 fms. S., sh., r. 51 specimens; adult and young.

P.F. 17486. False Bay, Cape Colony, 9 fms. S., sh. 14 specimens; young.

Mozambique, Nov. 1912, K. H. Barnard. 3 specimens; young.

* TOXOPNEUSTES PILEOLUS.

Echinus pileolus Lamarck, 1816. Anim. s. Vert., vol. 3, p. 45.
Valenciennes, 1846. Voy. Venus: Zoophytes, pls. 8 and 9.
Toxopneustes pileolus Agassiz, 1841. Int. Mon. Scut., p. 7.

This well known Indo-Pacific species is recorded from Mozambique by Bell (1884, ALERT Rep., p. 510).

Tripneustes gratilla.

Echinus gratilla Linné, 1758. Sys. Nat. ed. 10, p. 664.
Tripneustes gratilla Lovén, 1887. Ech. Linn., p. 77.

This widely distributed Indo-Pacific species has long been known from Zanzibar and Mozambique. In the present collection are two specimens, each somewhat more than half grown, and each with light coloured test and white spines. One was taken at Delagoa Bay, October 1912, by K. H. Barnard while the other bears the number

P.F. 11862–C, showing it was taken in the harbour channel at Durban, 1–3·5 fms., on a bottom of sand and shells.

STRONGYLOCENTROTIDAE.

This is a northern family with few representatives south of the equator. One of these was discovered by the Valdivia on the continental slope of South Africa and has been met with three times by the Pieter Faure but in very much deeper water than where the Valdivia specimens were taken. A second species, hitherto unknown to science, of notable size and appearance, has also been taken by the Pieter Faure. It belongs to the same genus as the Valdivia's species, the least specialized group of the family and the one nearest to Echinus. A third species, quite different from these two, has long since been recorded from South Africa, but its occurrence there is doubtful. The three species are superficially quite unlike and are easily distinguished as follows.

Key to the South African Species of Strongylocentrotidae.

Ambitus well above equator; rock-boring species . *Echinostrephus molare.*
Ambitus at or below equator; not rock-boring.
Size small, up to 40 mm. horizontal diameter; height half diameter or less; peristome one-third to one-half diameter; no tridentate pedicellariae with long, straight, narrow jaws . . . . *Paracentrotus agulhensis.*
Size large, up to 80 mm. h. d.; height from more than half to nearly two-thirds h. d.; peristome less than one-fourth h. d.; tridentate pedicellariae with straight narrow jaws, 1—2 mm. long, abundant *Paracentrotus grandis.*

* Echinostrephus molare.

Echinus molaris Blainville, 1825. Dict. Sci. Nat.: Oursin, p. 88.
Echinostrephus molare A. Agassiz, 1872. Rev. Ech., pt. 1, p. 119.
1873, Rev. Ech., pt. 3, p. 457; pl. V*a*, figs. 10–12.

Mr. Agassiz lists this species from both Natal and the Cape of Good Hope, as well as from Mozambique. Its occurrence at Mozam-

bique is not unlikely but needs confirmation. The occurrence south of there seems unlikely. Mr. Agassiz's figures are of an Hawaiian Island specimen, which is now regarded as specifically distinct from the one found in the East Indies and Indian Ocean.

Paracentrotus agulhensis.

Döderlein, 1905. Zool. Anz., vol. 28, p. 623. 1906, Valdivia Ech., p. 207; pls. XXVII, figs. 1–4; XXXV, fig. 17; XLVII, fig. 1.

The Pieter Faure specimens are all small but agree very well with a cotype in the M. C. Z. collection. They measure 6–22 mm. in horizontal diameter and only 2·75–9 mm. in height. They are uniformly whitish or light yellowish in colour. In the smallest specimen the ambulacral plates, actinally and at midzone contain only three elements, while abactinally they are perfectly simple; the specimen is thus an *Echinus*, a most interesting growth-stage! The Pieter Faure specimens are all from the abyssal region, while the Valdivia specimens were taken in much shallower water.

P.F. 17215. Cape Point, Cape Colony, N. 77° E., distant?, 660–700 fms. Gn. m. 3 specimens; adult and young.

P.F. 17269. Cape Point, E. $^3/_4$ N., 42 miles, 930 fms. Gn. m. 4 specimens; young.

P.F. 17351. Cape Point, N. 83° E., 43 miles, 900–1000 fms. Grey m. 2 specimens; young.

Paracentrotus grandis, sp. nov.

Plate XXII.

Test 78 mm. in diameter and 48 mm. high; height therefore about ·62 h. d. Coronal plates 18 or 19 in each column, all (or rarely, all but the uppermost) with primary tubercles and spines; interambulacral areas in midzone about 31 mm. wide; primary tubercles large, with shallow but sharply defined areolae, the diameter of which about equals height of plate. Ambulacral plates 21 or 22, the uppermost very rarely without a primary tubercle; ambulacra about 18 mm. wide in midzone, the interporiferous area about 10 mm.; poriferous areas not very narrow, the arcs of 4 large pore-pairs distinctly curved and not very near the outer margin of the plate; primary tubercles of ambulacra relatively large and conspicuous without crenulation or perforation, of course; their areolae ill-defined, shallow and small, the diameter about ·60–·80 of height of plate. Abactinal system 16·5 mm. across; oculars rather small,

pentagonal with distal side usually somewhat concave; ocular pore rather large, close to distal margin of plate; at center of each plate is a well-marked secondary tubercle and spine, proximal to which are several much smaller tubercles bearing miliary spines or pedicellariae; all oculars much exsert; genitals large, wider than high, broadly in contact, pentagonal with proximal side concave; madreporite large somewhat swollen and very fully occupied by the pores; each genital plate bears 3–5 conspicuous secondary tubercles and spines on the proximal side, with a number of miliary tubercles about them; genital pores large, close to distal angle of plate; both ocular and genital plates, aside from the pores and the sparse tubercles have a smooth and shining surface; anal system 9 mm. across, not very thickly covered with minute plates; there is no conspicuous suranal but a plate, somewhat larger than the others, adjoins genital 3, near its juncture with 2, and may be interpreted as such; there are no spinelets or pedicellariae on the periproct. Peristome only 17 mm. across and hence only ·22 h. d.; it is covered by a rather thick membrane in which are a considerable number of scattered small plates, some of which bear pedicellariae; buccal plates not very large scarcely in contact with each other, crowded with ophicephalous pedicellariae; gill cuts broad and shallow, hardly recognizable.

Primary spines all broken at tip, but it is evident that they were more than 20, but less than 30 mm. long; they are nearly 2 mm. in diameter at base; the surface is very delicately striated with 30 or more parallel longitudinal furrows. Secondary spines 5–6 mm. long, about half a millimeter thick at base, relatively few and well scattered; on an interambulacral plate in the midzone there are 10–14, well-spaced; on adjoining ambulacral plate, there are not more than 3 or 4. Miliary spines about 4 mm. long, about ·20 mm. thick at base, tapering steadily towards tip but suddenly expanded there into a thick flat-topped head, some ·20 mm. in diameter.

Pedicellariae abundant everywhere, on long stalks. The *globiferous* resemble closely those of *P. agulhensis* but are considerably larger, as the valves are often nearly a millimeter long. The *ophicephalous* too are like those of *agulhensis* but are somewhat larger. The *tridentate* are very numerous and very varied; some are like those of *agulhensis* with broad slightly curved valves, about ·50 mm. long, meeting only at tip; but most have straight, narrow valves ·60–2·20 mm. long, somewhat expanded near tip and more or less in contact there.

Colour of test white with a distinctly roseate tinge; all spines

and pedicellariae, white; muscles at base of spines and glands on globiferous pedicellariae, brown of lighter or darker shades, in more or less abrupt contrast; tubefeet pale brown.

P.F. 19020. About 160 miles south of Cape Infanta, Cape Colony, 36° 49′ S. × 21° 14′ E., 560 fms. Gn. s. 2 specimens; adult.

Holotype, South African Museum no. A 6452.

The second specimen is similar to the holotype in nearly every particular, although it is somewhat smaller, measuring about 62 mm. in horizontal diameter; the peristome is less than 15 mm. across. It is however somewhat flatter as the vertical diameter is less than 34 mm., instead of 39 as it should be to show the same proportions as the holotype.

This notable sea-urchin looks like an *Echinus* and it was a surprise to find the pairs of pores uniformly in arcs of four. The pores are large and conspicuous and well-removed from the margin of the plate. It is not inconceivable that these two specimens are the full grown adults of *agulhensis*, with which species they have much in common. But it is hard to see how a species which after it is 30 mm. in diameter is less than 15 mm. high and has a peristome whose diameter is one-third that of the test or more, can become transformed into such a high species, with so small a peristome, as *grandis*. The general appearance of the two species is quite unlike but it is possible that abundant material will show that the differences are due to age and individual diversity and are not specific.

ECHINOMETRIDAE.

Only one species of this tropical family has straggled southward along the South African coast. It is the following very variable and widely distributed Indo-Pacific species.

Echinometra mathaei.

Echinus mathaei Blainville, 1825. Dict. Sci. Nat.: Oursin, p. 94.
Echinometra mathaei Blainville, 1830. Dist. Sci. Nat.: Zoöphytes, p. 206.

It is a rather remarkable fact that this very common and widespread sea-urchin has never been adequately figured. Under the name *E. lucunter*, Mr. Agassiz has given a single figure of a nearly bare test (1873, Rev. Ech., pl. IV*b*, fig. 4) but the long axis of this specimen is less than 10 % longer than the short axis, whereas in many specimens the difference between the two axes is much greater than this and it is not often much less. The species is listed in the

"Revision" as occurring at Mozambique, Natal and Cape of Good Hope. In the collection before me, there is a specimen from Mozambique and one from Delagoa Bay. The former was taken in November, 1912 by Mr. K. H. Barnard and is chiefly of interest because its ambitus is so nearly a circle; the long axis is 45 mm. and the short one is only about 5 mm. shorter. The Delagoa Bay specimen, also taken by Mr. Barnard (October, 1912), is nearly the same length (44 mm.) but its breadth is much less (35 mm.).

The Pieter Faure has not taken an *Echinometra* and I doubt whether the species occurs regularly south of Delagoa Bay. The records in the "Revision" are based on Museum material of considerable age and the locality labels are not to be trusted implicitly.

CLYPEASTERIDAE.

The only published record of the occurrence of this family in South Africa is my own statement (1914, Mem. M. C. Z., vol. 46, p. 29) that there are specimens of *Clypeaster audouini* in the M. C. Z. collection from Natal. Since that time, I have found a small *Clypeaster*, also from Natal, in our collection, labelled *Laganum decagonale*, which while clearly a *Clypeaster* is certainly not *audouini*. In the Pieter Faure collection are two tantalizing specimens of *Clypeaster*, which can hardly be determined with certainty. One is a very young individual, which I am satisfied is identical with the small specimen from Natal in the M. C. Z.; I believe these young *Clypeasters* may best be referred to the wide-spread Indo-Pacific species, *C. humilis*, although they are really too young for certain identification. The other Pieter Faure specimen is a fragment of the lateral margin of a large Clypeaster, which the coarse tuberculation shows is certainly neither *audouini* nor *humilis*. The fragment (P.F. 12557) is nearly 80 mm. long and shows that the whole animal was about 140 mm. long. It is a somewhat waterworn fragment of a dead test and was taken 11 miles off Cape Natal in 180–200 fms. This locality and depth, as well as the condition of the specimen, show that it had undoubtedly come from farther north. The tuberculation of the fragment is quite similar to that shown by large specimens of *reticulatus*, but the individual from which it came was nearly twice as large as any known specimen of *reticulatus*, fully adult specimens of which are in the M. C. Z. collection from Mauritius. It seems probable that the Pieter Faure fragment comes from a species as yet unknown to science.

Key to the South African Species of Clypeasteridae.

Test about as wide as long, pentagonal with more or less concave sides; petals narrow with only slightly convex poriferous areas . . . *Clypeaster audouini.*
Test longer than wide, ambitus more or less elliptical; petals rather wide, with more or less obovate interporiferous area and strongly convex sides
Clypeaster humilis.

* Clypeaster audouini.

Fourtau, 1904. Bull. Inst. Egypt, ser. 4, no. 4, p. 418; pl. I, figs. 1–3.

There are in the M. C. Z. collection three very good specimens of this well-marked species, which were presented by Dr. Robert T. Jackson, who purchased them in London. They were labelled as having come from Durban, Natal. Fourtau's specimens were from the Red Sea, so the species would seem to be characteristic of the whole Eastern coast of Africa.

Clypeaster humilis.

Echinanthus humilis Leske, 1778. Add. ad Klein, pp. XIX, 121.
Clypeaster humilis A. Agassiz, 1872. Rev. Ech., pt. 1, p, 100.
H. L. Clark, 1914. Mem. M. C. Z., vol. 46, p. 36; pls. 137; 138, fig. 4.

Although this species has long been known from Mauritius it has not been recorderd hitherto from the African coast. A small clypeastroid in the M. C. Z. collection, supposed to be from Durban, Natal, seems however to represent this species, altho it may not be denied that it is possible it is a young *audouini*. The test is 36 mm. long and 34 mm. wide, so that a very slight change in the rate of growth of either axis might make a perfectly pentagonal test. The petals however are relatively wide with strongly convex poriferous areas. In spite of the petals, I should call this specimen a young *audouini*, were it not for the Pieter Faure specimen. This is a much younger individual, 18 mm. long and 16 mm. wide, with relatively wide petals having strongly convex sides. It seems to me unlikely that the young of *audouini* would be less pentagonal than the adult, or that its petals would be so wide. As *humilis* probably occurs on the African coast, it seems to me better to list these two young clypeastroids under that name, especially as they agree with a young *humilis* from Ceylon, in practically every particular.

P.F. 12084. O'Neil Peak, N.W. 1/4 W., 9 miles, 90 fms. Brk. sh. 1 specimen; very young.

LAGANIDAE.

This family has not hitherto been found on the South African coasts but there is an unmistakable laganid, probably of the following species in the Pieter Faure collection.

Laganum decagonale.

Scutella decagonalis Blainville, 1827. Dict. Sci. Nat.; Scutelle, p. 229.
Laganum decagonale Bell, 1884. Alert Ech., p. 122.

This species is still imperfectly known and indubitable specimens are rare. Usually specimens labelled *decagonale* turn out to be something else and it is so with the specimen in the M. C. Z. collection supposed to be from Durban, Natal. This proves on close examination to be a young *Clypeaster*. However there is a dead *Laganum* test, in poor condition, in the Pieter Faure collection which seems to be this species; owing to its poor condition, it is however impossible to assert whether it is a *Laganum* or a *Peronella*. It is 30 mm. long, by some 28 mm. wide and only about 4 mm. high; the abactinal system and a large part of the oral surface are missing but enough of the petals remain to warrant referring it to this species.

P.F. 11740. Off Tugela River, Natal, N.W. by N. $^3/_4$ N., 15 miles, 36–42 fms. M. 1 specimen; adult, poor.

FIBULARIIDAE.

This family also was unknown from South Africa until now. But the Pieter Faure has taken two specimens of an *Echinocyamus*, which I refer to the following species.

Echinocyamus elegans.

Mazetti, 1895. Mem. Reg. Accad. Sci. Modena, ser. 2, vol. 10, p. 216.

Of the two specimens taken by the Pieter Faure, one is a dead test but the other seems to have been living when taken and is densely covered with spines. The dead test is 8·5 mm. long, 6 mm. wide and 2·5 mm. high; the petals are well-developed with nearly straight and approximately parallel sides; there are 6 or 7 pore-pairs in each area; the genital pores are much larger than the ocular and are equal to or perhaps exceed the primary tubercles; the mouth is large, somewhat pentogonal, a trifle longer than wide,

and not much sunken; the periproct is not more than one-third as large as the mouth, is longer than wide, and lies half way between the posterior margin of mouth and the end of the test.

The other specimen is 9·5 mm. long, 7 mm. wide and about 3·5 mm. high. The crowded, very pale brown spinelets conceal the petals entirely but when they are rubbed off, it is possible to count 8 pore-pairs on one side of one of the paired petals, but they are so small and deeply sunken, it is hard to see them; the mouth is large, nearly circular, apparently about three times as large as the periproct; the latter is longer than wide.

In general these specimens answer well to Mazzetti's description, but in one or two particulars they differ; in his type, which was smaller than either of these, he counted *nine* pore-pairs, while eight is the maximum number for these larger specimens; again in these specimens the lower surface of the test is scarcely concave below while according to Mazzetti his specimen was markedly so. In spite of these differences however I think it better to refer the South African specimens to the Red Sea species *elegans*, than to establish a new species in a genus already overburdened with insufficiently known forms.

P.F. 10722. Cape Natal, W. by N., $6^1/_2$ miles, 54 fms. Fne. s. 1 specimen; adult; bare.

P.F. 13228. Cove Rock, N.W. $^3/_4$ N., 13 miles, 80–130 fms. Crl. and r. 1 specimen; adult.

SCUTELLIDAE.

This family is represented in South Africa by only the following species, both of which are well-known Indian Ocean forms.

Key to the South African Species of Scutellidae.

Each posterior ambulacrum with a long, narrow lunule distal to petal ·
Echinodiscus bisperforatus.

Each posterior ambulacrum with a deep, narrow slit, extending in from margin
Echinodiscus auritus.

Echinodiscus bisperforatus.

Leske, 1778. Add. ad Klein, p. 132. Agassiz, 1841. Mon. Scut., pl. XII (as *Lobophora bifora*).

There are specimens of this fine scuttellid in the M. C. Z. collection from Mozambique, Durban and Mossel Bay. It is well-known

from Madagascar, Zanzibar and Mauritius, and occurs also in the Red Sea and eastward to the Dutch East Indies.

* Echinodiscus auritus.

Leske, 1778. Add. ad Klein, p. 138. A. Agassiz, 1873. Rev. Ech., pt. 3, pl. XIIIc, figs. 1, 2.

This species is recorded from Mozambique by Sluiter and since its distribution is like that of *bisperforatus*, it may be expected along the coast at least as far south as Natal.

NUCLEOLITIDAE.

This old yet small family is but poorly represented in South Africa as two of the three species here listed occur only in deep water and the third is included here only on the basis of an old record, the reliability of which is open to question. The three species may be distinguished by means of the following key.

Key to the South African Species of Nucleolitidae.

Ambulacral pores wanting, and ambulacra hard to distinguish, on abactinal surface *Tropholampas loveni.*

Ambulacral pores very evident abactinally.

Abactinal poriferous areas long, reaching nearly or quite to the almost circular ambitus . . . . . *Echinolampas crassa.*

Abactinal poriferous areas not long, not nearly reaching the oval or elliptical ambitus . . . . . *Echinolampas ovata.*

Tropholampas* loveni.

Catopygus loveni Studer, 1880. Monatsb. Berlin Akad. Wiss., p. 878; pl. II, figs. 1–1*d*.

Neolampas loveni H. L. Clark, 1917. Mem. M. C. Z., vol. 46, p. 110.

One of the most interesting of the captures made by the Pieter Faure is revealed by two small bottles of little echini from two stations in moderately deep water. These prove on critical examination to be identical with the two dead tests taken by the Gazelle in 117 fms. south of the Cape of Good Hope, which Studer reported as a Recent species of *Catopygus*. Without seeing any specimens, I concluded that Studer's species would go better in

* *Τροφός* = nurse + *λαμπάς* = lantern, in reference to the care of the young and in conformity with the terminal syllables of allied genera.

Neolampas, but now that I have examined specimens, it seems to me this interesting form had best be placed in a genus of its own, although its relationship to *Neolampas* is evident. It differs from *Neolampas* in the complete absence of any anal furrow or pit, the periproct being flush with the surface of the test, in having 4 distinct genital pores and in the complete shutting out of the oculars from the abactinal system, the five pairs of interambulacral plates forming a closed ring surrounding the fused plate formed from the genitals. The oculars are greatly reduced and I failed to detect any ocular pores.

The most striking character however, though it may prove to be specific rather than generic, is the development of a sunken brood-pouch in the female. This appears to be formed by the invagination of the fused genitals with their surrounding ring of interambulacral plates, so that the genital pores lie on the floor of the pouch, whose wall is thin and carries very few spines. The pouch itself is about 1·5 mm. deep and 2–3 mm. in diameter; the entrance is about half the diameter. Relatively large spines and pedicellariae guard the entrance but are outside of it. In one female, whose pouch I opened, there was a single young one, nearly circular in outline, slightly flattened, about 1·5 mm. in diameter, covered with many primary, but few miliary, spines and with a central circular mouth. In the males, there is no pouch but there may be a slight depression of the proximal end of interambulacrum 5. Studer speaks of it as a shallow groove concealed by overcrossing spines but it is not at all noticeable in his figure nor in any of the Pieter Faure specimens.

There are four well marked genital pores. Studer says the left anterior pore is noticeably smaller than the others but it does not seem to be so in any of the present specimens. Again, Studer says the peristome is covered by naked skin, but probably he did not dry a specimen, for when the membrane is dry it is found to be filled with thin calcareous plates. In his description of the basico-ronal plates around the peristome, Studer does not refer to the large, glassy sphaeridia, one of which lies in a big, shallow pit at the middle of each ambulacral margin.

The miliary spines of *Tropholampas* are (like those of the other *Nucleolitidae*) similar to those of the *Laganidae*, in being made up of parallel rods, connected by cross-bars, and more or less expanded, flattened and toothed at the free end. Each spine is made up of six such rods in *Tropholampas* and each rod is so much expanded at the tip that the whole spine is abruptly three times as thick at the tip as elsewhere. While the miliary spines are thus noticeably

more capitate in *Tropholampas* than in *Neolampas*, it is interesting to find that the primary spines are much more acuminate, and are quite sharp.

The pedicellariae of *Tropholampas* are of only one kind so far as I can find, and they occur only about the abactinal system. They are large tridentate, with valves about ·20 mm. long; the basal part is about ·15 mm. wide and ·10 high; the blade is only about ·01 mm. wide at base but is twice that near tip; the valves are rather strongly curved near tip, where they meet only by their terminal edges.

The colour of these specimens in alcohol is pale grayish, with a slight yellowish tinge, but they are nearly white when dry. The largest is a male, measuring 8 mm. long, by 6 mm. wide and 5 mm. high. The largest female is about 7 mm. long but is nearly as wide and as high as the male.

There can be little doubt that this interesting little nucleolitid is nearly related to *Neolampas rostellata* of the Caribbean Sea. In this *Neolampas* there is a well-marked sexual dimorphism, as the genital pores of the female are very large so that a considerable part of the abactinal system is membranous. It is not hard to see how such a condition might lead to invagination of the area affected and thus a brood pouch would easily be formed. In *Neolampas rostellata* there are however only three genital pores, the left anterior (i. e. the one in genital 3) being wanting. In other particulars, the whole abactinal region of *rostellata* is less specialized than in the African species, for there are five distinct ocular pores and the ocular plates are in contact with the fused genitals.

The specimens of *Tropholampas* were taken at the following places.

P.F. 14252. Cape St. Francis, N. E. 29 miles, 75 fms. S., sh., r. 1 specimen; adult.

P.F. 15129. Table Mountain, E. by S. $^1/_2$ S., 25 miles, 190 fms. Gn. s., bl. spks. 12 specimens; adult.

Echinolampas crassa.

Palaeolampas crassa Bell, 1880. Proc. Zool. Soc. London, p. 43; pl. IV.
Echinolampas crassa H. L. Clark, 1917. Mem. M. C. Z., vol. 46, p. 113.

It is a little strange that the Pieter Faure has not met with this species. It is apparently very local, for the only known station for living specimens is two miles north-northeast of Kromhout in 14 fms. of water. The Valdivia met with a fragment of a dead test off the Cape Colony coast in 276 fms. but this had no doubt been washed out from much shallower water.

* Echinolampas ovata.

Echinanthus ovatus Leske, 1778. Add. ad Klein, p. 127.
Echinolampas ovata Döderlein, 1906. Valdivia Ech., p. 240. H. L. Clark, 1917, Mem. M. C. Z., vol. 46, pl. 153, figs. 1, 2.

This species is recorded in the "Revision" from the Cape of Good Hope but it has not been met with in recent years anywhere on the African coast south of the Red Sea. Evidently the South African record needs confirmation.

URECHINIDAE.

There is only a single species of this little family known from the region covered by this report.

Urechinus naresianus.

A. Agassiz, 1879. Proc. Amer. Acad., vol. 14, p. 207.
1881, Challenger Ech., pl. XXX.

Bell (1905, Mar. Inv. South Africa, vol. III, p. 173) lists this species as occuring in the South African material he studied, but he forgets entirely to give either place or depth. In the Pieter Faure collection is a lot of small urechinids in poor condition which I refer to this species with little hesitation. They are all rubbed more or less completely bare of spines and pedicellariae, and nearly all are broken or crushed to a greater or less extent. They range in length from 9.5 mm. to 21, but they show very little diversity in form, the height being half the length or a little less.

P.F. 17351. Cape Point, N. 83° E., 43 miles, 900–1000 fms. Gr. m. 40 specimens; young, bare.

POURTALESIIDAE.

The occurrence of this extraordinary family in the vicinity of South Africa was known only from a single small specimen identified by Bell as *Pourtalesia carinata* A. Ag. one of the Challenger echini, a large pourtalesiid, 90–100 mm. long, taken in 1600 fathoms near te Crozet Islands and at still greater depths further eastward. Fortunately the South African Museum collection contains ten Pourtalesias labelled as "duplicates of those sent to Bell". From these it is clear that the species is not *carinata* but a much smaller pourtalesiid, not very closely allied to that big, deep water form.

Pourtalesia alcocki.

Koehler, 1914. Ech. Indian Mus. Spat. p. 8, pl. 1, figs. 1–14.

The ten specimens before me accord well with Koehler's description and figures and confirm the validity of the species which was originally taken in the Golf of Oman. There is nothing but a most superficial resemblance to *carinata*, which is as Mortensen (1907, Ingolf Ech. pt. 2, p. 82), has shewn, really the representative of a distinct genus. Bell's reference of his specimen (1905, Mar. Invst. S. Afr. III, p. 172) to that species was probably based on geographical grounds as no other pourtalesiid has been recorded from any spot so near to Cape Town, as are the Croset Islands, far away as they are. The series of *alcocki* at hand range from 27–37 mm. in length; the largest is 18 mm. wide and the height is the same. The colour is light purple, darkest in the large specimens, and very pale in the small ones. All the specimens are from the station recorded by Bell, 46 miles west southwest of Cape Point, 900 fathoms.

HEMIASTERIDAE.

This widely distributed family is very poorly represented in South African waters although four genera and eleven species are characteristic echini of Antarctic and subantarctic waters on both sides of the region. One species has long been known from the Cape and a second has now been found by the Pieter Faure. They are easily distinguished from each other as follows.

Key to the South African Species of Hemiasteridae.

Vertical diameter of test about half the length; genital pores 3 *Brisaster fragilis.*
Vertical diameter of test ·60 of length or more; genital pores 2
Schizaster edwardsi.

Brisaster fragilis.

Brissus fragilis Düben and Koren, 1846. Skan. Ech., p. 280.
Schizaster (*Brisaster*) *fragilis* Gray, 1855. Cat. Ech. Rec. Brit. Mus., p. 61.
Mortensen, 1907. Ingolf Ech., pt. 2, pl. I, figs. 6, 7.

The single specimen in the Pieter Faure collection is badly crushed and throws no new light on the disputed question whether the Cape *Brisaster* is identical with the European species or not.

I cannot see that anything is gained by giving it even a varietal name for it is certainly so close to the northern form that from the zoogeographical point of view it is practically identical. The Pieter Faure specimen was apparently about 44 mm. long, 40 mm. wide and 20 mm. high.

P.F. 15143. Table Mountain, E. by S. ½ S., 25 miles, 190 fms. Gn. s. and spks. 1 specimen; adult, crushed.

Schizaster edwardsi.

Cotteau, 1889. Bull. Soc. Zool. France, vol. 14, p. 341. 1889, Compte-Rendu Cong. Int. Zool., p. 286; pls. III, figs. 7–12; IV, figs. 1–12.

Although the single *Schizaster* taken by the Pieter Faure was found on the Natal coast, and hence ought to belong to the Indo-Pacific species, it seems to be unquestionably identical with Cotteau's specimens from Cape Palmas, Liberia. Placed side by side with a specimen of *lacunosus* of the same size (28 mm. long, 24 mm. wide, 20 mm. high) from Japan, the differences are obvious, particularly in the width of petal III and the shortness and great divergence of the posterior petals. In my key to the species of *Schizaster* (1917, Mem. M. C. Z., vol. 46, p. 193), I have used the term "petal-length" without definition and hence in an ambiguous way; it refers to the length of the antero-lateral petals, not to the posterioir pair. It may also be mentioned in passing that *lacunosus* is somewhat variable in the character under consideration and specimens with petals I and V as divergent as in *edwardsi* will perhaps be found. — A careful search failed to reveal any pedicellariae on the Pieter Faure specimen of *edwardsi* but the specimen is badly damaged and most of the oral surface back of the labium is missing.

P.F. 11430. Off Tugela River, Natal, 12–14 fms. M. 1 specimen; small adult; damaged.

SPATANGIDAE.

This large and cosmopolitan family is well-represented in South Africa, although it is evident that none of its representatives are very common. Several species are identical with or at least very nearly allied to European forms. Two of these are recognizable as distinct and are here treated as endemic species. But the only really distinctive spatangoid is the one here made the type of a new genus, to which I have given the name *Spatagobrissus*. The seven species

occurring in the region covered by this report are easily distinguished from each other as follows.

Key to the South African Species of Spatangidae.

No internal fasciole present.
  Peripetalous fasciole well developed.
    Ambulacrum III dorsally sunken and more or less petaloid
      Brissopsis lyrifera.
    Ambulacrum III not at all sunken or petaloid.
      A distinct anal fasciole rises from subanal on each side of periproct
        Metalia spatagus.
      No anal fasciole . . . . *Spatagobrissus mirabilis.*
  Peripetalous fasciole wanting . . . . *Spatangus capensis.*
Internal fasciole present.
  Large, deeply sunken primary tubercles present in interambulacra; labrum very long and narrow; sternum with tubercles confined to posterior part
    Lovenia elongata.
  No large, deeply sunken, primary tubercles; labrum short and wide; sternum well covered with tubercles.
    Ambulacrum III not at all sunken, even at ambitus
      Echinocardium capense.
    Ambulacrum III distinctly sunken, especially at ambitus
      Echinocardium cordatum.

Brissopsis lyrifera.

Brissus lyrifer Forbes, 1841. British Starfishes, p. 187.
Brissopsis lyrifera Agassiz and Desor, 1847. Ann. Sci. Nat. Zool., (3) vol. 8, p. 14. Mortensen, 1907. Ingolf Ech., pt. 2, pl. III, figs. 2, 3, 7, 11, 12, 18, 20, 21, 22, 23.

The occurrence of this European species at the Cape of Good Hope has long been known. Mortensen thinks the Cape specimens are recognizable as a distinct variety and that more material may prove them to be entitled to specific recognition. I am unable to agree with him in this, and the small amount of material in the present collection provides no further reason for adopting his view. The specimens range from 6 mm. to 54 mm. in length. It is worthy of note that they were all taken on the west coast of Cape Colony and no *Brissopsis* was met with on the southern or eastern coasts.

P.F. Dassen Island, E. $^1/_2$ S., 9 miles, 76 fms. Gn. s. 3 specimens; adult.

P.F. Table Mountain, E. by S. $^1/_2$ S., 25 miles, 190 fms. Gn. s., blk. spks. 13 specimens; young.

*Metalia spatagus.

Echinus spatagus Linné, 1758. Syst. Nat. ed. 10, p. 665.
Metalia spatagus Lovén, 1887. Ech. Linn., p. 162.
Metalia maculosa A. Agassiz, 1873. Rev. Ech., pt. 3, pl. XXI*b*, figs. 8, 9.

This species is included here with great trepidation and solely on the strength of the reports that Peters took it at Mozambique in 1854. It is known from Mauritius but not from Zanzibar.

Spatagobrissus* mirabilis gen. et sp. nov.

Plate XXIII.

Test wide, low, well rounded in front, the ambitus rounded behind, but below ambitus interambulacrum 5 slopes abruptly forwards making an oblique surface on which opens the longitudinally elongated periproct. Peristome anterior, not deeply sunken. Ambulacrum III narrow, flush, not very distinct, ambulacra I and V moderately wide, conspicuously petaloid, the petals rather long, bluntly pointed, distinctly depressed; ambulacra II and IV similar, the petals as long or longer, and more divergent than I and V. Peripetalous fasciole a single very distinct band, enclosing a nearly circular area, containing numerous large primary tubercles. Subanal plastron small, subanal fasciole very distinct. Genital pores 4.

The above paragraph may serve for the generic diagnosis while the following additional data apply more particularly to the species. Test 112 mm. long, 95 mm. wide across anterior end of posterior petals but only 90 across their tips, and 53 mm. high posteriorly (about the same point as where widest) but only 43 high at peristome. Anterior petals 36 mm. long and posterior pair about the same. Anterior half of test above and below, inside and outside of peripetalous fasciole, crowded with primary tubercles, among which are secondaries and numerous miliaries also; the tuberculation is particularly thick in the midzone, outside the fasciole; on the posterior half of the test there are no primaries outside the peripetalous fasciole but within it they are nearly as numerous as anteriorly; even

* The characters of this genus combine so strikingly those of *Spatangus* and *Brissus*, it seemed to me fitting to combine those two generic names in one, dropping the n of *Spatangus* for euphony's sake and to accord with the names *Spatagocystis* and *Spatagodesma*. The significance of the specific name, *mirabilis*, is obvious.

in the interporiferous areas there are small primaries, though not in great number. In ambulacrum III the plates are high and have a well developed vertical pore-pair just distal to the centre; as the apical disc (which is anterior to the center) is approached the pore-pairs lie more and more towards the outer side of the increasingly lower plates. The apical system is small, compact and elongated; there are four large genital pores and a greatly elongated madreporite; from ocular III to a line joining the posterior margins of genital pores 1 and 4 is not quite 3 mm. but from that line to the distal tip of the madreporite in interambulacram 5 is nearly 4 mm. The peripetalous fasciole is very distinct, obviously depressed below the test level and about a millimeter wide; it does not bend in at any interradius and posteriorly has an evident narrow squarish outward bend. Peristome not very much sunken, about 21 mm. wide and its length not quite half as much; its anterior margin is 29 mm. from anterior end of test. Sternum and subanal plastron considerably projecting but the surface of the subanal plastron is nearly flat and almost horizontal. There are, on each side of the plastron, two large tube-feet and apparently only 3 plates enter the fasciole. Periproct 12 mm. high and 7 mm. wide, pointed at both ends; its upper end is just below the ambitus, so no part of it is visible from above; its lower end is 6 or 7 mm. nearer the mouth than its upper, so oblique is the surface on which it is placed.

The holotype, S.A.M. No. A 6451, of this new species is a dead but not waterworn test from Onrust River, near Hermanus, Cape Province. There is also a second specimen in the collection but it is from an unknown locality and has no label. It is somewhat damaged and is also a little deformed, the ventral surface on the left side being somewhat pushed in, forming a hollow, where, on the opposite side of the test there is a slight outward arching of the surface.

This remarkable spatangoid combines to a very striking degree the characters of *Spatangus* and of *Brissus*. The petals, the mouth and the form of the posterior part of the test are quite like *Spatangus*, while the presence of the peripetalous fasciole (but not its course), the form of the anterior half of the test and the form and position of the periproct are much like *Brissus*. The proximal part of the anterior poriferous areas of petals II and IV are very nearly complete and normal, not more or less reduced as in *Spatangus*. In the tuberculation of the test the new genus is unlike either of the others for the primary tubercles are much more numerous, than in *Spatangus* while they are much larger than in *Brissus*. In some particulars,

Spatagobrissus approaches *Eupatagus* but the shape of the test, the form and depression of the petals and the distribution of the primary tubercles preclude their close association. It is rather remarkable that so large and well characterized a spatangoid has not hitherto been described and the discovery of living specimens will be a matter of very great interest.

Spatangus capensis.

Döderlein, 1905. Zool. Anz., vol. 28, p. 624. 1906, Valdivia Ech., pl. XXXIII, figs. 1, 1*a*.

This seems to be one of the common and characteristic echinoderms of the Cape region. The Pieter Faure specimens show some diversity in relative height and width. They range in length from 68 to 115 mm.; the width is ·84–·94 of the length and the height is ·48–·56 of the length. The colour varies from deep purple to purplish-gray, one specimen showing only a faint purple tinge. They were taken at the following places.

P.F. 1935. Cape St. Blaize, N.W. $^1/_2$ N., 30 miles, 32 fms. R. 1 specimen; small adult.

P.F. 10325. Cape Hangklip, N. $^3/_4$ E., 29 miles, 48 fms. St. 1 specimen; adult.

P.F. 14841. Cape Castle, E. $^1/_2$ N., 9 miles, 89 fms. Dk. grey m. and s. 1 specimen; adult.

Agulhas Bank. 2 specimens; large adult.

Lovenia elongata.

Spatangus elongatus Gray, 1845. Eyre Voy., vol. 1, p. 436.
Lovenia elongata Gray, 1851. Ann. Mag. Nat. Hist. (2), vol. 7, p. 131. A. Agassiz, 1873. Rev. Ech., pt. 3, pl. XIX*c*, figs. 1–4.

This fine spatangoid has long been known from South Africa, whence its range extends to northern Australia and Japan. It is rather remarkable that the Pieter Faure collection contains only a dorsal fragment of one specimen.

P.F. 11028. Umhloti River, Natal, N.N.W. $1^1/_2$ miles, 27 fms. S., sh., r. 1 specimen; a fragment, with its spines.

* Echinocardium capense.

Mortensen, 1907. Ingolf Ech., pt. 2, p. 137; pl. II, figs. 5, 6, 11.

Although related to the North Atlantic species, *flavescens*, this form seems to be perfectly distinct. It is known only from the coasts of South Africa in 31–150 fms. Unfortunately it has not been taken by the Pieter Faure.

Echinocardium cordatum.

Echinus cordatus Pennaent, 1777. Brit. Zool., vol. 4, p. 69.
Echinocardium cordatus Gray, 1848. Brit. Rad., p. 6. A. Agassiz, 1873, Rev. Ech., pt. 3, pl. XX, figs. 5–7.

This cosmopolitan species is represented in the present collection collection by 28 specimens, ranging from 11 to 27 mm. in length, but a number are badly crushed.

P.F. 483. Algoa Bay, Cape Colony, 20 fms. M. 2 specimens; adult.

P.F. 608. Algoa Bay, 33° 49′ S. × 25° 56′ E.. Depth and bottom? 2 specimens; small adult.

P.F. 735. Between Roman Rock aud Cape Recife, 22 fms. M. 2 specimens; adult and young.

P.F. 2911 and 2912. False Bay, Cape Colony, 30 fms. S. and sh. 19 specimens; adult and young.

P.F. 2959. Cape Point, S. W. by W. $^3/_4$ W., $3^1/_2$ miles, 32 fms. S. and sh. 2 specimens; adult.

P.F. 4046. False Bay, 20 fms. Brk. sh. 1 specimen; large adult; crushed.

SEA-CUCUMBERS. HOLOTHURIOIDEA.

The collection of holothurians received from the South African Museum was an unpromising lot of material. It had previously been sent to a zoölogist whose work was interrupted by the war, and having been returned by him to Cape Town, was forwarded at once to me. Owing to transportation difficulties and custom's-house delays, it reached me only after some months of travel. Several jars and bottles were broken and from others the alcohol had vanished, so that many specimens were completely dried and appeared to be hopelessly unidentifiable. As a matter of fact however the collection proved to be a very interesting one and

only one specimen is beyond recognition. That is apparently a *Thyone* which was evidently preserved in formalin, and from which the anterior end is missing. As there are no calcareous structures left, there is no clue to its identity. The dried specimens yielded surprisingly well to prolonged soaking in water, followed by weak alcohol. The most serious difficulty with the collection however is the fact that in some way, at sometime, labels have been mixed, so that one jar containing five species bears both Natal and Mozambique labels and there are other jars in which there were more labels than specimens. On the other hand a few bottles contained no labels at all.

In spite of these drawbacks, the collection throws a great deal of light on the hitherto little known holothurian fauna of South Africa and its origin. There are also three species which seem to be new to science, each representing a large, cosmopolitan genus. One of the most striking features of the collection is the entire absence of apodous forms, neither a synaptid nor a molpadiid being present. This remarkable fact emphasizes anew the entire absence of apodous holothurians in the South African region. Possibly they may yet be found there but they must be at least relatively rare. The *Elpidiidae* are also conspicuous by their absence, a single specimen in the Pieter Faure collection being the only representative of the family as yet noted from that portion of the Southern Ocean.

The collection sent me contains 174 specimens of 24 species. It is a little hard to determine how many of these were previously known from South Africa for no list of the holothurians of the region has ever been published. In Theél's great monograph on the Challenger holothurians, the most useful, reliable and altogether satisfactory work dealing with this somewhat difficult class of echinoderms, there are some twenty species given which seem to occur in the region covered by this report. I have found a few other species recorded in subsequent papers, so that there are about 25 species now listed from South Africa but at least five of these are synonymous with others of the list, so that 20 seems to be the number of valid species now known. Of these 12 are in the collection sent to me from the South African Museum which also contains 12 species new to the fauna of the region. There are thus 32 species included in the present report, but it is perfectly clear from the available data that not more than three or four holothurians are at all common on the coasts of South Africa, at least south of Delagoa Bay.

Of the 32 species, 27 are truly littoral occurring in water less

than 20 fms. deep, and any one of them may be found at or just below low tide mark. Of the other five species, 2 are abyssal and 3 belong in the continental group. Of the 27 littoral species, 12 are endemic so far as our present knowledge goes but it is very probable that some of these have a wider range than is at present suspected. Of the other 15 species, one is known from the Red Sea, one is tropicopolitan and the others are well-known Indo-Pacific species. There is not a single Atlantic or West Indian species nor one known from the southern coasts of either Australia * or South America.

On the other hand, of the three continental species two are endemic while the third is a North Atlantic form, and of the two abyssal species, one is cosmopolitan and one is of the North Atlantic. It seems clear then that the very scanty deep water holothurian fauna of South Africa has come from the western side of the continent and apparently is closed allied to that of the North Atlantic, while the shallow water fauna is distinctly Indo-Pacific. It is noteworthy that there are included in this report no fewer than 9 holothurians not certainly known from south of Mozambique and there are 2 others not known from south of Delagoa Bay. As there are 5 others not known from south of Natal, it is evident that only 11 species of Holothurians occur on the coasts of Cape Colony.

In 1884, Bell (Alert Ech., p. 509) listed half a dozen holothurians from Mozambique, with the preliminary remark that they were "forms that are so thoroughly well known to students of this group of animals that it has not been thought necessary to burden the text with the ordinary bibliographical references". He even fails to give the authority for the names but these are easily guessed. In 1884, two years prior to Theél's great work, the identification of Holothurians was a tedious undertaking and there were few species of which it could be said that they were "thoroughly well known". Of Bell's six, one (*Actinopyga mauritiana*) is well-characterized and is fairly well-known but *Holothuria impatiens* is a very puzzling form, *H. maxima* is absolutely unknown in every detail, *H. amboinensis* is little known but is probably synonymous with *H. atra*, *H. pulla* is practically unknown and *H. lagoena* is now known to be synonymous with *H. leucospilota*. It might be added that we do not know whether the *H. maxima* of Bell's list is the species of Delle Chiaje or of Forskaal, and that *H. pulla* is listed with a question mark. Obviously

* Ludwig considers his *Colochirus australis* from Australia synonymous with *Pentacta doliolum* (Pallas) of Cape of Good Hope and Angra Pequena. Both forms are very imperfectly known and their identity seems to me highly improbable.

then the ALERT Report's list does not throw much light on the Holothurians of South Africa! Owing to our lack of knowledge as to their essential characters, I cannot include either *Holothuria maxima* or *H. pulla* in the present report.

The 32 species of South African holothurians represent only 3 families. These are easily distinguished from each other by the following characters.

Key to the South African Families of Holothurians.

Tentacles dendritic; retractor muscles well developed . . . *Cucumariidae.*
Tentacles more or less peltate; no retractor muscles.
No tentacle-ampullae; no respiratory trees . . . *Elpidiidae.*
Tentacle-ampullae and respiratory trees present . . *Holothuriidae.*

CUCUMARIIDAE.

This large and widespread family is represented in South African waters by 17 species of which 13 are in the collection before me. Three of the species belong in the continental fauna and one is abyssal. Two seem to be new to science. Generic differences in the family are not easily maintained for the genera have been largely based upon the number and arrangement of the tentacles, characters which show more or less considerable changes during growth. The South African species fit into their respective genera well however, except that several of the species of *Cucumaria* approach so close to *Pentacta* that the line of difference between the two genera is hard to maintain. It is worthy of special note that with a single exception, all the *Cucumariidae* of this report occur on (or off) the coast of Cape Colony, or the adjoining coast of Southwest Africa and of Natal. The family is thus the characteristic one for the South African region. Two of the species here reported are new to science, and nine others are endemic, a very unusual proportion. The 17 species may be distinguished from each other as follows.

Key to the South African Species of Cucumariidae.

Body wall soft or leathery, more or less filled with microscopic calcareous particles. Tentacles 10.
Ventral side of body not markedly distinct from dorsal nor are dorsal ambulacral appendages larger than those of ventral side.
Pedicels either confined to radii, or if present on the interradial areas they are much smaller there.
Inner layer of skin with numerous, often densely crowded, thick, knobbed perforated plates or buttons.

Outermost layer of skin with numerous minute branched rods, reticulated cups or "baskets" or very small plates with few large perforations regularly arranged.

Deposits of outermost layer of skin in form of reticulated cups or baskets.

Baskets with numerous little spines or knobs scattered over them . . . *Cucumaria discolor.*

Baskets smaller, perfectly smooth with few marginal projections . . *Cucumaria spyridophora.*

Deposits of outermost layer of skin not in form of baskets.

Deposits of outermost layer of skin short thick rods forked at each end, and often more or less further branched dichotomously . *Cucumaria insolens.*

Deposits of outermost layer of skin minute perforated plates, which appear to have been formed by fusions of the tips of branches of rods which have more or less frequently dichotomously branched *Cucumaria capensis.*

Outermost layer of skin apparently without deposits; no terminal plates in pedicels.

Small pedicels scattered over dorsal interambulacra *Cucumaria sykion.*

No pedicels on interambulacra . *Cucumaria jaegeri.*

Inner layer of skin with no knobbed plates or buttons.

Calcareous deposits in the form of more or less curved rods of two kinds . . . *Cucumaria frauenfeldi.*

Calcareous deposits in the form of reticulated baskets and large, smooth, perforated plates . *Cucumaria improvisa.*

Pedicels more or less generally distributed over body.

Calcareous deposits, in part at least, tables with irregular disk and spire of two rods . . . *Thyone serrata.*

No tables present.

Deposits, knobbed plates with a vertical arch at right angles to each surface . . . . *Thyone sacellus.*

Deposits, perforated rods and smooth plates *Thyone aurea.*

Ventral side of body modified to form a creeping sole; dorsal ambulacral appendages, large papillae . . . . *Pentacta doliolum.*

Tentacles more than 15.

Calcareous particles of skin, short thick rods with sharp spines at each end and around middle . . . *Phyllophorus frauenfeldi.*

Calcareous particles, large lenticular perforated plates *Pseudocucumis africana.*

Body wall wholly, or at least on dorsal side, covered with macroscopic calcareous plates, either overlapping or closely joined along margins.

Whole body encased equally . . . . *Echinocucumis typica.*

Only back, or back and ends with overlapping plates.

Body not very flat; ventral sole not sharply defined *Psolus imperfectus.*

Body very flat with sharp margins and ventral sole correspondingly well-defined . . . . . *Psolus squamatus.*

Cucumaria discolor.

Theél, 1886. Challenger Holoth., p. 64; pl. IV, fig. 8.

The type locality of this species is Simon's Bay, 10—20 fms. and although Theél had but one specimen his account is, as usual for him, accurate and satisfactory, while his figures are equally good. The specimens before me range from 24 to 55 mm. in length; all are more or less strongly contracted but are relatively slender, the diameter being about one-fifth of the length. The closed and contracted oral end is as markedly stellate as in Pentacta and the body in cross section is distinctly pentagonal rather than circular. The color is light brown or fawn-color. Theél says the anus is without teeth but so far as I can judge these specimens have very small anal teeth, which might however be easily overlooked, and perhaps are not present in all individuals.

P.F. 16336. False Bay, 14 fms. Brk. sh. 1 specimen; young.

P.F. 16365. False Bay, Fishhook Bay, 5 fms. Fne. s. 3 specimens; adult.

False Bay; 3 specimens; 2 young.

Locality? 1 specimen.

Cucumaria spyridophora* sp. nov.

Body somewhat pentagonal in cross section, about 45 mm. long by 12 mm. in diameter; in the present specimens, which are much contracted the body is noticeably thicker at the anterior than at the posterior end. Color light brown, more or less finely mottled with darker; on one specimen the dark color predominates. Pedicels rather large, not at all crowded, confined to the ambulacra; in the midventral and two dorsal ambulacra there are only two well separated series of pedicels, but in the latero-ventral, the pedicels are more numerous and there are more or less evident indications of a third series; the dorsal pedicels seem to be a little smaller than the ventral. Tentacles 10, the two midventral very much smaller than the other eight. Anal teeth well developed but in these contracted specimens, they are rather difficult to demonstrate. Calcareous ring moderately stout, with no posterior prolongations; the radial pieces are more deeply notched than the interradial and have slightly shorter but wider anterior projections; the interradial pieces are about 3 mm. high.

Calcareous particles of skin in two very distinct layers; the inner

* *σπυρίς* = a round, plaited basket + *φορέω* = to bear, in reference to the characteristic calcareous particles.

is a densely crowded layer of very numerous knobbed buttons while the outer is a single layer of rather crowded reticulate "baskets" or cups. The buttons are quite uniform in size and shape, ·07—·08 mm. long and about two-thirds as wide; each button is perforated by four holes and carries, on each surface, two central and ten marginal knobs; on some buttons there are a few more knobs, or the knobs may be swollen and more or less fused but there is no marked tendency to form larger knobbed plates or spheres. The "baskets" are very characteristic for while they show some diversity in size and considerable diversity of form, scarcely two being exactly alike, they are mostly about ·03 mm. long, not quite so wide and about one-half to two-thirds as deep; the rims are slender and with either no knobs or a few low, small ones, while the dichotomous rod forming the floor of the basket is somewhat flattened, perfectly smooth and rather stout. They are thus much like those of *Cucumaria punctata* (see Ludwig, 1875, Arb. Zool. Inst. Wurzburg, vol. 2, pl. VI, fig. 8) but the rims are much more slender and lack the prominent spinelets. Pedicels well supplied with broad curved supporting rods, having perforations at each end. Terminal plates seem to be wholly wanting.

Mossel Bay, Cape Colony. 3 specimens; adult. "Colour red".

Holotype, South African Museum No. A 6453.

This species belongs very evidently, to judge from its form and general appearance, in the same group with *C. discolor*, *insolens* and *capensis* but it is easily distinguished from any of these by the calcareous baskets of the outer layer of skin. Although in these baskets, there is some resemblance to *C. punctata*, in no other respect does *spyridophora* resemble that West Indian species.

Cucumaria insolens.

Théel, 1886. Challenger Holoth., p. 70; pl. IV, fig. 5.
Cucumaria leonina var. *africana* Britten, 1910. Schultze's Zool. Anthrop. Erg. Forsch. Südafrika, vol. 4, pt. 1, p. 240.

It is rather curious that Britten does not refer to *insolens* in his discussion of his supposed new *Cucumaria* from Angra Pequena Bay. However there are in the M. C. Z. collection several cotypes of his variety and they are unquestionably identical with the material before me from Cape Colony. The specimens at hand show much diversity in size, colour and form but agree well in the distribution of the pedicels and in the calcareous parts. Those from Saldanha Bay are 12—23 mm. long, very dark brown above, much lighter

below; these colours in the living animals, according to Mr. Barnard's notes, are dark maroon red above, bright scarlet below. Those from the unknown station are a trifle larger and are more or less uniformly light dirty gray-brown; they are in rather poor condition. Those from 1938 range up to 45 mm. in length and are dirty cream-colour; the body wall in these specimens is softer than, and the colouration utterly unlike, that of the Saldanha Bay specimens, but the calcareous particles seem to be identical. Comparing this material with Théel's description and figures has satisfied me that all must be called *insolens*. Evidently in shallow water, pigmentation occurs much more heavily than at greater depths, especially on the dorsal surface.

P.F. 1938. Cape St. Blaize N.W. $^1/_2$ N., 30 miles, 52 fms. R. 11 specimens; adult.

Saldanha Bay; low tide lying exposed in pools with sea-weed. 5, IX, 1912, K. H. Barnard. 20 specimens; young.

Saldanha Bay; low tide, under stones. 5, IX, 1912, K. H. Barnard. 7 specimens; young.

Locality unknown, but Pieter Faure collection and probably from off Cape Point. 23 specimens; young.

Cucumaria capensis.

Théel, 1886. Challenger Holoth., p. 62; pl. V, fig. 2.

In the form of the body, the distribution of the pedicels, and the firmness of the body-wall, this species approaches Ocnus and I was inclined to refer the specimens before me to that genus, but on comparing them with Théel's description and figures of *C. capensis*, I realized that they belong in that species. The Pieter Faure specimens are 16 and 38 mm. long, with a diameter about equal to one-fourth or one-fifth of their length. The smaller one is light gray but the larger one is nearly white.

P.F. 2836. Vasco de Gama Peak, N. 71° E., $18^1/_2$ miles, 230 fms. St. 1 specimen; young.

P.F. 14987. Lion's Head, S.E. $^1/_2$ E., 47 miles, 175 fms. Gr. s. 1 specimen; adult.

Cucumaria sykion.

Semperia sykion Lampert, 1885. Die Seewalzen, p. 250.
Cucumaria sykion Théel, 1886. Challenger Holoth., p. 266.

The type locality for this species is Algoa Bay, but it seems to be rather common along the eastern coast of Cape Colony and

southern Natal. The specimens at hand range from 22 to 57 mm. in length; the larger individuals are quite stout, the diameter equalling half the length or more; all are strongly contracted. While most of the specimens still retain more or less of the characteristic black colouration, some are not at all black; the lot from East London is a uniformly light brown. The absence of deposits in the outer layer of skin and the lack of terminal plates in the pedicels are noticeable features of this species.

P.F. 918. 1 mile east of Cove Rock, East London, low tide. 9 specimens; adult.

Natal: Port Shepstone and Scottsburgh. K. H. Barnard coll. 6 specimens; adult and young.

Natal: Umhlali. K. H. Barnard coll. 2 specimens; adult.

Cape Colony: Port Elizabeth. 2 specimens; adult.

Locality unknown. 10 specimens; adult and young.

* Cucumaria jägeri.

Lampert, 1885. Die Seewalzen, p. 249.

This species seems to me to be very near the preceding but as there are no specimens at hand which I can refer to it, it is best to let the species stand as Lampert left it. The differences between *jägeri* and *sykion* in their calcareous particles is hard to understand (and Lampert gives no figures) while the differences in the distribution of the pedicels are of doubtful importance.

Cucumaria frauenfeldi.

Ludwig, 1882. Notes from Leyden Mus., vol. IV, p. 130.

This species has hitherto been inadequately described or at least, the descriptions are quite unsatisfactory. Ludwig gives no description, simply referring to Semper's notes on, and figures of, an unnamed species. Lampert, three years later, ignorant apparently of Ludwig's work, gave the same species another name (*posthuma*) and added some useful notes on the morphology, but neither he nor Britten (1910, Schultze's Zool. Anthrop. Erg. Forsch Südafrika, vol. 4, pt. 1, p. 239) have given a clear statement as to the calcareous particles. I have had one of Britten's specimens for comparison with those in the collection of the South African Museum.

The calcareous particles in this species are remarkably characteristic. They consist altogether of rods but there are two very distinct sorts of these rods. In the outer layer of the skin the

rods are very slender, more or less curved, but often nearly straight, with the ends more or less forked or branched; sometimes these branches unite and thus give rise to apparent perforations in the ends of the plates. Lampert evidently thought these slender rods were the supporting rods of the pedicels. While it is true that they occur abundantly in the walls of the pedicels, they also form a close, but not dense, layer all over the body surface. Beneath them, in the deeper layers of the skin are the other sort of rods, the so-called "spectacles" or "eye-glasses." They are very much stouter rods which usually have a single large perforation at each end; the rod is often nearly straight but when short and sufficiently curved the rememblance to eye-glasses is obvious. Many of these rods however are simply notched more or less deeply at the end and not perforated; probably such rods are but growth stages of the "eye-glasses".

The specimens of *frauenfeldi* in the present collection are of moderate or small size, the largest about 65 mm. long. The largest specimens are uniformly black but some of the smaller ones are light brown or brown. The body wall is relatively thin, not nearly so thick and firm as in the specimen from Angra Pequena. It seems to me quite probable that the *Cucumaria* from Java, which is in the Vienna Museum and which must be considered the type of *frauenfeldi*, is not identical with the South African form but until a critical comparison can be made, the two must remain under the same name.

P.F. 918. 1 mile east of Cove Rock, East London. Low tide. 2 specimens; adult.

Cape Colony: False Bay. 5 specimens; adult.

Cape Colony: Knysna, low tide. 11, III, '97, R. M. Lightfoot. 1 specimen; young.

* Cucumaria improvisa.

Ludwig, 1875. Arb. Zool.-Zoot. Inst. Würzburg, vol. 2, p. 85; pl. VI, fig. 10.

The type locality for this species is Algoa Bay. So far, as I know it has not been met with since its description. Théel thinks it probable that it is identical with the European *C. elongata* but whether that is so or not, it is evidently quite distinct from any of the other South African *Cucumarias*.

*Thyone serrata.

Britten, 1910. Schultze's Zool. Anthrop. Erg. Forsch. Südafrika, vol. 4, pt. 1, p. 242.

This species is closely related to the European *T. fusus* but seems to be recognizably different. It is known only from Angra Pequena Bay where it seems to be fairly common.

Thyone sacellus.

Stolus sacellus Selenka, 1867. Zeit. f. wiss. Zool., vol. XVII, p. 355; pl. XX, figs. 115, 116.
Thyone sacella Théel, 1886. Challenger Holos., p. 138.

This species, well characterized by its calcareous ring and particles, has long been known from Zanzibar and Mozambique. The presence in the South African collection of specimens from Delagoa Bay, marks a note-worthy extension of the range southward. These specimens are 42—70 mm. long and are white or very pale reddish in color. They are accompanied by the following notes:

Delagoa Bay: Inyack Island. Oct. 1912. K. H. Barnard. Dull claret. In rock crevices. 1 specimen; adult.

Delagoa Bay: Inyack Island. Oct. 1912. K. H. Barnard. Claret colour. Beneath corals. 2 specimens; adult and young (half grown).

Thyone aurea.

Holothuria aurea Quoy and Gaimard, 1834. Astrolabe Zool., vol. IV, p. 120; pl. 7, figs. 15—17.
Thyone aurea Semper, 1868. Holothurien, II heft, p. 66.

The presence of some twenty *Thyones*, in more or less poor condition, from Table Bay, indicates that the species is common at the Cape. Most of the specimens were found washed up on the beach, some at least among the "holdfasts" of Laminaria. The colour of these specimens is said to have been "pink". While one cannot determine positively from Quoy and Gaimard's account, whether this *Thyone* is their *Holothuria aurea* or not, I feel so sure that it is, I am unwilling to give it a new name. The calcareous ring is like that of *T. sacellus* but the calcareous particles in the skin are entirely different and are very distinctive. They are small flat rods perforated at one or both ends, and irregular plates, of which these rods are the apparent starting point; thus there may be a hole on either or

on both sides of what was the primary rod; these holes differ greatly in size and shape and are not infrequently divided transversely in two; scarcely two of the plates are exactly alike. These deposits are unlike those of any species of *Thyone*, of which I know, and taken in connection with the wide calcareous ring, made up of many pieces and having long radial, posterior prolongations, and with the presence of well-marked anal teeth, they make the species easy to recognize. Since Quoy and Gaimard say their *Holothuria aurea* was found "parmi les racines de fucus de la rade du Cap de Bonne-Espérance", the habits and habitat of the *Thyone* at hand point strongly to *aurea*. The difference in colour, I think, may be due to the fact that all of the specimens at hand, of which the colour is given, were washed up on the beach and were very probably dead specimens from which most of the orange-red colour of the living animal had been washed out.

P.F. 15967. Zwartklip N.E. 1/4 N., 1 mile, 10 fms. Brk. sh. 17, XI, '02. 1 specimen; adult.

P.F. 16365. False Bay: Fish Hook Bay, 5 fms. Fne. s. 24, XII, '02. 5 specimens; adult and young.

Table Bay: Mouille Point, amongst roots of laminaria, washed up on beach. Colour pink. June, 1912. Dr. L. Péringuey. 2 specimens; adult.

Table Bay: Woodstock Beach. July, 1915. K. H. Barnard. Pale pink. 15 specimens; small adults and young in very poor condition.

* Pentacta doliolum.

Actinia doliolum Pallas, 1766. Misc. Zool., p. 152; pl. XI, figs. 10—12.
Pentacta doliolum Goldfuss, 1820. Handbuch der Zoologie, pt. 1, p. 177.
Colochirus doliolum von Marenzeller, 1874. Verh. zool.-bot. Gesell. Wien, vol. XXIV, p. 303.

It is a matter of great regret to me that the collection from the South African Museum contains no specimen which I can refer to this species, originally described from the Cape of Good Hope and in 1887 recorded by Ludwig from Angra Pequena Bay. It is a curious fact that the species was not taken by the Challenger at the Cape nor by Schultze at Angra Pequena, while species of *Cucumaria* taken by those parties at those places, and also represented in the present collection, have calcareous particles of the same general type as those which Ludwig describes for his specimens from Angra Pequena. The line of separation between *Cucumaria* and *Pentacta* needs further elucidation.

If Ludwig and von Marenzeller are correct in assigning Pallas' *Actinia doliolum* to the genus *Colochirus*, instituted by Troschel in 1846, there is no doubt that the genus must be called *Pentacta*, for Goldfuss established *Pentacta* for Pallas' species alone; at least it is the only species named. *Pentacta* has usually been considered a synonym of *Cucumaria*, but there seems to be no good reason for such an opinion unless *doliolum* is a *Cucumaria*. And, as already stated, von Marenzeller long since (1874) showed it was a *Colochirus* and this view has been strongly confirmed by Ludwig (1887). *Pentacta* therefore simply replaces *Colochirus*.

Phyllophorus frauenfeldi.

Ludwig, 1874. Arb. Zool.-Zoot. Inst. Würzburg, vol. II, p. 95; pl. VI, fig. 22.

Among the specimens before me which suffered much from dessication is what must have been a very fine example of this Red Sea species. The tentacles are well expanded and show distinctly the following asymmetrical arrangement: 3 large, 1 small, 4 large, 1 small, 3 large, 1 small, 2 large, 1 small, 3 large, 1 small. It has long been known that individuals of this genus show so much diversity in the relative size and arrangement of the tentacles that neither generic nor specific distinctions can be based thereon. The calcareous rods of this species are very distinctive, except that they are so suspiciously like those of *Urodemas ehrenbergii* Selenka, which is also a Red Sea species, that the identity of the two forms seems highly probable. But Selenka speaks of a peculiar arrangement of the rods in trios, which is not evident in the specimen at hand. This specimen has the label: Natal Coast. Dr. J. D. F. Gilchrist.

Pseudocucumis africana.

Cucumaria africana Semper, 1868. Holothurien, II heft, p. 53, pl. XV, fig. 16.

Pseudocucumis africana Ludwig, 1888. Zool. Jahrb. Abt. Syst., vol. III, p. 815.

There are two specimens in the present collection of this wide spread Indo-Pacific species. They are in a bottle with labels indicating both Natal and Mozambique (coll. K. H. Barnard) as the locality. Probably the latter is the correct one.

ECHINOCUCUMIS TYPICA.

M. Sars, 1859. Forh. Vid. Selsk. Christiana f. 1858, p. 174.

There are two small dried specimens of an *Echinocucumis* in the collection which are not unnaturally listed as *typica*, although the form of the body is somewhat different from that of any examples of *typica* in the M. C. Z. collection. The most noticeable difference is the very short "neck" and caudal regious, but this apparent elimination of the terminal prolongatious may be due to the drying. At any rate, I find no satisfactory characters by which these specimens may be separated from the northern species. The specimens are about 8—9 mm. long by 5—6 mm. thick.

P.F. 17350. Cape Point N. 86° E., 43 miles, 900—1000 fms. Grey mud. 2 specimens; young.

PSOLUS IMPERFECTUS * sp. nov.

Body nearly cylindrical and truncate at each end in these much contracted specimens, of which the larger is about 9·5 mm. long by 5 mm. in diameter, while the smaller is about 8 mm. long by 3·5 mm. in diameter. Color light yellow-brown. The middle of the ventral surface is slightly flattened to form a very imperfect sole, to which the pedicels are completely confined. On each lateral margin of the sole, which is rounded and not at all sharply defined there is a single series of pedicels, 8 in the smaller and 10 in the larger specimen; the median part of the sole is occupied by a few pedicels, anteriorly and posteriorly but is quite bare centrally; in the larger specimen, there are about 6 pedicels at the anterior end and 4 behind but in the smaller specimen the numbers are only 4 and 2. The skin of the sole is moderately thick and contains calcareous plates which are rather thick, with rounded margins, and perforated by 20—24 holes. The remainder of the body is covered by large overlapping plates, about half a millimeter across; these plates are covered by a thin epidermis but it is evident that if the animal was dried the plate margins would be conspicuous. The mouth is not dorsal but distinctly anterior and not protected by any special valves; the tentacles are completely retracted in the larger specimen and very much so in the smaller. The anus is distinctly dorsal and around it the plates are smaller than elsewhere.

* *Imperfectus* = incomplete, in reference to its incomplete approach to the typical *Psolus* form.

P.F. 18929. Southeast from Cape Agulhas, 36° 40′ S. × 21° 26′ E., 200 fms. Gn. s. 2 specimens; young?

Holotype, South African Museum, No. A 6454.

These little holothurians are quite unlike any I have ever seen but they approach several of the previously known species of *Psolus*. They are perhaps nearest to the Antarctic *P. charcoti* Koehler and Vaney, but the sole is more distinct and the calcareous plates it contains are perfectly distinctive. In life this species must look very much like the figure of *P. boholensis* given by Semper (1868, Holothurien, Heft II, pl. XII, fig. 3), although the sole is not quite so distinct and the color is brighter. Why Semper should say (p. 6) that *boholensis* is "von ausgesprochensten ascidienartigen Habitus" is impossible to see from his figure, which is not in the slightest degree ascidian-like!

Psolus squamatus.

Holothuria squamata O. F. Müller, 1776. Prod. Zool. Dan., p. 232.
Psolus squamatus M'Andrew and Barrett, 1857. Ann. Mag. Nat. Hist. (2) vol. 20, p. 45.

There are five small specimens of a *Psolus* at hand which I am unable to distinguish from *squamatus* and I therefore refer them to that northern species. But the specimens are too young for satisfactory determination. It is important however to emphasize what has been well said by both Ludwig and Théel that the proper descrimination between the northern and southern species of *Psolus* must await the accumulation of far more abundant material from a considerable number of localities. Owing to a suggestion of Lütken's that O. F. Müller's *Holothuria squamata* is the young of *Psolus phantapus*, the specific name of this holothurian is usually dated from Düben and Koren. Those authors however refer to Müller's name and I do not see how any one could question that the Danish author's name refers to either the present species or the form subsequently separated from it as *P. fabricii*. It seems highly improbable to me that Müller's figures represent the young of *P. phantapus*.

P.F. 14310. Cape Seal, N. by E. 3/4 E., 37 miles, 80 fms. (Agulhas Bank). S., sh., r. 20/2/02. 4 specimens; young.

P.F. 18929. Southeast of Cape Agulhas, 36° 40′ S. × 21° 26′ E., 200 fms. Gn. s. 1 specimen; young; dry.

ELPIDIIDAE.

The right of this family to a place in this report is based on the extraordinary Planktothuria, whose position in the family is dubious, and on a single specimen in the Pieter Faure collection, which seems to be referable to the following nearly cosmopolitan species.

Benthodytes sanguinolenta.

Théel, 1881. Challenger Holoth., pt. 1, p. 104; pl. XXIII.

The single specimen referred to this species is in two unusually solid fragments 50–60 mm. long and 25–30 mm. in diameter. Owing to their condition my identification is based on the colour and general body-form.

P.F. 16822. Cape Point, N.E. by E. $^1/_4$ E., $38^1/_2$ miles, 750 fms. 8/VII/03. Green mud. 1 specimen; adult.

Planktothuria diaphana.

Gilchrist, 1920. Quar. Jour. Mic. Sci., vol. 64, p. 373.

Although a careful and complete description is given of this remarkable pelagic holothurian, the locality and depth are recorded only as "deep water off the Cape of Good Hope".

HOLOTHURIIDAE.

This large tropicopolitan family is not well represented in South Africa proper, for of the following 14 species, only two occur south of Natal and only half a dozen are from south of Mozambique. All are littoral species, none being reported from a depth of more than 20 fms. Only three of the species are endemic and of these one is new to science. It will be noticed that within the genus *Holothuria*, the calcareous particles of the skin furnish almost the only reliable guide to the species. The various forms of these particles (tables, plates, buttons, rosettes, rods, etc.) are fully illustrated in Théel's invaluable Challenger Report.

Key to the South African Species of Holothuriidae.

Anus not protected by conspicuous calcareous teeth.
No large, pointed tubercles on back and sides.
Tables, more or less well formed, present in the outer layer of skin.
Rosettes or perforated plates present with the tables, but no rods or buttons.
Rosettes and small, irregular perforated plates present, but no large circular plates.

Color more or less uniformly black . *Holothuria atra.*
Color dark brown or blackish above, rose-color (in life) or gray (in alcohol) beneath . . *Holothuria edulis.*
No rosettes but rather large circular perforated plates present *Holothuria africana.*
No rosettes or plates present.
Curved, roughish rods present but no buttons *Holothuria cinerascens.*
No rods but buttons present.
Buttons smooth, without knobs.
Pedicels on ventral surface; pedicels or small papillae on back.
Buttons symmetrical usually with 3 pairs of holes.
Tops of table-spires squarish with 20 or more teeth . . . *Holothuria difficilis.*
Tops of table-spires circular with about 8 teeth *Holothuria leucospilota.*
Buttons more or less asymmetrical, usually with fewer than 6 holes, collected in heaps or circles *Holothuria pardalis.*
Large papillae all over the body *Holothuria impatiens.*
Buttons knobbed . . . *Holothuria scabra.*
No tables present.
Spinous, thick rods in skin . . . *Holothuria parva.*
Small irregular smooth rods and very diversified, asymmetrical plates in skin . . . . . *Holothuria grammata.*
Large pointed tubercles on back and along sides of quadrangular body; color deep green in life (dull yellow-brown in alcohol, usually) *Stichopus chloronotus.*
Anus guarded by 5 large, calcareous teeth.
Tentacles 25 or more . . . . *Actinopyga mauritiana.*
Tentacles about 20 (18—23) . . . . *Actinopyga miliaris.*

Holothuria atra.

Jaeger, 1833. De Holot., p. 22. See also Edwards, 1908, Biometrika, vol. VI, pp. 236—301, pls. I—V.

This common Indo-Pacific species has long been known from Mozambique and Zanzibar. A specimen in the present collection is labelled: Conducia Bay, Mozambique. Rock pools. Nov. 1912. K. H. Barnard.

* Holothuria edulis.

Lesson, 1830. Cent. Zool., p. 125; pl. 46, fig. 2.

This species has been recorded from Mozambique by Semper but it is not represented in the present collection. Although the cal-

careous particles are similar to those of *atra* the general appearance of the two species, especially in life, is quite unlike. The bright rose-red ventral surface of *edulis* makes it much the handsomer of the two, but unfortunately the colour is soon lost in alcohol.

* Holothuria africana.

Théel, 1886. Challenger Holoth., p. 174; pl. VIII, fig. 7.

Although the type locality for this species is Simon's Bay, 10—20 fms., it is not in the present collection and I therefore can add nothing to Théel's satisfactory description and figures.

Holothuria cinerascens.

Stichopus (*Gymnochirota*) *cinerascens* Brandt, 1835. Prod. Descr. Anim., p. 251.
Holothuria cinerascens Lampert, 1885. Die Seewalzen, p. 82.
Holothuria pulchella Selenka, 1867. Zeits. f. W. Zool., vol. XVII, p. 329; pl. XVIII, figs. 61, 62.

It is a pity to have to abandon Selenka's familiar name for the older and less euphonious one of Brandt but Ludwig's demonstration of the identity to the two leaves us no choice. Ludwig's Revision of Brand's holothurian names (1881, Zeits. f. w. Zool., vol. XXXV, p. 575) was one of the most valuable contributions to the study of holothurian taxonomy ever made, and it is unfortunate that neither he nor Théel adopted the resulting changes in nomenclature.

This species, previously known from Mozambique and widely distributed in the Indo-Pacific region, is represented in the present collection by two specimens. The larger is either from Mozambique or Natal, while the smaller, which is in poor condition, is said to be from Durban, Natal. The species therefore evidently ranges as far south as Durban, but is apparently not common as Mr. Barnard did not meet with it at the intermediate locality of Delagoa Bay.

Holothuria difficilis.

Semper, 1868. Holothurien, Heft III, p. 92; pl. XXX, fig. 21.

A single specimen of this Indo-Pacific species is in the collection of the South African Museum. It bears the label: Mozambique. In rock pools, freely exposed. Light brown. Nov. 1912. K. H. Barnard. Although known from Mauritius, this species was not

recorded hitherto from the African coast. The calcareous tables form a very uniform layer, making the surface of the body slightly rough to the touch and the epidermis quite brittle.

Holothuria leucospilota.

Stichopus (*Gymnochirota*) *leucospilota* Brandt, 1835. Prod. Descr. Anim,, p. 251.

Holothuria leucospilota Lampert, 1885. Die Seewalzen, p. 71.

Holothuria vagabunda Selenka, 1867. Zeits. f. w. Zool., vol. XVII, p. 334; pl. XIX, figs. 75, 76.

Although Lampert cannot bring himself to abandon the universally used name, given by Selenka, for the earlier and often inappropriate name of Brandt, nevertheless he publishes the combination *Holothuria leucospilota* and seems to have been the first writer to do so. It is of course regrettable to have to abandon the name *vagabunda* but after all, very few zoologists indeed are acquainted with the specific names of holothurians and the abandonment of one in favour of another causes exceedingly little inconvenience. There is no valid reason therefore for not using the correct name.

Of this well-known and wide-spread Indo-Pacific species, long known from Mozambique, there are five specimens in the present collection, one of which is from either Mozambique or Natal (coll. K. H. Barnard), while the other four are said to be from Durban. They are very greatly contracted and in poor condition but there is little reason to doubt their identily. The range of the species is thus extended far to the southward along the coast. But Mr. Barnard did not find the species at Delagoa Bay.

Holothuria pardalis.

Selenka, 1867. Zeits. f. w. Zool., vol, XVII, p. 336; pl. XIX, fig. 85.

There is a single specimen of this common Indo-Pacific species in the present collection. There is no means of determining whether it is from Mozambique, as seems probable, or from Natal. (Coll. K. H. Barnard).

Holothuria impatiens.

Fistularia impatiens Forskål, 1775. Desc. Anim., p. 121; pl. 39. 1776, Icon. Rev. Nat., pl. XXXIX, fig. B.

Holothuria impatiens Gmelin, 1790. Syst. Nat. Linn. ed. XIII, p. 3142.

This very common tropicopolitan species has long been known from Mozambique. The single poor specimen in the present collection

is probably from Mozambique but may be from Natal. (Coll. K. H. Barnard).

HOLOTHURIA SCABRA.

Jaeger, 1833. De Holothuriis, p. 23.

This large Indo-Pacific species was not hitherto recorded from south of Querimba but in the present collection are five very badly contracted specimens, which are apparently from Delagoa Bay. They are recognizable by the large size, gray and white coloration and the characteristic calcareous particles. There are two labels with these specimens; one reads: "Inyack Island, Delagoa Bay, on sandy shore, light gray with black speckles. Oct. 1912 K. H. Barnard. 2 large specimens". I think there can be no doubt that this label belongs with the two largest and best preserved of the quintet. The other label reads: "Ilha da Inhaca, Delagoa Bay, low tide, burrowing in the sand. Oct. 1912. K. H. Barnard. 3 specimens. Ref. no. 305." I doubt if this label belongs with the remaining trio of *scabra* as I can hardly think this big species lives "burrowing in the sand".*

*HOLOTHURIA PARVA.

Lampert, 1885. Die Seewalzen, p. 246; fig. 38.

Although Lampert's description and figures show quite clearly that this is a valid species, collected by Krauss on the coast of Natal, Ludwig always considered it identical with *lubrica* Selenka and hence has listed the latter species from Natal. Lampert's species is not in the collection of the South African Museum nor have I ever seen a specimen, but I believe he is right in insisting on its distinctness from *lubrica*.

HOLOTHURIA GRAMMATA** sp. nov.

Body very much contracted and distorted, about 50 mm. long by 20 mm. thick in the largest specimen. It is impossible to determine the number, arrangement or nature of the ambulacral appendages, but they seem to be few, scattered and like large pedicels arising from distinct papillae. Body wall thick and soft. Number of tentacles cannot be determined. Calcareous ring low, the anterior prolongations small and the posterior margin of each piece with a wide

* This statement as to the habitat is quite true. [Ed.].

** γράμματα = the alphabet, in reference to the diversity of form of the calcareous particles, many of which are fanciful representations of letters.

deep concavity. Polian vessels 1 or 2. Stone canal small, lying in the dorsal mesentery. Color, in life, red; in alcohol the specimens are cream-color or very light brown.

Calcareous particles very numerous but all of one kind, though no two are exactly alike. The fundament is a slender rod of variable length, which is forked at one end, and usually at both ends. All the extraordinary diversities shown by the particles result from the more or less extensive development of the forks and the curve that they take in growing; often the forks at each end of the rod curve inward, fusing when they meet, thus forming a straight rod, flattened and perforated at each end; a totally different result comes from the forks curving rapidly outwards until the original rod is met in the midline or forks from opposite ends of the rods meet; a curious triperforate plate arises when only one end of the rod has a fork and these forks are as large as the main rod; each of the three then forks and curves sharply outwards until adjoining forks meet and thus a very symmetrical ring with three radial bars is formed. By unequal growth of the forks, most asymmetrical and even bizarre figures arise and by the use of the imagination many, if not all, of the letters of the alphabet, either in script or print form, can be made out.

P.F. 918. One mile east of Cove Rock, East London. Low tide. 1 specimen; adult.

P.F. 10008. Sebastian Bluff. Low tide. Colour red. 1 specimen; adult; eviscerated.

P.F. coll. Sebastian Bay. 15, VII, '00. Low tide. Colour red. 3 specimens; young.

Holotype, South African Museum No. A 6455. P.F. 918.

I have been unable to satisfy myself whether this interesting and well marked species is a *Stichopus* or a *Holothuria*. There seem to be, in one specimen at least, two genital bundles and the ambulacral appendages are also *Stichopus*-like dorsally. On the other hand the small size, red color, slender calcareous ring and absence of numerous pedicels ventrally, all are features more like *Holothuria*. The calcareous particles are rather more like some species of *Holothuria* than they are like those of any known *Stichopus*. For the present, therefore the species may be placed in *Holothuria* with the understanding that more and better material may put it distinctly in *Stichopus*.

Stichopus chloronotus.

Brandt, 1835. Prod. Descr. Anim., p. 250.

This widespread Indo-Pacific species is easily recognized in life

by the characteristic form and colour, in which there is little diversity. It has long been known from Mozambique and there are two small specimens in the present collection collected at that place in Nov. 1912 by Mr. K. H. Barnard. It is a pity the colour quite disappears in alcohol.

* Actinopyga mauritiana.

Holothuria mauritiana Quoy and Gaimard, 1833. Astrolabe Zool., vol. IV, p. 138.

Actinopyga mauritiana W. K. Fisher, 1907. Holot. Hawaiian Is., p. 648; pl. LXVII, figs. 1—1*d*.

This species is recorded from Mozambique by Bell but it is not represented in the present collection.

Actinopyga miliaris.

Holothuria miliaris Quoy and Gaimard, 1833. Astrolabe Zool., vol. IV, p. 138.

Actinopyga miliaris Bell, 1887. Sci. Trans. Roy. Dublin Soc. (2), vol. 3, p, 653.

Although Bell pointed out many years ago (1887, Ann. Mag. Nat. Hist. (5), vol. 19, p. 392 and vol. 20, p. 148) that the genus Mülleria as used for holothurians was preoccupied, few zoologists have troubled to correct the error. Fisher has done so however and used *Actinopyga*, as noted under the preceding species. It is by no means clear to me that *mauritiana* and *miliaris* are really different species. The former is supposed to have 25 tentacles or more but Fisher says his Hawaiian specimens had 22—26. On the other hand, *miliaris* is supposed to have only 20 tentacles but of the two adults in the present collection, one has 22 and one has 23. The difference in tentacle-number therefore is of doubtful value. Whether the calcareous particles show reliable differences, and whether there are any constant differences in color, habits or habitat, still remain to be demonstrated.

Mozambique (Island). Lying free in rock-pools. Skin usually with adherent sand-grains. Nov. 1912. K. H. Barnard.

Locality unknown. 1 specimen; very young.

INDEX.

Specific names are listed in this index only in connection with the accepted genus. Synonyms are in italics. Page references of first importance are in black-face type.

EXPLANATION OF PLATES.

All figures are natural size except where otherwise stated:

Plate VIII.

Fig. 1.	*Monachocrinus coelus* n. sp.	Holotype enlarged 8 times, the distal parts of the arms not shown.
Fig. 2.	*Liparometra multicirra* n. sp.	Holotype.
Fig. 3.	*Comanthus wahlbergii* (J. Müll).	
Fig. 4.	*Chondraster elattosis* n. sp.	Upper surface of holotype a little more than one half nat. size.

Plate IX.

Figs. 1, 2.	*Tosia tuberculata* (Gray).	Upper and lower surfaces.
Figs. 3, 4.	*Pteraster capensis* Gray.	Upper and lower surfaces.

Plate X.

Figs. 1, 2.	*Hymenaster gennaeus* n. sp.	Upper and lower surfaces of holotype.

Plate XI.

Figs. 1, 2.	*Cryaster brachyactis* n. sp.	Upper surface and a side view of holotype.
Figs. 3, 4.	*Hymenaster lamprus* n. sp.	Upper and lower surfaces of holotype.

Plate XII.

Figs. 1, 2.	*Pseudarchaster brachyactis* n. sp.	Upper and lower surfaces of holotype.
Figs. 3, 4.	*Calliaster acanthodes* n. sp.	Upper and lower surfaces of holotype.

Plate XIII.

Figs. 1, 2.	*Cladaster macrobrachius* n. sp.	Upper and lower surfaces of holotype.
Figs. 3, 4.	*Plutonaster proteus* n. sp.	Upper and lower surfaces of holotype.
Figs. 5, 6, 7.	*Plutonaster proteus* n. sp.	Juveniles to show growth changes.

Plate XIV.

Figs. 1, 2.	*Ceramaster patagonicus* var. *euryplax* n.	Upper and lower surfaces of holotype.
Figs. 3, 4.	*Ceramaster trispinosus* n. sp.	Upper and lower surfaces of holotype.
Figs. 5, 6.	*Ceramaster chondriscus* n. sp.	Upper and lower surfaces of holotype.

Plate XV.

Figs. 1, 2.	*Echinaster reticulatus* n. sp.	Upper and lower surfaces of holotype.
Figs. 3, 4.	*Poraniopsis capensis* n. sp.	Upper and lower surfaces of holotype.

Plate XVI.

Figs. 1, 2.	*Mediaster capensis* n. sp.	Upper and lower surfaces of holotype.
Figs. 3, 4.	*Asterina gracilispina* n. sp.	Upper and lower surfaces of holotype, enlarged 3 times.
Figs. 5, 6.	*Asterina dyscrita* n. sp.	Upper and lower surfaces of holotype, enlarged 3 times.

Plate XVII.

Figs. 1, 2.	*Asterina granifera* (Gray).	Upper and lower surfaces.
Fig. 3.	*Asterina granifera* var. *sporacantha* n.	Upper surface of paratype.
Figs. 4, 5.	*Anseropoda habracantha* n. sp.	Upper and lower surfaces of holotype, enlarged 3 times.

Plate XVIII.

Figs. 1, 2.	*Lophaster quadrispinus* n. sp.	Upper and lower surfaces of holotype.
Fig. 3.	*Perissasterias polyacantha* n.g. and sp.	Holotype, a little more than one half nat. size.

Plate XIX.

Figs. 1, 2.	*Dictenophiura anoidea* n. g. and sp.	Upper and lower surfaces of holotype, enlarged 4 and 3 times respectively.
Figs. 3, 4.	*Ophiacantha nerthepsila* n. sp.	Upper and lower surfaces of holotype, enlarged 3 times.
Figs. 5, 6.	*Ophiomitrella corynephora* n. sp.	Upper and lower surfaces of paratype, enlarged 3 times.

Plate XX.

Figs. 1, 2.	*Ophiochiton australis* n. sp.	Upper and lower surfaces of holotype, enlarged 4 and 3 times respectively.
Figs. 3, 4.	*Ophiactis carnea* Ljung.	Upper and lower surfaces, enlarged 3 times.

Figs. 5, 6. *Astrothamnus papillatus* n. sp. Upper and lower surfaces of holotype, the latter enlarged 3 times.

Plate XXI.

Figs. 1, 2. *Coenopedina capensis* n. sp. Upper and lower surfaces of holotype, enlarged 3 times.

Fig. 3. *Coelopleurus interruptus* Döderl. Upper surface.

Plate XXII.

Figs. 1, 2, 3. *Paracentrotus grandis* n. sp. Upper, lower and lateral surfaces of holotype.

Plate XXIII.

Figs. 1, 2, 3. *Spatagobrissus mirabilis* n.g. and sp. Upper and lower surfaces of holotype. $\frac{7}{8}$ natural size.

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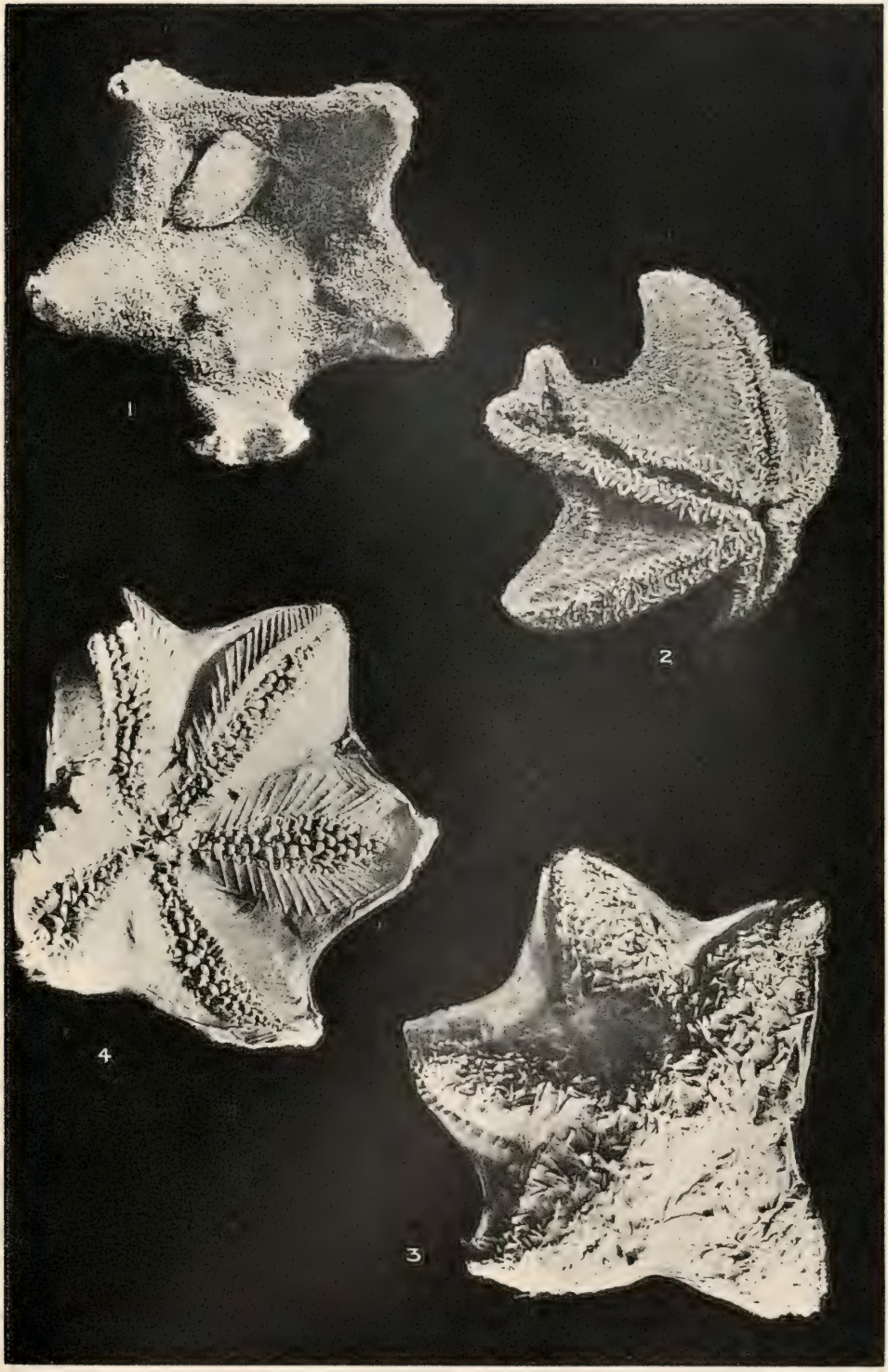

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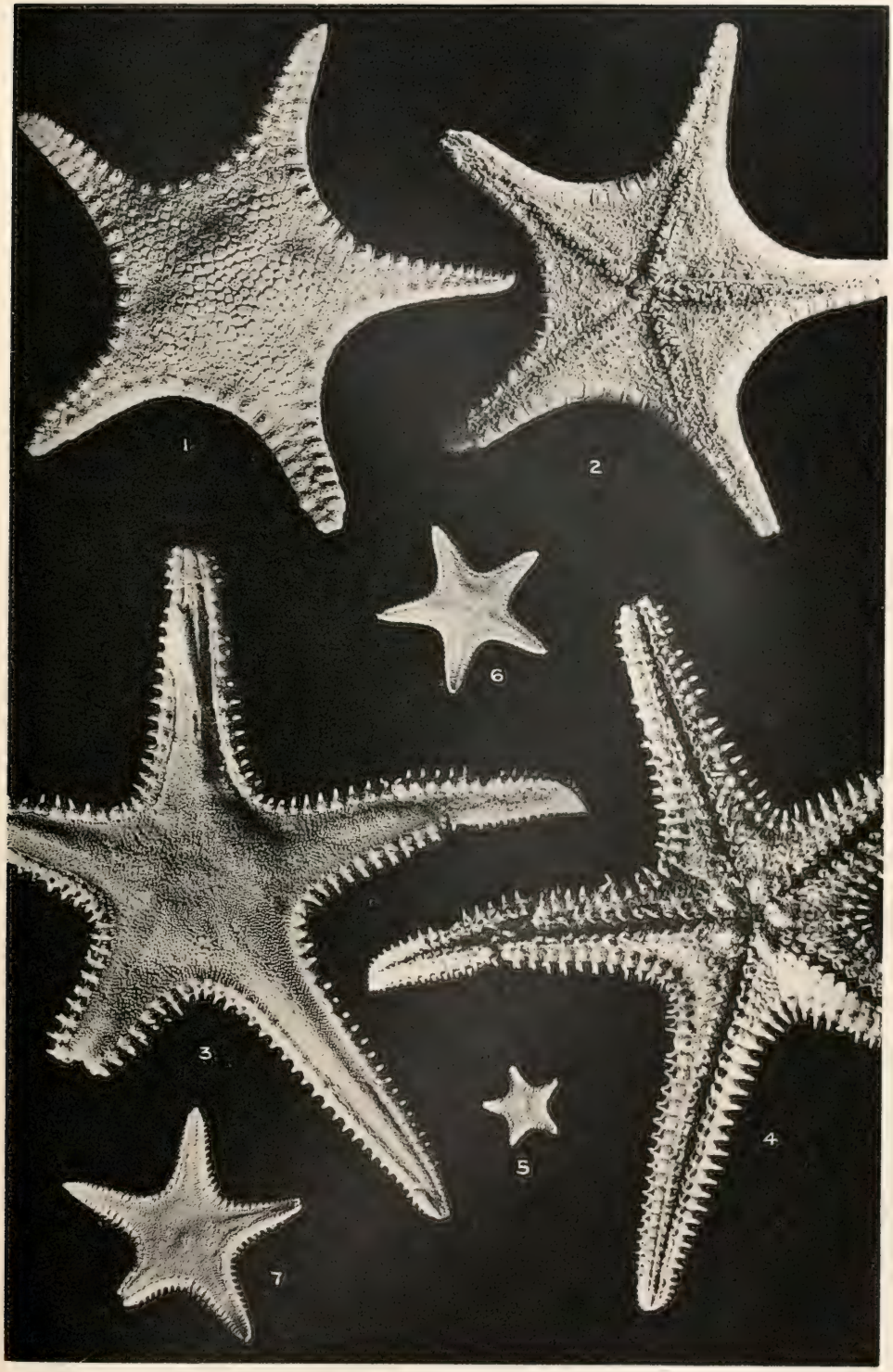

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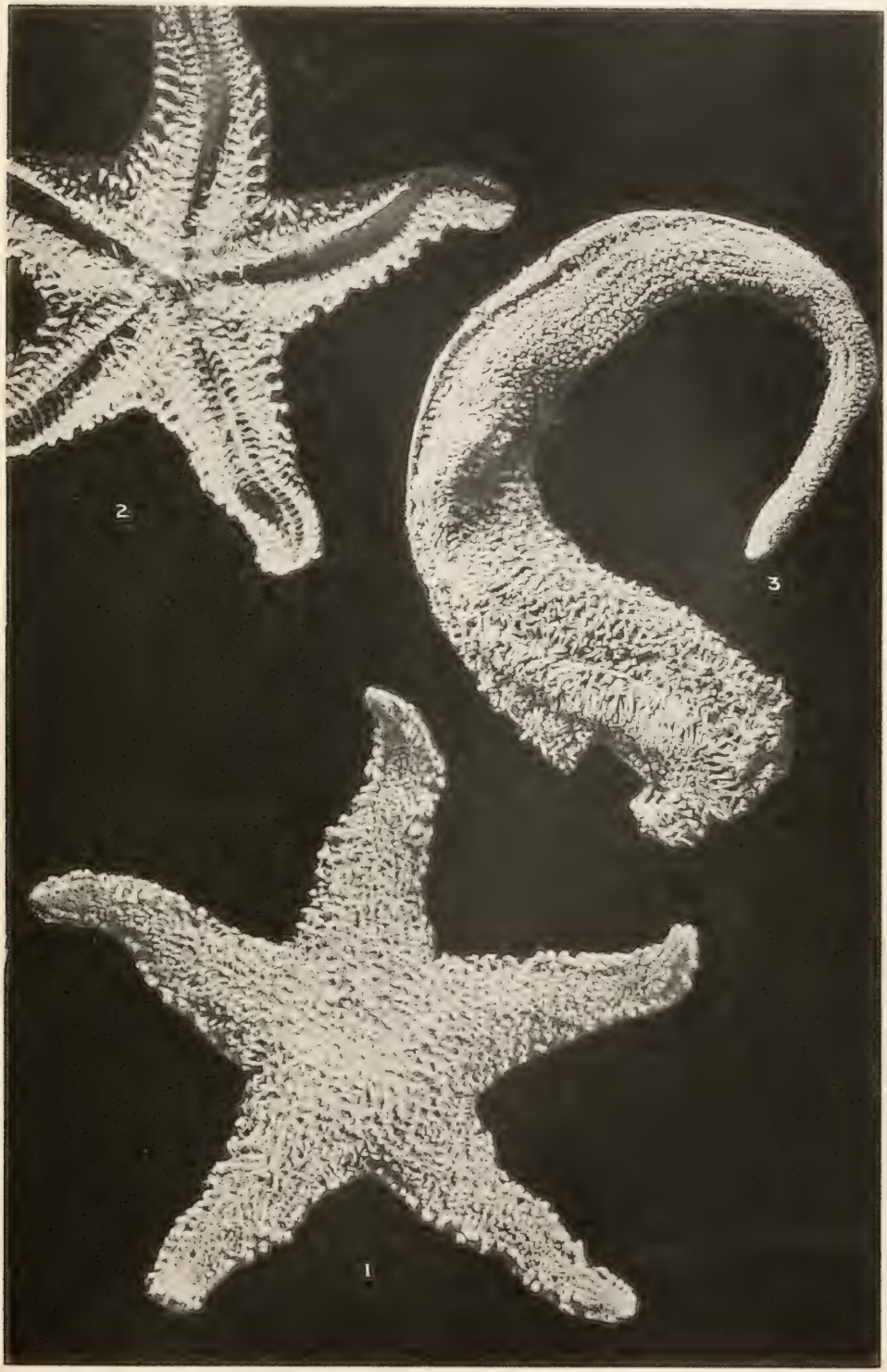

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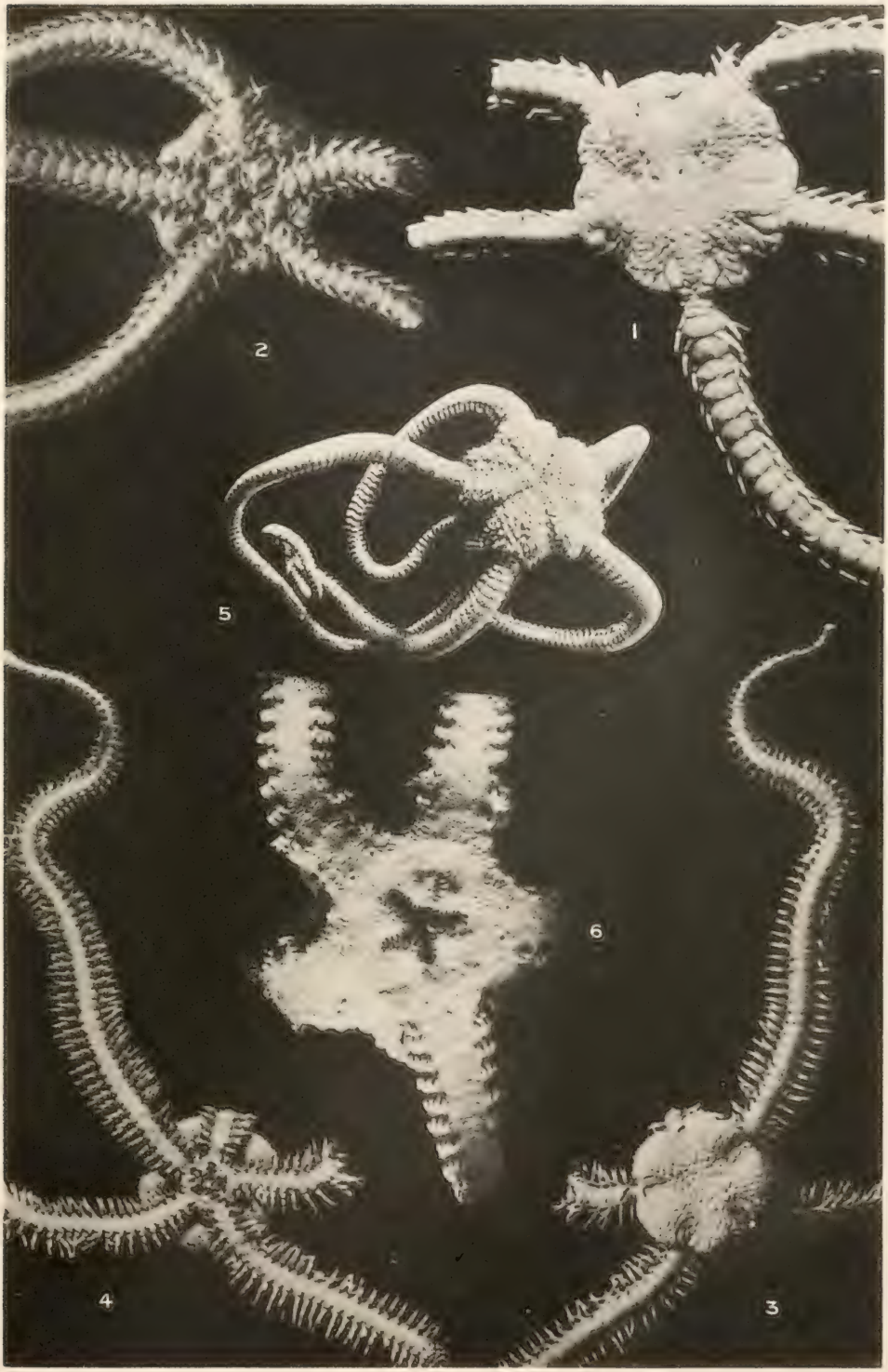

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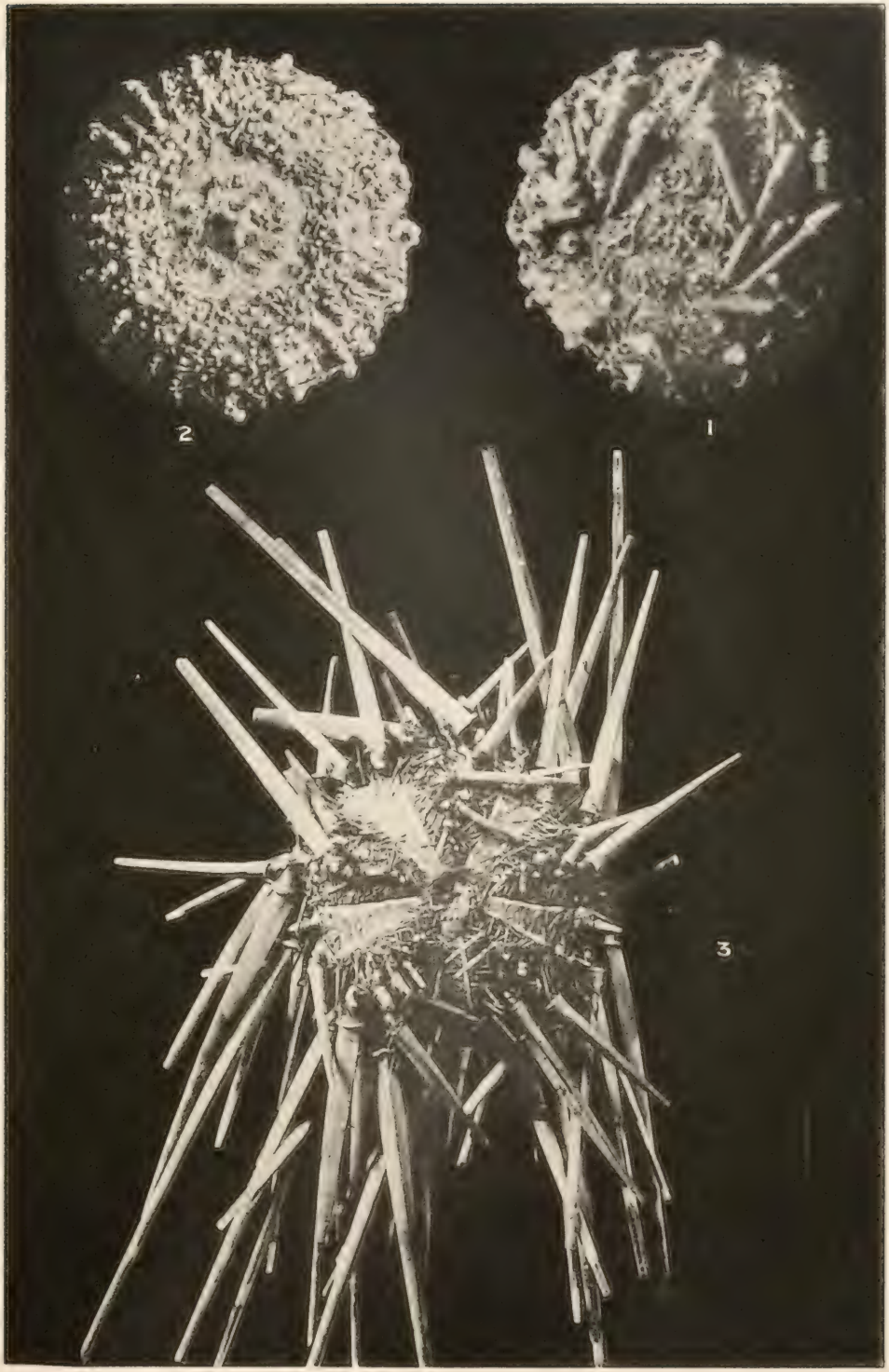

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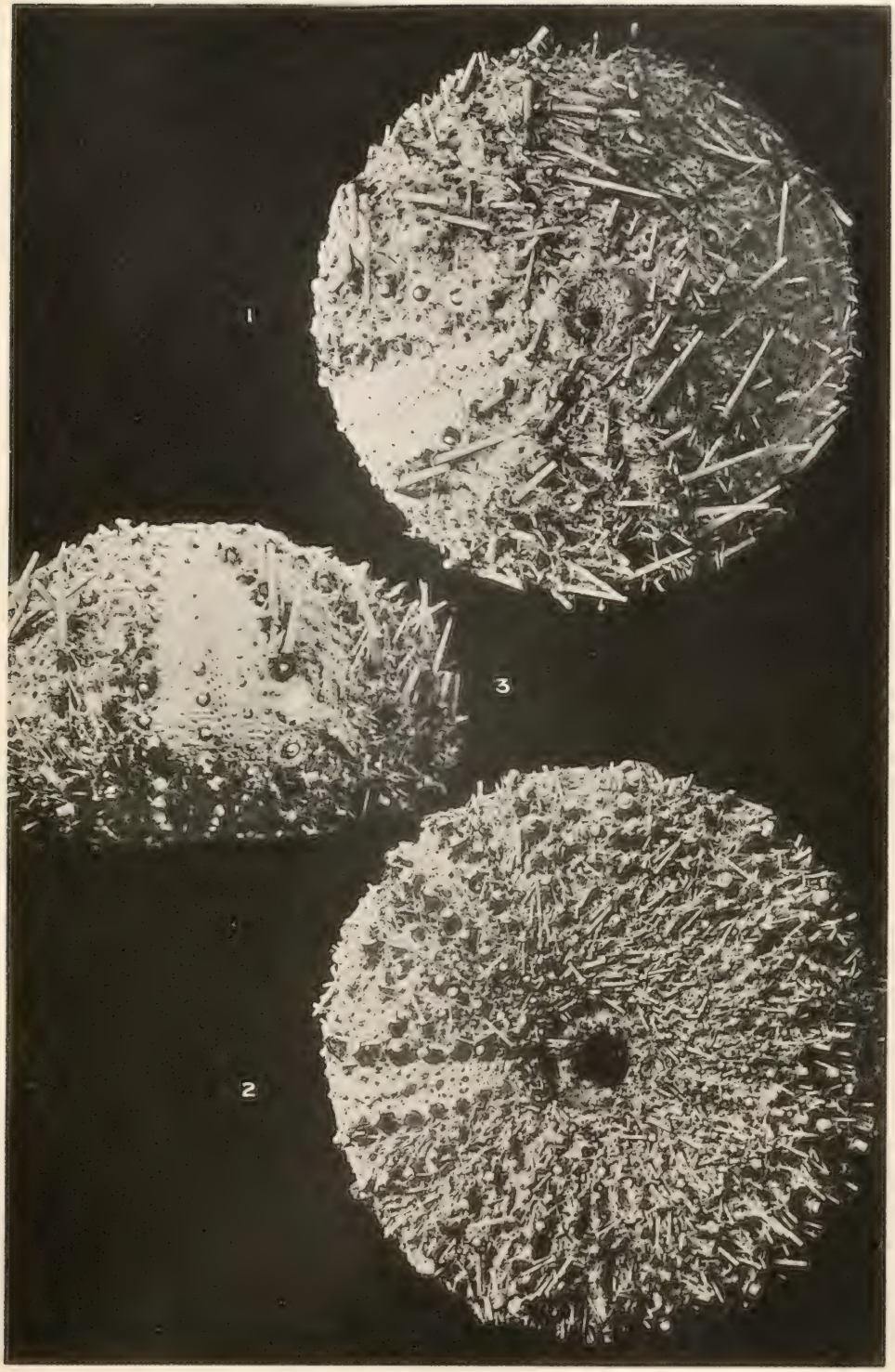

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13. — *Descriptions of three new Fresh-water fishes from Northern Rhodesia.* — By G. A. Boulenger, F.R.S. etc.

Family CHARACINIDAE.

Alestes péringueyi, n. sp.

Depth of body $3\frac{1}{2}$ times in total length, length of head 4 times. Head twice as long as broad, $1\frac{1}{4}$ times as long as deep; snout a little longer than eye, which is lateral and 4 times in length of head; adipose eyelid fully developed; maxillary not extending to below anterior border of eye; 16 teeth ($\frac{3}{7}$) in upper jaw, 10 ($\frac{3}{2}$) in lower; lower border of second suborbital longer than eye. Gill-rakers long and slender, 22 on lower part of anterior arch. Dorsal II 8, originating above last ray of ventral, at equal distance from end of snout and from caudal, longest ray $\frac{3}{4}$ length of head. Anal III 13. Pectoral $\frac{3}{4}$ length of head, not reaching ventral. Caudal forked. Caudal peduncle $1\frac{1}{2}$ times as long as deep. Scales with radiating and anastomosing canals, $29\frac{4\frac{1}{2}}{3\frac{1}{2}}$, 2 between lateral line and root of ventral. Silvery, speckled with black above the lateral line; a whitish streak from the upper border of the gill-cover to the caudal, a black band, widest in front, extending on the middle rays of the caudal. Total length 133 mm.

A single specimen from Mansa River, N. Rhodesia; collected by Dr. Colyer.

Type in the South African Museum, No. 14530.

This species comes very near the West African *A. kingsleyae* Gnthr.

Nannocharax multifasciatus, n. sp.

Depth of body $5\frac{1}{2}$ times in total length, lenght of head $4\frac{1}{3}$ times. Head $2\frac{1}{2}$ times as long as broad, deeper than broad; snout rounded, feebly projecting, as long as eye, which is $3\frac{1}{3}$ times in length of head and equals inter-orbital width. Dorsal III 10, originating a little in advance of vertical of root of ventrals, equally distant from eye and from caudal; longest ray $\frac{2}{3}$ length of head. Anal III 6.

Pectoral about $\frac{2}{3}$ length of head, not reaching root of ventral. Lobes of caudal obtusely pointed. Caudal peduncle nearly twice as long as deep. Scales $41\frac{5\frac{1}{2}}{6\frac{1}{2}}$, 5 between lateral line and root of ventral; lateral line complete. Yellowish, with 15 brown vertical bars; a large black, light-edged ocellus at the root of the caudal fin, as in *N. ocellicauda* Blgr. Total length 48 mm.

A single specimen from Sesheke, R. Zambezi; presented by the Rev. L. Jalla.

Type in the South African Museum, No. 14844.

Closely allied to *N. luapulae* Blgr. (Rev. Zool. Afr. IV, p. 164, 1915) from the Luapula River, Katanga (Congo System).

Family SILURIDAE.

Synodontis colyeri, n. sp.

Depth of body equal to length of head, 4 times in total length. Head $1\frac{1}{6}$ times as long as broad, feebly rugose above behind snout, which is rounded and slightly longer than postocular part of head; eye supero-lateral, 6 times in length of head, twice in interorbital width; lips moderately developed; premaxillary teeth forming a short and broad band; movable mandibular teeth $\frac{1}{3}$ diameter of eye, 22 in number. Maxillary barbel with a narrow marginal membrane at the base, as long as head, reaching anterior fourth of pectoral spine; outer mandibular barbel not quite twice as long as inner, the former with long slender branches, the latter with tubercular branches. Gill-opening not extending downwards beyond root of pectoral spine. Occipito-nuchal shield $1\frac{1}{2}$ times as long as broad, with pointed posterior processes. Humeral process much longer than broad, not keeled, sharply pointed. Dorsal I 7; spine $\frac{4}{5}$ length of head, feebly curved, smooth in front, rather strongly serrated behind. Adipose dorsal 4 times as long as deep, 3 times as long as its distance from rayed dorsal. Anal III 7, rounded. Pectoral spine a little shorter than head, strongly serrated on both sides. Ventral not reaching anal. Caudal strongly forked, upper lobe the longer. Caudal peduncle as long as deep. Olive-brown above, whitish beneath, with numerous black spots. Total length 142 mm.

A single specimen from Mansa River, N. Rhodesia; collected by Dr. Colyer.

Type in the South African Museum, No. 14529.

Allied to *S. zambesensis* Peters.

14.—*Diagnoses of New Species of Marine Fishes from South African Waters.*—By K. H. Barnard, M.A., F.L.S., Assistant Director.

The following diagnoses of new species of Fishes are the result of an examination of the Collection of Fishes in the South African Museum. When the whole collection has been thoroughly examined there will probably be some more species to be described, but it is thought that these should be published as soon as possible with a view to aiding the work being done on the Fishes of this region by other workers.

CYCLOSTOMATA.

Family MYXINIDAE.

Heptatretus profundus, n. sp.

Five gill-openings. Teeth, 11 in outer, 10 in inner row, the anterior 3 in the outer, the anterior 2 in the inner, row, basally fused. Head (*i.e.* from nostril to first gill-opening) $4\frac{3}{4}$ times, depth of body (at level of gill-openings) 12 times in total length. Ventral fin ending at a great distance (100 mm.) behind last gill-opening. 620 mm. Dark brown.

Off Cape Point, 400 fathoms. s.s. *Pieter Faure.*

The forward position of the gills at once removes any doubt as to this specimen being merely a five-gilled aberration of the Common South African Hag (*H. hexatrema*). The second gill-pouch on the left side is degenerate, being only about a quarter of the size of the others. This is the first record of a five-gilled *Heptatretus* and the deep-water habitat is exceptional for a member of this genus.

Heptatretus octatrema, n. sp.

Eight gill-openings. Teeth 10 in both rows; the anterior 3 in the outer, the anterior 2 in the inner, row, basally fused. Head 4 times, depth of body 25 times in total length. Ventral fin ending only a short distance (8–10 mm.) behind last gill-opening. 300 mm. Brownish.

Agulhas Bank, 25–40 fathoms. s.s. *Pieter Faure.*

Easily distinguished by its greater slenderness from the Japanese *okinoseanus*, Dean, 1904, the only other known species with eight gill-openings.

ELASMOBRANCHII.

Family RAIIDAE.

Raia spinacidermis, n. sp.

♀, shape of *microps* (Günther, Challeng. Rep. I, Plate IV), but a little broader in proportion to length, and snout sharper. Width equal to distance from snout to middle of tail. Snout pointed but not produced, about 90°, anterior margin almost straight, outer pectoral angle broadly rounded, hind margin convex. Eye a little less than interorbital width, which is $3\frac{3}{4}$ in preocular length of snout. Internasal width less than distance of nostril from tip of snout. Rostral cartilages narrow and slender, united for a little more than half their length. Anterior rays of pectoral reaching to 25 mm. from tip of snout. Tail a little shorter than length of body; the lateral cutaneous fold confined to the posterior third. Teeth 60, the median ones slightly pointed. Whole upper surface of disc and upper and lateral surfaces of tail covered with closely-set fine setiform spinules (resembling the skin of *Spinax*, whence the name), larger and closer on the tail than elsewhere; large spines entirely absent; lower surface of tip of snout with a few spinelets, lower surface of tail, except the median line of the basal two-thirds, with setiform spinules similar to those on upper surface. 600 mm. Pale slaty-grey, becoming slightly darker towards hinder margins of pectorals and distinctly darker on pelvics. Lower surface similar to upper.

Exact locality unknown. s.s. *Pieter Faure.*

This hitherto undescribed species is represented by a ♀ only, and is noteworthy for the entire absence of enlarged spines.

ISOSPONDYLI.

Family ALEPOCEPHALIDAE.

Alepocephalus australis, n. sp.

Depth of body $5\frac{3}{4}$–6, length of head 3 in length of body. Greatest depth at level of pectoral. Eye equal to snout, not quite twice

interorbital width, $3\frac{3}{4}$ in length of head, $10\frac{1}{2}$–11 in length of body. Eye touching dorsal profile, interorbital space flat or slightly concave. Maxilla posteriorly enlarged, extending to vertical from centre of eye. Opercular flaps voluminous, overlapping. D 16–17, A 16–17. Dorsal commencing opposite vent, slightly in advance of anal, which commences behind middle of body. P 10. Caudal peduncle $2\frac{3}{4}$ times its greatest depth. Scales: l. l. 53–55; l. tr. 13–14. Gill-rakers 14 on lower part of anterior arch. Pyloric caeca (14–) 15. Up to 325 mm. Deep violet black on head, lighter on body.

Off Cape Point, 630 fathoms. s.s. *Pieter Faure.*

This species is closely allied to *blandfordi* Alck. (1892) from the Arabian Sea, but differs in the slightly larger eye, the maxilla extending farther back, the fewer scales, and the more slender caudal peduncle. Described from two specimens, 325 and 280 mm. long, and from three somewhat mutilated young specimens.

APODES.

Family SYNAPHOBRANCHIDAE.

Diastobranchus, n. g.

Dorsal commencing behind vent, which is less than a head's length distant from gill-slits. Pectoral considerably longer than snout. Gill-slits ventro-lateral, oblique, separated. Tail more than 3 times length of body to vent. Scales extending over head and cheeks. The patch of teeth on front of vomer distinctly separated by a gap from the single series on the hinder part, the first two teeth of which are conical and larger than any of the other teeth in the mouth.

Except for the separate gill-slits, the species for which this new genus is proposed, might well go into *Synaphobranchus*, as the forward position of the vent is not by itself of sufficient importance to be considered a generic character. In the short extension of the cleft of the mouth behind the eye it resembles *Ilyophis*.

Diastobranchus capensis, n. sp.

Depth of body 3 (adult)–4 (juv.), length of head (to pectoral) $1\frac{2}{3}$–$1\frac{3}{4}$ in length of body (to vent). Length of body $4\frac{3}{4}$–5 in total length. Eye 2–$2\frac{1}{4}$ in snout, 1–$1\frac{1}{4}$ in interorbital width, 6–7 in length of head. Mouth not more than twice length of snout, extending not more than an eye's length behind posterior margin of eye, $1\frac{2}{3}$ in length of head.

Dorsal commencing about $\frac{2}{3}$ of a head's length behind vent. Pectoral inserted considerably nearer vent than tip of snout, $\frac{1}{2}$–$\frac{2}{3}$ as long as head, extending to or almost to vent, pointed. Gill-slits separated at their anterior ends by a space equal to the length of one gill-slit. Teeth in jaws as in *Synaphobranchus pinnatus*; teeth on front part of vomer enlarged, conical, in an oval patch, separated by a space from the single series on the hind part of the vomer, the first two teeth of which are also conical and larger than any of the others. Up to 790 mm. Blackish-brown, the branchial region with a violet tinge, mouth blue-black.

Off Cape Point, 470 fathoms. s.s. *Pieter Faure.*

Described from several specimens from 240 mm. upwards, in excellent condition. The food consists of various Crustacea.

Family CONGRIDAE.

Congermuraena albescens, n. sp.

Depth of body about 5, length of head nearly 3 in length of body to vent. Length of body to vent about $1\frac{1}{4}$ in distance from vent to tip of tail. Eye $1\frac{1}{2}$ in snout and in interorbital width, $5\frac{1}{2}$ in length of head. Dorsal commencing above middle of pectoral, which is $3\frac{3}{4}$ in length of head. Lips rather thick and fleshy, upper jaw slightly longer than lower, but snout not projecting, cleft of mouth extending to below centre of eye. Teeth in about 4 series on jaws and vomer; maxillary and mandibulary bands 4 mm. wide (wider in front), vomerine band elongate ovate, 6 mm. wide, extending back beyond tip of tongue and almost to level of front margin of eye; the teeth mostly conical, but the inner ones more or less tubercular with rounded tops, the vomerine teeth especially so. Length of gill-slit $2\frac{1}{2}$ in interspace. 700 mm. Yellowish-white, vertical fins without any traces of dark edging.

Off Cape Point, 250 fathoms. s.s. *Pieter Faure.*

Congermuraena australis, n. sp.

Depth of body about 7, length of head $2\frac{1}{2}$ in length of body to vent. Length of body about $1\frac{1}{2}$ in length of tail. Eye nearly equal to snout, twice interorbital width, $4\frac{1}{2}$–5 in length of head. Dorsal commencing immediately behind origin of pectoral, which is 3 in length of head. Lips thick and fleshy, snout overlapping lower jaw by at least half the

diameter of eye, cleft of mouth extending to below anterior third of eye. Vomerine teeth extending back to tip of tongue, *i.e.* not as far as front margin of eye; about 3 series in each band, more numerous in front, some of the vomerine teeth subtubercular. Length of gill-slit half the interspace. Vertebrae about 136. Up to 375 mm. Brownish, the vertical fins with dark edging.

Coast of S.W. Africa, off Cape Peninsula, False Bay, Tristan d'Acunha, 2–60 fathoms.

This species resembles *mystax* in the longer tail proportionately to the head and trunk, and in the projecting snout and thick lips; but it has the vertical fins with black edging as in *balearica*, and is intermediate between the two northern species in the number of vertebrae.

As is evident from a series of Leptocephali in the South African Museum, this is the adult of the form described by Kaup as *Leptocephalus capensis*.

Family DYSOMMIDAE.

Dysomma anguillaris, n. sp.

Length of body to vent 5 times in length of tail. Length of head (to gill-slit) 7 in total length. Head flat above. Eye 4 in snout, $3\frac{1}{2}$ in interorbital space. Snout overlapping lower jaw, $4\frac{1}{2}$ in length of head. Lips thick and fleshy. Cleft of mouth extending 2 eye diameters behind eye. Posterior nostril almost as large as eye. Pectoral about $4\frac{1}{2}$ in length of head. Dorsal commencing above or slightly in advance of gill-slits, which are subequal to the interspace between them. Distance of vent from posterior end of gill-slit equal to length of one gill-slit. A narrow band of villiform teeth on posterior $\frac{2}{3}$ of maxilla; 2 conical teeth, set transversely in front of upper jaw, followed by 4 canine teeth on vomer, the third being the largest; 7–8 canine teeth on each mandible, set well apart, but not so large as those on vomer; each of the canine teeth is set in an oval, conical, fleshy papilla with only its point projecting. Snout and lower jaw thickly covered with minute villiform papillae. 360 mm. Silvery-white, base of vertical fins posteriorly dark, but the edges white.

Off Tugela River mouth, Natal, 63 fathoms. s.s. *Pieter Faure*.

The elongate form at once distinguishes this species from the only other known species of the genus: *bucephalus*, Alck. 1889. The body cavity extends to within 70 mm. of the end of the tail, but the intestinal loop only extends to about the middle of the total length of the body. The stomach contained portions of Crabs,

Family OPHICHTHYIDAE.

Ophichthys triserialis, n. sp.

Length of head $2\frac{1}{2}$ in distance from gill-slits to vent. Tail three-quarters as long again as body. Snout conical, somewhat depressed. Cleft of mouth moderate, not extending beyond hind margin of eye. Lips not fringed. Eye 2 in snout, subequal to interorbital width. Teeth pointed, subequal, but largest in front of upper jaw, triserial in both jaws and on vomer. Dorsal commencing just behind end of pectoral, which is 4 in length of head. 300 mm. Uniform brownish, vertical fins with dark margins posteriorly.

Algoa Bay, 55 fathoms. s.s. *Pieter Faure.*

This specimen bears a very close resemblance to *unicolor* which was also described from Algoa Bay. The difference in the teeth is indeed the only important distinguishing character, but in this respect the specimen is clearly distinct from the type of *unicolor* which I have examined in the British Museum.

Sphagebranchus acuticeps, n. sp.

Body cylindrical. Depth of body $4\frac{1}{2}$ in length of head. Length of head a little over 3 in distance from gill-slits to vent. Tail only a very little longer than rest of body. Cleft of mouth 3 in length of head. Snout pointed, projecting, $4\frac{1}{2}$–5 in head. Eye about in middle of cleft of mouth, well developed but small, about 4 in snout, subequal in length to interorbital width. Gill-slits longitudinal, parallel, subequal in length to snout. Branchiostegal membranes rather swollen. Teeth rather large, pointed, lancet-shaped, recurved, uniserial, 15 in upper jaw, 12 on vomer and in lower jaw, 3 in a triangle in front of upper jaw, the vomerine series extending back beyond tip of tongue, which is free. 188 mm. Brown, eyes black.

Off Tugela River mouth, Natal, 37 fathoms. s.s. *Pieter Faure.*

Very like *vulturis*, Weber & Beauf, 1916, but differing in the proportions.

INDEX.

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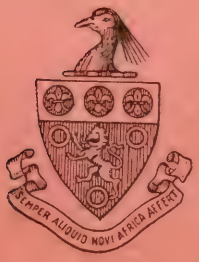

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