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ON SOME NUDIBRANCHS FROM EAST AFRICA
AND ZANZIBAR. Part IV. BY SIR C. ELIOT,
K.C.M.G., late H.M. Commissioner for the East African
Protectorate, F.Z.S.—Dorididæ Cryptobranchiatæ, II.

[From the PROCEEDINGS OF THE ZOOLOGICAL SOCIETY OF LONDON,
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On some Nudibranchs from East Africa and Zanzibar.
Part IV.* By Sir C. ELIOT, K.C.M.G., late H.M. Com-
missioner for the East African Protectorate, F.Z.S.—
Dorididæ Cryptobranchiatæ, II.

(Plates XXIII. & XXIV.†)

[The complete account of the new species described in this communication appears here; but as the names and preliminary diagnoses were published in the 'Abstract,' such species are distinguished here by being underlined.—EDITOR.]

In my last paper ‡ I discussed the Cryptobranchiate Dorids represented by such genera as *Archidoris*, *Discodoris*, *Platydoris*, &c. These are oval flattish forms, mostly of sombre coloration, with a dorsal surface rarely smooth but generally granulated, or bearing papillæ, warts, or tubercles. The branchiæ are usually tripinnate. A labial armature is more often absent than present, there is no central tooth, and the radula consists of uniform, simply hamate teeth, rarely differentiated or denticulate. In the present paper I propose to consider some forms belonging to another group typified by *Chromodoris* and its allies. These Dorids are often (but not always) elongated and limaciform in shape, brightly coloured, and smooth. The branchiæ are usually simply pinnate. A labial armature is nearly always present (absent only in *Thorunna* and *Aphelodoris*). In the radula a central tooth is rare, but sometimes occurs (in *Cadlina*, *Tyrinna*, and *Chr. scabriuscula*), and rhachidian thickenings are frequent. The teeth are generally denticulate, and the tooth next to the rhachis is nearly always different in shape from the others. The stomach is usually enclosed in the liver, and there is rarely any armature in the reproductive organs. All these characters are well seen in *Chromodoris*; and I am inclined to think that the following genera are more or less closely allied to it:—*Casella*, *Ceratosoma*, *Thorunna*, *Aphelodoris*, *Orodoris*, *Sphærodoris*, *Cadlina*, *Tyrinna*, *Halla* §, *Rostanga*, and *Audura*. The common character possessed by all these forms is in the mouth-parts:

* For Part III. see P. Z. S. 1903, vol. ii. p. 354.

† For explanation of the Plates see p. 406.

‡ Since writing the third part of this paper (cf. P. Z. S. 1903, vol. ii. p. 354) I have read the last fasciculus by Prof. Bergh which has appeared in Semper's 'Reisen' (Bd. ix. Th. vi. Lief. i. Nudibranchiata, January 1904), and it appears to me that the genus *Peronodoris* is practically equivalent to that which I proposed to call *Sclerodoris*, and as it has priority should take the place of the latter name. The only difference in the generic characters is that for *Peronodoris* is given "penis stylo armatus." I did not see this style in any of the forms which I have described, but even if it is present in some species and absent in others, this variation would not in my opinion necessitate the creation of separate genera.

Archidoris violacea Bergh seems nearly allied to my *A. africana*, and *A. nanula* Bergh to my *A. minor*; but the identity of the forms, though not impossible, cannot be demonstrated from the descriptions.

§ [This name is preoccupied by a Polychæte worm, *Halla parthenopeia* A. Costa, Ann. Accad. d. Aspiranti Naturalisti Napoli, ii. p. 63 (1844).—C. CROSSLAND.]

nearly all have a labial armature, and all* have teeth more or less differentiated. I confess that I am afraid of attaching too much importance to the radula: a case like *Aldisa*, where a Dorid with otherwise ordinary characters has a unique dentition, certainly shows that the teeth may vary without any corresponding change in other characters; but in the genera here grouped together it will be found that the buccal characters are usually accompanied by some other feature which allies them to *Chromodoris*, such as simply pinnate branchiæ or a long narrow shape. It may be said that the teeth of Dorids are never really uniform, and in the genera described in my previous paper are often denticulate at the outer end of the row. This is true, but the outermost teeth are less well developed and more exposed than the others. They therefore have a natural tendency for purely mechanical reasons to become smaller and more irregular, and a particular form of this irregularity, due perhaps to some peculiarity of texture, is seen when they split up and become jagged or denticulate. But no such mechanical explanation will account for the innermost teeth being larger and more elaborately formed than the rest. Also this peculiarity is confined to certain genera, whereas the irregularity of the outermost teeth is general among the Cryptobranchiates and as noticeable in *Chromodoris* as elsewhere.

Casella and *Ceratosoma* are clearly closely allied to *Chromodoris*, the former being perhaps not really a separate genus. *Thorunna* is practically *Chromodoris* without a labial armature. *Aphelodoris* has an elongate shape and narrow mantle-edge, but tripiinnate branchiæ and no labial armature. It seems, however, to be allied to *Chromodoris* by the presence of an accessory denticle on the innermost teeth. The remaining genera are of more or less oval shape, with a fairly wide mantle-margin, and papillæ or tubercles on the back, peculiarities which are found in some species of *Chromodoris*. *Sphaerodoris* has simply pinnate branchiæ and a radula which, though peculiar, is essentially of the *Chromodoris*-type. *Orodoris*, which Bergh associates with *Sphaerodoris* and *Miamira*, has the median part of the radula much as in *Chromodoris*. *Halla*† and *Rostanga* are allied to *Chromodoris* by their simply-pinnate branchiæ as well as by their buccal parts: indeed, the former appears to me almost an aberrant *Chromodorid* akin to such forms as *Chr. sykesi* described below. In *Rostanga* the Mediterranean species *perspicillata* has denticulate inner teeth: in *coccinea* they are merely bifid. The buccal parts of *Tyrinna* and *Cadlina* strongly resemble those of *Chr. scabriuscula*, which has also a somewhat oval form and tuberculate back. I somewhat doubtfully refer *Audura* to the same group, in virtue of its radula. This position is somewhat supported by its smooth skin and scanty bipinnate branchiæ, but the structure of the foot suggests other affinities.

* Except the very anomalous *Miamira*, which Bergh regards as allied to *Sphaerodoris* and *Orodoris*.

† See note § on p. 380.

The following is a list of the forms noticed below :—

Chromodoris A. & H.

1. *Chr. reticulata* Pse.
2. *Chr. sykesi*.
3. *Chr. cavee*.
4. *Chr. annulata*.
5. *Chr. splendens*.
6. *Chr. tryoni* (Gar.).
7. *Chr. vicina*.
8. *Chr. elizabethina* B., var. *africana*.
9. *Chr. runcinata* B.
10. *Chr. nigrostriata*.
11. *Chr. scurra* B.
12. *Chr. hilaris* B.
13. *Chr. lineata* Souleyet.
14. „ „ var. *nigrolineata*.
15. *Chr. ? magnifica* Q. & G.
16. *Chr. inconspicua*.
17. *Chr. flava*.

Casella H. & A. Adams.

18. *Cas. atromarginata* (Cuv.).

Ceratosoma Adams & Reeve.

19. *Cer. cornigerum* (Ad.).

Sphaerodoris B.

20. *Sph. laevis* B.

Orodoris B.

21. *O. miamirana* B. } (From Willey's New Britain
Collection.)
22. *Mia. nobilis* B. }

Genus CHROMODORIS.

More than 100 forms are referred to this large genus, but are by no means all equally certain. About 40 have been described by Prof. Bergh, and may be regarded as well established. Most of the remainder are known only from the external characteristics often very superficially described, and many of the so-called species are probably merely varieties.

The animals are as a rule soft, smooth, and brightly coloured. The branchiæ are simply pinnate, the tentacles small and capable of retraction. There is a strong labial armature and a characteristic radula. The rhachis often bears thickenings: the first tooth on each side of it is denticulate on both the inner and outer sides, and thereby differs from the rest, which are denticulate on the outer side only. The outermost are irregular and denticulate on the apex only. There is no stomach outside the liver.

Within the limits of these characters there is such great variety that it may be doubted if the genus should not be split up.

The following notes on the principal divergencies presented have no pretension to be exhaustive, but may perhaps prove useful.

1. As a rule the shape is somewhat high, elongated, and limaci-form, with a narrow mantle-edge, but some species are low and distinctly oval, with the mantle-edge very wide and ample. Such are *Chr. reticulata*, *sykesi*, *cavae*, and *annulata* here described; and it would appear from the published plates and descriptions that *Chr. albescens*, *iheringi*, *punctilucens*, *histrion*, *propinquata*, *splendens*, *albo-pustulosa* have a similar shape. Some species (e. g. *Chr. vicina*) are capable of assuming two forms—one high and narrow, the other flat and oval; so the distinction in shape may perhaps not be absolute*.

2. The skin is usually soft and smooth, but the dorsal surface bears tubercles in *Chr. orsinii*, *sannio*, *pustulans*, *verrucosa*, *lapinigenis*, and the somewhat doubtful *roseopicta* of Verrill. The very abnormal *Chr. scabriuscula* is spiculate with hard lumps.

3. *Chr. runcinata*, *pantharella*, *sannio*, *picturata*, *camoena*, *elegans*, *glauca*, *californensis*, *gonatophora*, *sycilla*, have small knobs, apparently of a glandular character, on the underside of the mantle-margin.

4. The colour is hardly ever uniform. There is usually a coloured border (sometimes double) round the mantle-edge, and generally a pattern on the back formed of stripes or spots. Although this pattern may vary considerably within the species, the spotted and striped forms appear to be distinct. Sometimes, however (e. g. in *Chr. runcinata*), spots arranged in a line unite to form a stripe, and *Chr. semperi* and *nigrostriata* appear to be the same, except that the first is spotted and the second striped. It would be rash in the present state of our knowledge to make any general statement as to the correspondence between these two types of pattern and other characters, but in a considerable number of species stripes are combined with an elongate form and bifid teeth, with or without accessory denticles under the bifurcation (e. g., *Chr. caerulea*, *gracilis*, *messinensis*, *sycilla*, *carnea*, *hilaris*, *lineata*, *marenzelleri*, *thalassopora*, *lapinigenis*); while another combination, of an oval form, spotted pattern, and teeth bearing many denticles but not bifid, is presented by *Chr. reticulata*, *sykesi*, *cavae*, *annulata*, *punctilucens*, *splendens*, and *histrion*. Elongated spotted forms are not uncommon, but none of the oval forms with ample mantles as yet recorded are striped.

5. The branchiæ range from 5 to nearly 30 in number, and are variously arranged in a complete circle, or a circle more or less open behind or a double spiral (see Plates XXIII. figs. 2 & 8; XXIV. fig. 2). Sometimes the plumes are uniform in size; sometimes those in front (more rarely those behind) are larger. Typically they are quite simple, but frequently some are bifid and sometimes several branches are developed (e. g. *Chr. tryoni* and *striatella*). But when this occurs the ramifications are thin and irregular, and

* [I observed this change of shape in some of the species here dealt with during life.—C. C.]

the plumes do not resemble the ample and elaborate rosettes of *Archidoris*, *Platydoris*, &c. The arrangement and the approximate (but not the exact) number of branchiæ will probably be found good specific characters in cases where a sufficient number of individuals has been examined; but I think that the number of plumes increases with age, at any rate in some species, and that hence the data furnished by a single specimen may be misleading. This is the case particularly in forms with a spiral arrangement, where it seems likely that the small plumes in the spire are developed later than the others. Thus in *Chr. sykesi* the number varies from 12 to 18 and in *Chr. annulata* from 9 to 16. In the latter species a spire is present in some cases and absent in others. The commonest number of branchiæ seems to be about 10 (varying from 8 to 12 in individuals). A distinctly smaller number (3 to 7) is found in *Chr. cardinalis*, *juvenca*, *elegantula*, *iheringi*, *krohnii*, *virginea*, *gloriosa*, *scurra*, *luxuriosa*, *albonotata*, *inconspicua*, *elegans*, *camana*, *rudolphi*, *pantharella*, and is indicated in the drawings of many other species. In *Chr. punctilucens*, *lineolata*, *paupera*, *tryoni*, *bennetti*, *splendens*, *crossei*, *dalli*, *reticulata*, *godeffroyana*, *mollita*, *vicina*, *sykesi*, and *annulata* the number of plumes is more than 12 and often exceeds 20.

I have observed that in making a superficial examination of the living animal one is very apt to under-estimate the number of branchiæ, inasmuch as the longer ones may project and the shorter ones be hidden. Hence the plates and descriptions of older authors cannot be considered as decisive on this point.

6. The labial armature consists sometimes of two plates and sometimes of a continuous ring. The elements are hardly ever straight, but are more or less bent or hooked. They are of very varying shape and thickness, and sometimes swollen just below the tip or terminal hook, so that they assume a mace-like appearance. The shape usually affords a good specific character, but in some species the elements are bifid in one part of the armature and entire in another.

7. The radula offers many differences. *Chr. scabriuscula* has a central tooth and *Chr. juvenca* a central plate which is called "false" by Bergh, though it seems well developed. Rhachidian thickenings, more or less distinct, are found in *Chr. cærulea*, *iheringi*, *mörchii*, *gonatophora*, *porcata*, *carnea*, *mariana*, *hilaris*, *sannio*, *lineolata*, *marenzelleri*, *cardinalis*, *reticulata*, *dalli*, *cava*, *annulata*, *splendens*. The radula is as a rule of moderate size, but is very narrow in *Chr. elegantula*, *krohnii*, *gloriosa*, and rather narrow in *pustulans* ($75 \times 28.0.28$) and some other forms. In *scabriuscula* it is $108 \times 30.1.30$. It is unusually broad in *thalassopora* ($71 \times 162.0.162$), and above all in *sycilla* ($81 \times 290.0.290$).

The formulæ for the radula given in my descriptions are merely the shortest way of describing the teeth of a given specimen, and must not be understood as necessarily characteristic of the species. The proportion between length and breadth is generally roughly the same in different individuals, but the number of rows and of

teeth in them varies greatly and apparently increases with the size (that is probably the age) of the animals.

As regards shape, the teeth present several types :—

(1) They are simply bifid in *cærulea*, *semperi*, *nigrostriata*, *marenzelleri*, *crossei*, *thalassopora*, *camæna*, *lapinigenis*. In these species the innermost tooth bears a single accessory denticle on the inner side and hence appears trifid.

(2) They are bifid with accessory denticles below the bifurcation in *gracilis*, *messinensis*, *syccilla*, *hilaris*, *bennetti*, *californensis*, and *agassizi*. In *runcinata* the accessory denticles are very small and inconspicuous.

(3) In *scurra* the apex of the tooth is three or five times cleft, and a somewhat similar arrangement, by which the denticles are all on the upper part of the tooth, appears to occur in *pustulans*, *gloriosa*, and *rudolphi*.

(4) The commonest form of tooth is hamate, with several (6-10) denticles on the outer side. These are generally fine and minute, but in some forms (e. g., *porcata*, *rosans*, *mariana*, *elizabethina*, *paupera*, *tryoni*, and *godeffroyana*) are large and strong. In this class of radula the innermost teeth have generally several denticles on each side, but sometimes (e. g., *mörchii* and *gonatophora*) only one on the inside.

Of the species described below, the first four are closely related, and form a group to which I am almost disposed to accord generic rank. I have not done so out of deference to the high authority of Prof. Bergh, as one of the animals appears to be identical with the *Goniobranchus reticulatus* of Pease, examined by him and referred to *Chromodoris*. All four forms agree in being oval and flat in shape, with a very ample mantle-margin. The consistency is very soft, and the dorsal pattern composed of spots, not stripes. The innermost teeth of the radula bear a few denticles on both sides; the rest 6-10 denticles on the outer side only. The branchiæ are numerous, and the sides of the mouth are connected with the upper lamina of the grooved foot. This latter peculiarity was noted in the living as well as in the alcoholic specimens; but I am not sure that it is of much morphological significance, for in a very soft animal with ample flaccid integuments such folds may easily be formed at the corners of the mouth without constituting distinct structures.

Nos. 12-15, described as *hilaris*, *lineata*, *lineata* var., and ? *magnifica*, are very likely all varieties of one striped species, with bifid teeth bearing accessory denticles, and about 10 branchiæ, but a larger number of living animals must be examined before this identity can be established.

All my species which are not new have been previously found in the Indo-Pacific, which appears to be the head-quarters of the genus, though not enough is known of the Nudibranchs of the tropical Atlantic to make any comparison as to numbers of species. About half a dozen forms are reported from the West Indies and the Gulf of Mexico. The genus is mainly tropical, and in

Europe is not found north of the Mediterranean. In the Pacific it extends to Japan and Puget Sound.

1. *CHROMODORIS RETICULATA* Pease. (Plate XXIII. figs. 1-5.)

[See Bergh, "Neue Nacktschnecken, No. iv.," Jour. Mus. Godeffroy, Heft xiv. p. 9 ff.]

Four specimens, found at different times on both the East and West Coasts of Zanzibar at low tide.

The colour and size vary considerably. The following is the description of one living specimen:—"23 millimetres long, 12 wide. Foot narrow, with the sides crinkled. Mantle-edge fairly ample and undulated. The whole animal very soft and almost gelatinous. The dorsal surface whitish, with numerous red reticulations, which became closer at the edge and formed a red border. Outside this was a yellow border, passing over to the underside. The rhinophore and branchial openings were not raised. The rhinophores were crimson-lake, with fine white lines on the perfoliations. The branchiæ were of a transparent light pink, with two lines of crimson-lake down the main axis. The under surface of the animal was of a beautiful opaque white. The foot projected behind the mantle."

Another specimen (67 millimetres long and 30 broad) was described as much lighter than that just noticed, but having similar lines and reticulations; there was no crimson-lake and no red border; all the red and yellow markings were bright and light. It was infested with violet-coloured copepoda.

On the other hand, two other specimens were of a much darker colour. The general effect was reddish brown, due to a close reticulation of that shade on a dirty-white ground. The mantle-border was a dark reddish orange. The gills were of a very deep colour, and in one specimen almost black. The pinnæ were so thick and swollen that until closely examined each plume appeared to be a simple column.

The alcoholic specimens are flat, smooth, and very soft. The branchial openings are fairly large, but in the living animal were capable of contracting and almost closing. The branchiæ are 22 to 24 in number, set in an incomplete circle with the ends turned inwards in a spiral (Pl. XXIII. figs. 2 & 3). The front plumes are long and slender, while those behind in the spiral are very small. Hence on a superficial examination only 10 or 12 are visible. The foot is rounded and grooved anteriorly, and the upper lamina is connected with the sides of the mouth (Pl. XXIII. fig. 1). Near the points of junction appear to be two indistinct retracted tentacles.

The labial armature is a dense mass of long rods, slightly curved and bifid at the end. On the rhachis of the radula* are transparent lozenge-shaped thickenings. The innermost teeth

* Only one preparation of the radula has been preserved from one of the darker specimens.

next to the rhachis bear 3-4 small denticles on each side, and those nearest to them are somewhat similar but denticulate only on the outer side; the others are long and hamate, with about 8 denticles on the outer side (Pl. XXIII. fig. 4, *a, b, c*). The outermost bear 3-4 denticles on the apex. A drawing of the alimentary canal is annexed (Pl. XXIII. fig. 5).

I think these animals can be referred to *Chr. reticulata* Pease, with which Collingwood's *Chr. alderi* seems to be identical. All my specimens are flat, with ample mantle-margins, and this agrees with Collingwood's description and plate. Bergh, on the contrary, says: "Die Körperform ist länglich nicht sehr niedergedrückt . . . der Mantelsaum ziemlich schmal." But these soft Chromodorids have great powers of changing their shape and proportions. The branchiæ are much more numerous than in the specimens previously described, but a multiplication of the small plumes in the spiral does not appear to constitute a specific difference.

2. CHROMODORIS SYKESI. (Plate XXIII. fig. 6.)

Chromodoris sykesi Eliot, Abstr. P. Z. S. 1904, No. 4, p. 15, March 8.

Numerous specimens from the East Coast of Zanzibar, obtained both on the shore and by dredging. A few of the animals were of a reddish brown with dirty yellow markings, but in the majority the coloration was most gorgeous (Pl. XXIII. fig. 6). The dorsal surface was bright orange, passing into light yellow towards the edge of the mantle, round which was a double border of reddish brown internally and bright violet externally. On the back were numerous rings of opaque white, but otherwise the whole body was translucent. The foot and underside of mantle were of a rich light yellow. The rhinophores and branchiæ were both of a deep brown-red with opaque white spots. The perfoliations of the rhinophores were indistinct, and the pinnae of the branchiæ small though made conspicuous by white lines drawn along them. The animal was rather flat and very soft. The mantle was very ample.

The largest alcoholic specimen is 40 mm. long, 27 broad, and 10 high. The free edge of the mantle measures 7 mm. over the head, 10 at the sides of the body, and 13 over the tail. In giving the measurements, the breadth of the body is estimated as the mantle falls in its normal position: the edge of the mantle is taken as extended, but not stretched unnaturally. The openings of the rhinophores and branchiæ are small and only slightly raised, but the interior of the branchial pocket is a capacious and very strong bag. The branchiæ are arranged as in *Chr. reticulata* and vary from 12 to 18, according to the size of the spiral. They are red and striped with white. The anal papilla is tall, red and spotted with white. The foot is rounded and grooved in front. Two rather strong folds connect the upper lamina with the corners of the mouth. The oral tentacles were not distinctly

developed in any specimen, but in some there were bulges which may represent these organs in a state of contraction. The labial armature is a strong, rough yellowish ring; it consists of fairly long rods, hooked at the end. The radula is deep red; the formula is about $55 \times 50.0.50$. The innermost teeth have a moderately broad central cusp, with two or three denticles on the side nearest the rhachis and five or six on the outer side. The next two or three teeth are much like them, but are denticulate only on the outer side. The other teeth are long and hamate, with from six to ten minute but distinct denticulations on the outer side only. The outermost teeth retain their form fairly well, though they are smaller than the others.

This beautiful species is dedicated to my friend Mr. E. R. Sykes as some slight acknowledgment for the invaluable assistance he has rendered me in seeing my papers on the Nudibranchiata through the press.

3. CHROMODORIS CAVEÆ. (Plate XXIII. figs. 7 & 8.)

Chromodoris caveæ Eliot, Abstr. P. Z. S. 1904, No. 4, p. 15, March 8.

Several specimens from the East and West Coasts of Zanzibar.

The following are the notes on the living animal:—"Colour yellowish white, with indefinite large drab blotches laterally. Edges of mantle and foot bordered with light violet. On the back are black spots surrounded by a white line and also irregular dull orange spots. The foot is not very broad, white in colour, with a row of dull orange spots and black spots below them. The tip and anterior side of the rhinophores are purple; the lamellæ are reduced to fine striations. The margins of the rhinophorial and branchial pockets are not at all raised; the rhinophores and gills when retracted are not completely out of sight. The mantle is ample. The skin is quite smooth and even. In captivity the animals sometimes swim on the surface of the water, foot uppermost."

The measurements of the largest alcoholic specimen are:—Length 60 mm., breadth 34 mm., height 14 mm., free edge of mantle 10 mm. over the head, 9 mm. at sides of body. The branchiæ (Pl. XXIII. figs. 7 & 8) vary from 12 to 16. Ten are fairly large and form a circle open behind. On the inside of this circle are set on either hand from one to three smaller plumes. The foot is grooved in front and the upper lamina is attached to the side of the head. The mouth is a very distinct vertical slit, and at its lower corners, just about the point where the lamina of the foot terminates, are a pair of fairly well-developed tentacles. The labial armature is a not very compact mass of long bent rods, not bifid at the end. The rhachis of the radula bears transparent lozenge-like thickenings, which are, however, not very distinct. There are about 60 rows containing about 70 teeth on each side of the rhachis. The innermost are much as in *Chromodoris sykesi*, but the central cusp is broader and there are about 5 denticles on the

outer side. The second and third are much like the innermost, but are denticulate on the outer side only. The rest are simply hamate, of the ordinary shape, and bear about 10 minute denticles. The outermost are, as usual, irregular, and the denticulations are mainly on the apex.

4. CHROMODORIS ANNULATA. (Plate XXIV. figs. 1-3.)

Chromodoris annulata, Eliot, Abstr. P. Z. S. 1904, No. 4, p. 15, March 8.

Many specimens found among *Zostera* off the mouth of the Creek at Zanzibar and other places at low water during spring-tides.

The living animal (Pl. XXIV. fig. 3) was very soft, with an ample undulated mantle-margin. A large specimen when in an extended condition was 55 mm. long and 15 wide, but when contracted the same individual was 45 mm. long and 25 wide. The upper surface was of a somewhat translucent white, studded with yellow spots. Round the margin was a border of deep purple, and two rings of the same colour were so placed as just to include the rhinophores anteriorly and the branchiæ posteriorly within their respective areas. The underside was white, with yellow spots on the tail and the sides of the foot. The rhinophores were deep purple, and so long that they were rarely wholly retracted. The branchiæ were white, with a deep purple stripe down both the inner and outer edge, and were kept waving from side to side. The animals were found in conspicuous positions, and made no attempt to hide themselves among the *Zostera* weed.

By a somewhat unusual change, which deserves to be noticed as showing how preserving-fluids may alter colour, the alcoholic specimens have become of a reddish purple with white spots, the border and rings having disappeared* and apparently diffused their pigment over the whole surface. Fortunately the notes on the living animal were very full, and there appears to be no doubt that the specimens are the same despite their transformation. The body is very soft and the skin perfectly smooth. The mantle is ample, the free edge measuring 7 mm. over the head and 6 at the side in a specimen where the visceral mass is 10 mm. broad. The openings of the rhinophores and branchiæ are slightly raised in some, but not in all the specimens, and vary in size. They are no doubt capable of contraction and expansion in life. The branchiæ (Pl. XXIV. fig. 2) vary in number from 9 to 16 according as an inner row is present or not, but on an average the smaller number is more frequent in this species than in *Chr. reticulata*, *sykesi*, and *cavae*. The foot is narrow and rounded, grooved in front but not notched. Two small folds pass upwards from the foot, uniting it with the sides of the head and with the mantle. The tentacles are small and placed at the lower angles of the mouth. The labial

* Their dark purple-blue became almost at once a light red, which disappeared gradually.—C. C.]

armature is formed of two large strong triangular plates, almost united into a ring, dark brown, and formed of a mass of long hooks. The rhachis of the radula (Pl. XXIV. fig. 1) bears lozenge-shaped thickenings, on each side of which are about 45 teeth. The number of transverse rows is about 70. The innermost teeth have a large denticle on the inner side, and three small ones on the outer; the rest are simply hamate, with 8-10 minute denticles; the outermost irregular and denticulate on the apex in the younger rows, but in the older the denticulations seem to have been worn off.

5. CHROMODORIS SPLENDENS.

Chromodoris splendens Eliot, Abstr. P. Z. S. 1904, No. 4, p. 15, March 8.

[? = *Chr. splendida* Angas, Journal de Conch. i. 1864, p. 55.]

Two specimens from Chuaka, East Coast of Zanzibar. The notes on the living animal are as follows:—"General colour somewhat miscellaneous, being produced by thick collections of purple and white dots, in different proportions in different places. A vivid orange border round the whole body. Underside milk-white. Mantle ample. Gill-pocket fairly large, gills purplish."

The alcoholic specimens are of a uniform dirty yellow, and of about the same size. Length 40 mm., breadth 13, height 10. The free portion of the tail is 6 mm. long, but is entirely covered by the mantle, the free margin of which measures 7 mm. behind and 5 mm. at the sides and head. The rhinophores are large. The edge of the branchial opening is slightly raised. The total number of branchial plumes is 27, but of these three seem to be accessory ramifications and not independent branchiæ. The circuit is open behind, and the two ends are turned inwards in a spiral. The anterior plumes are large, and those in the spiral very small, so that the living animal shows ten or twelve branchiæ. The foot is rather wide, with thin margins, and is dilated and deeply grooved in front. The tentacles are distinct. The inconspicuous labial armature consists of two small yellowish plates, composed of fairly long bent rods, most but not all of which are bifid. The radula is also yellowish, with about $70 \times 60.0.60$ for formula. On the rhachis are indications of triangular thickenings, but the base of the triangle is not distinct. The innermost teeth bear three or four denticles on the inner and five on the outer side. The rest are hamate, rather erect, with six denticles under the hook decreasing in size downwards. The outermost show less difference from the rest than usual, and are long, erect, with about four denticles on or near the apex.

I think it very probable that this is the animal described as *Goniodoris splendida* in the 'Journal de Conchyliologie,' and I have indicated this probable identity in the name. The scheme of coloration is very similar, and the ample mantle, large rhinophores, and numerous branchiæ are also points of resemblance, but the purple in the present specimen is distributed in the form

of small dots, and not collected into large spots. But it is possible that the buccal parts of *Chr. splendida*, respecting which we have no information, may present specific differences, and identification is therefore at present not warranted.

6. CHROMODORIS TRYONI (Gar.) var. (= *Chr. aureo-purpurea* Collingwood).

[See Bergh, "Neue Nacktschnecken, No. iv.," Jour. Mus. Godeffroy, Heft xiv. p. 14 ff.]

Two specimens from Chuaka, the larger of which was about three inches long in life. The body was quite smooth and very soft. The mantle and edge of foot bordered with light violet; the back translucent, allowing a rough, broad, net-like grey pattern to be seen beneath the surface; the whole surface covered with opaque spots of bright orange-yellow. Foot broad and deep, with white sides bearing orange-yellow spots. The rhinophores with purple lamellæ and a longitudinal white stripe behind. The simply pinnate branchiæ white, with a deep purple stripe down each edge*. The animal was lively in its movements, and the branchiæ continually waved with a quick vigorous motion from side to side.

The alcoholic specimen is 35 mm. long, 13 broad, and 15 high, stoutly built, with a narrow mantle-edge of only 3 mm., and the tail projecting 8 mm. behind. The edges of the rhinophore and branchial pockets are slightly raised. The branchiæ seem to be 27 in number, the median anterior plume being the largest. The circuit is interrupted behind, and the ends of the row of plumes turned inwards in a spiral. Several of the plumes are bifid at the tip. The anterior margin of the foot is slightly grooved but not notched. The labial tentacles are very small and set somewhat above the mouth. The lips are large. The labial armature consists of two strong, rough plates composed of a closely-compacted mass of small thick hooks. The long white radula has 96 rows of colourless teeth, containing about 50 teeth on each side of the rhachis, which exhibits folds and puckers. The teeth have the characters usual in the genus; the innermost bear four denticles on both sides, the others five large and distinct denticles below the terminal hook on the outermost side only, the highest being the largest. In the outermost the denticles move upwards, till they are all on the apex of the teeth. The form of the teeth and labial armature is accurately represented in Bergh's plates.

I think this form may be safely identified with *Chr. tryoni*. It differs from Bergh's description only in the absence of ocelli with black centres. It appears to be also identical with Collingwood's *Chr. aureo-purpurea*, though the latter is said to have only 10 branchiæ. The two varieties may be described as *Chr. tryoni* var. *ocellata* and var. *aureo-purpurea*.

* [I quote from the notes on the living animal, but must admit that this expression is obscure. (Outer and inner sides, parallel with blood-vessels shown in fig. 3, Pl. XXIII.—C. C.)]

7. CHROMODORIS VICINA.

Chromodoris vicina Eliot, Abstr. P. Z. S. 1904, No. 4, p. 15, March 8.

Twelve specimens from Chuaka.

The following notes were made on the living animal:—

“Mantle and foot bordered with light violet, the latter border a row of dots. Middle of back drab-brown with bright violet spots, the larger ones with a white centre. Near the edge of the mantle a number of yellow spots with white borders, which are often confluent. The foot deep and narrow, white with some yellow spots near the lower edge. The rhinophores dark brown with white tips. Each of the branchiæ bore two black bands.”

The alcoholic specimens are of a dull reddish brown and present two very different forms: one long and narrow, measuring 37 mm. in length and 9 mm. in breadth, and the other oval, being 27 mm. long and 20 broad. Both are about 20 mm. high. The margin of the mantle is about 6 mm. wide, and forms a sort of hood over the head. The branchial opening is very small. Both it and the rhinophore openings are slightly raised. The branchiæ are 16 in number, the circuit is open behind, and the row of plumes turns inwards in a small spiral. The foot is long and narrow. In the long form of the animal it projects about 5 mm. beyond the mantle; in the broad form it is covered by it. The anterior margin is rounded and grooved, but not notched. On each side of the mouth is a small conical tentacle.

The labial armature consists of two yellowish plates composed of rather long rods, bifid at the tip and generally bent into the form of hooks, but sometimes straight. These are much like the same organs in *Chr. striatella* (vide Bergh, ‘Challenger’ Reports). The formula of the radula is about $50 \times 45.0.45$. The rhaclis is bare but exhibits in places a slight wavy fold. The innermost teeth bear three denticles on each side of the central cusp. The next two or three are of much the same shape, but denticulate only on the outer side. The majority are tall and straight, bearing five large and distinct denticles under the terminal hook, and sometimes two or three small irregular denticles in addition. The five or six outermost are irregular in shape, and bear from three to six irregular denticulations mostly on the apex.

This species is closely allied to *Chr. tryoni*, and will not improbably prove to be a mere variety of it. All the present specimens, however, have a somewhat different coloration, fewer branchiæ, and more numerous denticles on the teeth.

8. CHROMODORIS ELIZABETHINA B., var. AFRICANA. (Plate XXIV, fig. 4.)

Two specimens from the East Coast of Zanzibar. The notes on the living animal describe the dorsal surface as black and white, black preponderating. The mantle had a double border, yellow

outside and white inside, as had also the foot. In the middle of the back were two longitudinal white lines uniting behind the branchiæ; on the tail, which projected well behind the mantle, was one white line. The gills and rhinophores were yellow, and the slightly raised pockets of both were fringed with the same colour. The creeping-surface of the foot was narrow. The sides of the body were black with a white stripe between the mantle and the foot.

The alcoholic specimens are high and stout, with the colours fairly well preserved. The largest is 26 mm. long, 13 broad, and 10 high. The mantle-margin is fairly ample, measuring about 3 mm. at the sides and head, 5 mm. over the tail. Of the branchial plumes there is only one which can be called simply pinnate in the strict sense, all the rest being more or less bipinnate. Some are merely bifid, and some bear four or five branches. It is rather difficult to say what is the number, as when a small plume springs up at the base of a large one it may be counted either as an accessory branch or as a separate branchia, but they may perhaps be described as 10, set in a semicircle. The foot is grooved and notched in front; the tentacles are close together above the mouth, conical and larger than usual in the genus. The labial armature is greyish and formed of a thick mass of bent rods, some bifid but most simple. The formula of the radula is in one specimen $94 \times 90.0.90$ and in the other $90 \times 75.0.75$. The innermost teeth bear three denticles on both sides; the remainder 3-4 minute denticulations on the outer side only, and some are quite smooth and simply hamate.

I think these specimens may be referred to Bergh's *Chr. elizabethina* (S. R. xi. pp. 466-473). The difference in appearance, though striking, is due to the relative preponderance of black in one and of white in the other variety. The dentition and the tendency to bipinnate branchiæ are strong points of resemblance. On the other hand, the differences found in both the African specimens are sufficient to constitute a well-marked variety. (1) Whereas the specimens from the Philippines are whitish with black stripes, these are black with white and yellow stripes. (2) The denticles on the teeth of the African specimens are fewer and finer and many of the teeth are smooth.

9. CHROMODORIS RUNCINATA B.

[Bergh, in S. R. xi. pp. 479-481.]

One specimen from Chuaka on the East Coast of Zanzibar.

The general colour of the living animal was light blue with many spots, some dark blue and some whitish yellow, on the back, tail, and sides, but not on the foot. Some of the yellow spots were arranged so as to form a rather irregular border at the sides of the mantle and a line down the middle of the back. The rhinophores and axes of the gills were a bright, light red. The gills were kept in motion.

The alcoholic specimen is high and stoutly built; length 14 mm., breadth 5, height 6. The mantle is moderately ample; under its posterior margin it bears eight conical protuberances, four of which are very distinct and the rest smaller. There are none, however, on the anterior portion of the mantle as in the specimens described by Bergh. The branchiæ are 12 and exposed in the preserved specimen. The foot is rounded in front and strongly grooved. The labial armature and radula are much as described and figured by Bergh. The formula of the latter is about $50 \times 70.0.70$. The teeth are bifid; the innermost bear an accessory denticle on the inner side and hence appear trifid. The others bear two or three very fine denticulations below the two prongs. The outermost have 5-7 rather larger denticles.

A second specimen subsequently examined has also only a few conical protuberances behind and none in front, so that this peculiarity is perhaps characteristic of East African specimens.

10. CHROMODORIS NIGROSTRIATA. (Plate XXIV, figs. 5 & 6.)

Chromodoris nigrostriata Eliot, Abstr. P. Z. S. 1904, No. 4, p. 15, March 8.

One specimen from the mouth of Chuaka Bay, found among the branches of growing coral at extreme low tide.

The living animal was 15 mm. long and 3 broad when fully extended. The foot was broad and high; the mantle-edge was narrow, and in the alcoholic specimen has become a mere low ridge. The ground-colour was a violet-blue grey, with rather ill-defined blotches of light primrose-yellow on the back, mantle-edge, and sides of the foot. On the back and sides of the foot were also very distinct curved black lines, one of which formed a horseshoe round the gill-pocket, while the rest were arranged in a nearly symmetrical figure. The edges of the rhinophore and gill-pockets were not raised. The gills were seven and completely retractile into a pocket which could close over them. The separate plumes were orange-red, but the rather large basal part, where they were all united, was of the same violet-grey as the body. The rhinophores were of a rather deep red.

The alcoholic specimen is of a uniform bluish grey; the yellow blotches have disappeared, but the black lines are very distinct and vivid. The rhinophores are large, and of the seven gills three appear to be much larger than the others, which is not apparent from the drawings or descriptions of the living animal. The tentacles are entirely withdrawn and only indicated by two puckers, one on each side of the mouth. The front of the foot is round, and no groove is visible. The anterior part of the body has been torn, with the result that the buccal parts have been injured. The labial armature is a mass of thick stout hooks, shaped much as in Bergh's figure of *Chr. semperi*, arranged in a regular tessellated pattern. The radula, which seems small and brittle, is much damaged. No rhachis or rhachidian teeth are

discernible. All the teeth which I examined were hamate, with bifid tips, exactly like those of *Chr. semperi* as figured by Bergh.

Another specimen captured at Chuaka, on the East Coast of Zanzibar, seems to belong to the same species, though at first sight is strikingly different from the individual described above, being larger, stouter, and of another colour. The notes on the living animal describe it as lemon-yellow, with very deep purple-black stripes; the gills and rhinophores vermilion; the foot purplish underneath and at the edges.

The preserved specimen is pale yellow, with black lines arranged much as already described, including a horseshoe round the branchiæ, but shorter and more numerous. It is 30 mm. long, 15 high, and 13 broad. The mantle-edge is a narrow thick ridge, measuring 1.5 mm. at the sides, 2.5 over the head, and 3 over the tail, which is 10 mm. long. The body is high and thick, but the sole of the foot narrow (maximum 3 mm.). The pockets of the rhinophores and branchiæ are small and very slightly raised. The branchiæ are ten, set in a complete circle, but the anterior plumes are larger than the posterior. One of the latter is very small and perhaps merely an offshoot. The foot is rounded in front, grooved but not notched. The tentacles are retracted and hardly visible.

The labial armature is yellowish and formed of short thick hooks. The formula of the large and closely-packed but very fragile radula is about $90 \times 75.0.75$. The teeth are mostly bifid at the tip and otherwise smooth. Only the innermost have an accessory denticle on the inner side, and are thus trifid. The outermost are serrulate at the apex.

These two specimens seem to be merely colour-varieties of a single species which is closely related to *Chr. semperi* B. Except that the external teeth of the radula bear more numerous and more distinct serrulations, the principal characters appear to be identical. But whereas *Chr. semperi* is spotted, the animals here examined are marked with exceptionally clear and narrow black lines, which seem engraved on the surface. They must therefore be accorded specific rank, at least provisionally. It is possible that intermediate forms may be discovered, as the variety first described bears some yellow blotches.

II. CHROMODORIS SCURRA B.

Chromodoris scurra Eliot, Proc. Acad. Nat. Sci. Philadelphia, Dec. 1899, p. 518.

[Bergh, S. R. xi. p. 478, and Journal de Mus. Godeffroy, Heft vi. 1874.]

Two specimens from Zanzibar Harbour.

The colours of the living animal are brilliant. Down the centre of the back runs a white line, and on each side of it are borders in the following order: (1) narrow deep red line, (2) broad orange-yellow band, (3) narrow deep red line, (4) violet band, which broadens out anteriorly and posteriorly, (5) white border running

round the mantle. The foot is of a light violet-blue; the branchiæ orange with deep violet tips; the rhinophores uniform deep violet. The animals are sluggish and not very sensitive to touch.

The buccal parts and other characters are as described by Bergh. One specimen has six branchiæ, the other eight, of which one was posterior to the others and very small.

12. *CHROMODORIS HILARIS* B., var. (? = *lineata* Soul.)

[S. R. xvii. pp. 935-937.]

Nine specimens from Tundaa, Pemba, found on a sandy shore.

The description of the living animals is as follows:—"Creamy white. Foot and mantle edged with violet. On the back four undefined brown lines with three violet lines between. Foot projects behind mantle. Gills and rhinophores vermilion. About $1\frac{1}{2}$ inches long."

The preserved specimens are longish and not very stoutly built. The measurements of the largest are: length 25 mm., breadth 10 mm., and height 9 mm. The colour is the ordinary alcoholic yellow; on the back are traces of four brownish and three white lines, the latter representing the violet of the living animal. Some, but not all, of the specimens appear to have a similar white line on the sides of the body between the mantle and the foot. The branchial aperture is very small; the branchiæ themselves not very small and 10-12 in number. The foot is rounded in front and slightly grooved. The tentacles are distinct. The mantle-edge is of very varying shape, sometimes fairly wide and thin, sometimes merely a thick ridge.

The labial armature and radula are much as represented in Bergh's plates. The former is a grey ring composed of mace-like elements. The latter is small and transparent. Most of the teeth are bifid, with four or five accessory denticles below the two prongs. The innermost have one or two denticles on the inner side. The rhachidian thickenings are small and not very distinct.

Bergh's specimen was in life "hell ocker-gelb" with four bluish-black lines on the back, but on the whole the colour and markings are sufficiently similar to justify us in regarding the present specimens as merely varieties.

13. *CHROMODORIS LINEATA* Soul. (? = *Chr. hilaris* B.) (Plate XXIV. fig. 7.)

One specimen from the East Coast of Zanzibar.

The notes on the living animal are as follows:—"Cream-coloured. Gills and rhinophores vermilion. There were bright violet lines on the cream-yellow ground, bordering the foot and mantle: two along the sides of the body and five along the back. The two outside ones encircled the rhinophore-pits and joined in front; the median encircled the gill-pocket."

The alcoholic specimen is yellow and the violet lines have become white. It is high and stout, the dimensions being—length

15 mm., breadth 7, height 8. The mantle-edge is narrow except over the head, where it is ample. The branchial opening is minute; the branchiæ are small, 10 in number, and apparently set in a perfect circle. The foot is rounded and grooved in front; the shape of the head is spatulate. The labial armature is a yellow ring of mace-like elements. The radula is small and transparent, the formula being about $35.0.35 \times 80$. The ordinary teeth are bifid, and all appear to have four denticles under the top hook. The innermost have one or two denticles on the inner side. The outermost are irregularly serrate (*vide* Pl. XXIV. fig. 7). No rhachidian thickenings are to be seen.

Although the published plates of *Chr. lineata* and *Chr. hilaris* are remarkably different, the scheme of coloration is much the same; and I think it probable that the two forms are really varieties of one species.

14. CHROMODORIS ? LINEATA, var. NIGROLINEATA.

One specimen from Chuaka on the East Coast of Zanzibar.

The notes on the living animal are as follows:—"Shape spatula-like. Dorsal side whitish at edges, lemon-yellow medianly with longitudinal black lines. Gills and rhinophores short, orange-red. Underside colourless, but edge of foot and mantle bright dark blue (not purple)." Size 18 mm. long, 6 mm. broad.

The alcoholic specimen is of a waxy white. There are only faint traces of the blue borders, but there are five distinct black lines on the back, two of which are divided again so as to form long loops. The mantle-edge is thick and narrow. It measures about 2 mm. over the head and tail, but is hardly distinguishable at the sides. The anterior end of the foot is rounded and grooved. The small branchiæ are set in a circle and exposed. The buccal mass is small. The labial armature is transparent, and consists of rather irregular short hooks, some cleft. The small transparent radula is as in *Chr. hilaris*.

15. CHROMODORIS ? MAGNIFICA Q. & G., var.

One specimen from Zanzibar, dredged in 4 fathoms.

The following are the notes on the living animal:—"40 mm. by 10 mm. Elongate in form, fore end spatula-shaped. Colour white and rather translucent. Mantle with a thin yellow border, within which was a band of deep but brilliant violet, broadest in front and behind but broken laterally. There was also a violet line along the sides of the foot, and six longitudinal lines of deep chocolate-colour and different lengths along the back. They were surrounded by thin clear lines of opaque white. There was also a line of chocolate blotches along the side of the foot just below the shelf-like edges of the mantle. Branchiæ 10, simply pinnate, with a band of orange-red along each side of each plume. Rhinophores a deeper tint of orange. The tail projected well behind the mantle and bore chocolate blotches."

The alcoholic specimen is of a pale yellow, with the above-

described markings fairly well preserved but all white. The form is high and stout. The tail projects 6 mm. behind. The mantle-edge is narrow and very thick: it measures about 3 mm. over the head and tail, and 2 mm. at the sides. The pockets of the rhinophores and branchiæ are not at all raised. The front of the foot is rounded and grooved, the upper lamina being connected with the base of the tentacles; but, as in many other cases, it is hard to be sure that this feature is not due to contraction. The labial armature consists of two yellowish plates composed of rather large elements of varying size. The most perfect form appears to be a short thick hook, but in many cases this degenerates into a simple triangle. The formula of the radula is about $65 \times 70.0.70$. The teeth are crowded over the small naked rachis. They are of the bifid type, and have usually 3-5 denticles under the two prongs. These denticles are smaller in the inner half of the rows, where many teeth are quite smooth, and larger in the outer half. The innermost teeth have generally, but not always, a denticle on the inner side: the outermost are irregular and jagged.

The buccal parts of this animal ally it to *Chr. hilaris* and *Chr. carnea*, and its coloration is not altogether dissimilar to the former. I think it is probably the *Chr. magnifica* of Quoy and Gaimard, though identification is uncertain in the absence of information as to the radula of that species.

16. CHROMODORIS INCONSPICUA.

Chromodoris inconspicua Eliot, Abstr. P. Z. S. 1904, No. 4, p. 15, March 8.

One specimen from Zanzibar Harbour, dredged in 5 fathoms.

The living animal was translucent white, with numerous opaque white spots, and a few brown ones in the middle of the back; the rhinophores black; the gills greyish. It was stiff and sluggish, and somewhat resembled a *Phyllidia*.

The alcoholic specimen is of a uniform grey, 18 mm. long, 7 broad, and 6 high. The mantle-edge is narrow all round, including the parts above the head and tail, and is somewhat undulated. The pockets of the rhinophores and branchiæ have raised edges. The latter are small, 8 in number, and apparently set in a complete circle. The anterior end of the foot is slightly grooved. The tentacles are retracted. The labial armature is colourless, and consists of small thick hooks, sometimes bifid. The radula is also transparent. There are no rachidial thickenings. The innermost teeth are unusually broad and square; they bear 8 denticles inside and 7 outside. The next two or three are also broader than the rest, which are slender, erect, slightly hamate, with one or sometimes two almost vertical clefts, so that they appear bifid or sometimes trifid. Below these clefts are from 3 to 5 long distinct denticles on the outer edge. The outermost teeth are tall and slender, with 3 or 4 denticles on the apex, but otherwise smooth.

This form has many points of resemblance to *Chr. albo-notata* B., but the dentition seems different.

17. (?) CHROMODORIS FLAVA. (Plate XXIV. figs. 8 & 9.)

Chromodoris flava Eliot, Abstr. P. Z. S. 1904, No. 4, p. 15, March 8.

One specimen dredged on the West Coast of Zanzibar.

The living animal was 11 mm. long and 3 wide. The colour everywhere, including the rhinophores and branchiæ, was a bright lemon-yellow. Round the mantle-edge ran a blood-red border of irregular width. The branchiæ were six, simply pinnate, and with few pinnae. The mantle-edge was undulated and ample. The back was flat. The foot projected about 2 mm. posteriorly, and was considerably expanded in front. (From the drawing it appears to be grooved but not notched.) The animal adhered very strongly. The tentacles were hardly visible, being merely two small blunt knobs on the snout.

The specimen has unfortunately been lost, but I give the figures.

Genus CASELLA (Cuv.).

This small group, though easily recognised by its clearly marked and much undulated mantle-margin, is not distinguished from *Chromodoris* by any features of importance, and there is no sufficient reason, except convenience, to maintain it as a separate genus. The chief character is the aforesaid undulation of the fairly broad mantle-edge, and the outermost teeth of the radula are smooth instead of being denticulate on the apex. Bergh recognises three species, all from the Indo-Pacific.

CASELLA ATROMARGINATA (Cuv.).

[Bergh, Jour. d. Mus. Godeffroy, vi. 1874, pp. 102-9; id. S. R. xvii. p. 942.]

One specimen from the West Coast of Zanzibar.

The notes describe the living animal as long and tapering, with a flat back and a mantle-edge only slightly projecting but elaborately wrinkled at the sides. The foot hardly extended beyond the dorsal area. The general colour was brown, with numerous small grey spots, but towards the edge of the mantle became first yellowish and then greenish. The mantle-edge itself was defined by a very distinct black border. The rhinophores were black, with a grey line on the edge of each lamella. The gills were black and grey, set in a double spiral and kept in motion. The animal was about two inches long, and, in spite of its sombre coloration, a handsome creature.

These characters and colours are well preserved in the alcoholic specimen. The mantle is narrow both at the sides and behind, and somewhat expanded only over the head. The branchiæ are arranged in a double spiral meeting in front but leaving an open

space behind. They are 24 in number: those in front are fairly large, but the size diminishes backwards, and those in the spirals are extremely small. The head and anterior portion of the foot are much retracted, but the latter was apparently round and grooved in life.

The mouth leads into an unusually large and spacious cavity, but the buccal mass is very small, the radula minute, and the œsophagus extremely narrow. The labial armature is small but strong, with rough projecting teeth; the elements are small, yellowish, bent rods, mostly bifid. No rhaclidian thickenings are visible; the innermost teeth have three denticles on the inner and about four on the outer side. The remainder have mostly five on the outer side only. The number of denticles increases towards the outside of each row, but the outermost teeth are smooth. The teeth are very small, crowded, and extremely numerous.

This specimen corresponds with previous descriptions of *C. atromarginata*, except that there are no thickenings on the rachis of the radula and that the gills are much more numerous than in the specimens previously described. There seems to be some doubt on this point (see Bergh, Mus. Godeffr. l. c.), but the arrangement in the present specimen is perfectly clear. *Casella cincta* from Mauritius has 22 gills (Bergh, S. R. xvi. 2, p. 839), but presents differences in the coloration and buccal parts.

Genus CERATOSOMA, Adams & Reeve.

This genus is rendered unique among Nudibranchs by its extraordinary shape, but in its essential characters it is closely allied to *Chromodoris*. Indeed, if one looks at one of the high, stout Chromodorids (e. g. the figure of *C. semperi* in S. R. Heft xi. pl. lv. fig. 2), it will be seen that one has only to somewhat prolong the tail and to thicken and develop the mantle-edge in order to obtain the characteristic shape of *Ceratosoma*. The large strong radula is like that of *Chromodoris*, but the denticles are minute and inconspicuous. The branchiæ are much divided. Bergh recognises nine species, but I have only seen the descriptions of those examined by himself (*cornigerum*, *gracillimum*, *trilobatum*, *ornatum*, *polyomma*). In Zanzibar I have inspected more than forty specimens which are apparently referable to one species, and are connected together by numerous gradations in colour and shape, though the extreme forms look remarkably different. As the five species mentioned above are distinguished by their external characters only, and offer no certain differences in the dentition or other organs, I am inclined to think they are merely varieties and that there is only one real species. It is to be noted, however, that though many of my specimens resembled the figure of *Ceratosoma gracillimum* (S. R. pl. xxv. fig. 8) the border was never red as there depicted, but always violet, and in no case did ocelli occur as in *C. polyomma*.

CERATOSOMA CORNIGERUM*.

[Bergh, Semper's Reisen, x. pp. 393 ff.; id. 'Challenger' Reports, pt. xxvi. p. 80 ff.]

Numerous specimens of *Ceratosoma*, mostly found together and apparently belonging to one species, were captured at Chuaka in February 1901. About 40 of them were preserved.

The living animals varied greatly in coloration, the ground-tint ranging from olive-green to deep chestnut-red, with gradations in each shade. On this ground were numerous dark brown spots and white mottlings in varying proportions, but it is to be noted that the variations in the ground-colour were real and did not depend on the markings. In all specimens there were a row of violet dots round the foot, and violet lines or spots on the head near the rhinophores, and generally near the branchiæ as well. The ground-colour near the edge of the foot was white. One specimen was dark green with orange-yellow spots, and in all cases there were a few yellow spots near the edge of the foot and the genital orifices.

Many of the animals were found in shallow pools, crawling over seaweed and in no way hiding themselves. They were sluggish in their movements, and had a peculiar, unpleasant, strongly aromatic odour. In many specimens the tail or the posterior dorsal process appeared to have been bitten off. Possibly the curious shape may really be a protection to the animal by enabling it to escape with nothing worse than the loss of an unimportant part when it is seized by a carnivorous foe. No instances of self-mutilation were observed.

The alcoholic specimens show considerable variation in size and proportions. Some are stout, some slender with relatively longer tails; in some the lobes are much thicker than in others. Note was taken of one living specimen which had no lobes at all; another had two lobes like horns near the rhinophores. It does not appear that these variations in size and shape correspond with any differences in the radula, branchiæ, or other organs.

The measurements of an average fine specimen are as follows:—Total length 89 mm., tail 34 mm.; extreme height to tip of posterior lobe 33 mm., extreme breadth across lateral lobes 26 mm. The posterior lobe rises 10 mm. above the level of the back, and the lateral lobes project 6 mm. from the line of the sides. The pockets of the rhinophores and branchiæ have slightly raised rims in some specimens, but not in all. The rhinophores are rather large; the club bears about 40 perfoliations on each side, and is supported on a stalk about as large as itself. The branchiæ are long and string-like; in nearly all the specimens they project from the pocket and are not retracted. The arrangement is

* In my paper on Mr. Gardiner's collection of Nudibranchiata, in the 'Fauna and Geography of the Maldive and Laccadive Archipelagoes,' I inadvertently alluded (p. 552) to *Ceratosoma polyomma* as common in East African waters. I should have said *C. cornigerum*.

variable, and does not lend itself to expression in a formula. In most of the larger specimens it is somewhat as follows:—All the branchiæ rise from a ring which forms the common support; in front and behind (where it is united with the anal papilla) it is about 4 mm. high. From it rise in front three longish separate plumes, bifid or trifid at the tip. On each side is a group of about five plumes, united together by a common portion some 6 mm. high; each plume is divided into three or four subdivisions, and each of these subdivisions is branched again.

The anterior margin of the foot is deeply grooved, but so retracted in most specimens that it is hard to see. The tentacles are also generally retracted. The buccal mass is a large elongated yellow cone, and the retractor muscles are very conspicuous. The labial armature is composed of small slender hooks, rather irregular in shape but not bifid. The large radula is supported by a stiff strong membrane, from which the teeth are not easily detached. In the larger specimens the formula is about 150.0.150 × 70. There is a slight rhachidian fold. The innermost teeth have one denticle on the inner side and 3 to 4 on the outer. The rest bear 1–3 inconspicuous denticles on the outer side only, of which the highest is the largest. The outermost teeth are degraded, but not much serrulated. In one specimen a number of irregular teeth, bifid and variously jagged, occurred in the middle of several rows. The rest of the internal organs appeared to be as described by Bergh. There is hardly any dilatation which can be called a stomach before the digestive tract enters the liver.

Genus SPHERODORIS.

This genus is characterised by its peculiar dentition, simply pinnate branchiæ, and the external conformation of the mouth-parts. In outward appearance the species differ greatly, for whereas *punctata*, *papillata*, and *verrucosa* bear ridges and warts, *lavis* is smooth. Bergh classes the genus with *Orodoris* and *Miamira*, apparently on account of these warts and ridges; but it appears to me to be more nearly allied to *Chromodoris* in virtue of its simple branchiæ and its dentition, which is substantially similar, although it has peculiarities of its own. The teeth are straight, long, and thin, with a comb-like denticulation. The innermost are broader than the others and divided into two parts, one of which is smooth and the other denticulate—an arrangement which is perhaps analogous to that of *Chr. mörchii* and *Chr. gonatophora*, where the innermost teeth have one large smooth denticle on the inside and several small ones on the outside, although in *Sphaerodoris* it would appear that the smooth part of the tooth corresponds to the outside.

Four species are known, all from the Indo-Pacific.

SPHÆRODORIS LÆVIS, var. *VARIEGATA*.

[Bergh in Semper's Reisen, Heft xvii. p. 924, 1890.]

One specimen from Mneimba on the East Coast of Zanzibar, found in the act of laying a ribbon of light violet-coloured eggs. The body of the living animal was described as firm and shiny, dark brown in colour above, with greenish and sandy patches; the underside was a lighter shade of uniform brown.

The alcoholic specimen is 31 mm. long, 20 broad, and 14 high. The foot, which is nearly as large as the body, is 28 mm. long and 15 broad. The colour is mottled-brown of darker and lighter shades. There are also bands formed of minute black spots, not very conspicuous, and arranged in an irregular pattern, particularly in the neighbourhood of the branchial opening. Though the dorsal surface cannot be described as either tuberculate or papillose, it is not, strictly speaking, smooth, but bears low irregular excrescences which resemble a marine growth. Also, there are about 10 shallow pits (? glandular) distributed at irregular intervals round the mantle-edge. Like the bands, they are inconspicuous, about 1 millimetre wide, with slightly raised edges and a black centre. The edges of the rhizophore and branchial pockets are not much raised and entire. There are 14 small but stout, simply pinnate gills, set in a circle which is slightly open posteriorly. The head is joined to the upper lamina of the foot at the sides, and there are no distinct tentacles, though two small prominences by the mouth may represent these. There is a very narrow but strong labial armature, composed of minute hooks. The radula is rather narrow, with a wide naked rhachis. There are about 70 rows, each containing about 25 teeth on either side of the centre, but the teeth mostly point towards the rhachis, and the whole arrangement is very irregular so that the usual radula formula hardly meets the case. The teeth present the form characteristic of the genus, but the innermost are somewhat wider than Bergh's figures of *S. lævis* (*l. c.* pl. lxxxviii.) and bear 7 or 8 denticles. The denticles on all the teeth are extremely delicate and fine. There is no stomach apart from the hepatic mass. The reproductive apparatus is unarmed.

This form is clearly a *Sphærodoris* (as shown by the buccal parts, head, and branchiæ), and, equally clearly, neither *S. punctata*, *papillata*, nor *verrucosa*. It undoubtedly comes very near to *S. lævis*, of which I provisionally describe it as a variety, but it varies somewhat from the type specimen described by Bergh both in the pits, which he does not mention, and in the teeth, and may prove to be a new species.

I have also examined several individuals, apparently referable to *S. lævis*, captured by the Skeat Expedition at Pulau Bidang near the Malay Peninsula. Their dentition is like that described above, and they have a few (in one specimen only two) pits, but the back is quite smooth and of an almost uniform bluish-olive colour.

Since writing the description of this species I have examined another specimen, found at Mombasa at low tide. It is strongly arched, and of a sandy-brown colour with patches of darker brown. Near the branchial opening are a few bands of minute black spots, almost invisible except under a lens. On the dorsal surface are 22 pits, scattered quite irregularly round the margin and in the middle. The preserved specimen has a small ridge between the rhinophores, not extending before or behind them, and possibly due to contraction after death. Around the branchial pocket is a circular area, marked off from the rest of the back by being somewhat flatter and lighter in colour. This feature was not found in any of the other specimens.

Genus ORODORIS.

This genus, which Bergh regards as allied to *Miamira*, has the oval shape, wide mantle-margin, and tripinnate branchiæ of an ordinary Dorid. The dorsal surface bears ridges and tubercles. The mouth-parts show some affinity to *Chromodoris*. There is a labial armature composed of bent rods, and the rhachis of the radula presents thickenings. The innermost teeth are denticulate on both sides, the next few on the outer side only, and the rest are smooth.

ORODORIS MIAMIRANA B.

[Bergh, "Neue Nacktschnecken," Jour. Mus. Godeffroy, Heft viii. 1875, pp. 67-71.]

One specimen from New Britain, kindly given me by Dr. Willey. It is, as preserved, of a uniform olive-green, with a few white spots on the foot and underside. The length is 58, the breadth 32, and the height 26 mm. The foot does not project beyond the mantle; it is deeply grooved in front and is broad, measuring 15 mm. across without counting the margins, which are turned inwards. The dorsal surface is arched, and the greater part of it is covered with composite tubercles. Over the head and round the edge of the mantle are many smallish tubercles roughly arranged in three rows. There is one large tubercle somewhat resembling the terminal lobe of *Miamira* over the tail, but no corresponding formation at the other end. Down the middle of the back runs a thick ridge, in which is set the large branchial opening. It bears six tubercles, one rather small one between the rhinophores, then two more small ones, followed by two large ones; then comes the branchial pocket, and behind it is another large tubercle. From this central ridge three transverse ridges, also composed of compound tubercles, run to the sides. The branchial pocket has a raised rim roughly circular but wavy in outline. Bergh gives the branchiæ as 7; in this specimen there are three on each side, an open space behind, and in front a very broad plume with a small accessory plume at its side. The anal

papilla is very large and connected with the front branchia by a membrane, from which an accessory membrane runs to the accessory branchia. The rhinophores are protected by raised tubes about 4 mm. high and covered with tubercles. The external opening of the mouth is unusually large. On each side of it is a conical well-developed tentacle pointing laterally.

The internal organs correspond with Bergh's description. There is a moderately large stomach with membranous walls, almost entirely enclosed in the liver, there being no dilatation whatever in the digestive tract before it enters this organ. Within the liver the cavity of the stomach measures about 6 mm. across, and the intestine when it issues is nearly the same size.

Genus MIAMIRA.

This curious form is of very uncertain affinities. Its elongate shape and labial armature seem to ally it with *Chromodoris*. But the teeth are uniform and hamate, without denticulations, the back bears ridges and tubercles arranged in a regular pattern, and the branchiæ are tripinnate. A unique character is presented by the lappets on the mantle-edge, with gill-like lamellæ on their underside.

MIAMIRA NOBILIS B.

[Bergh, "Neue Nacktschnecken," Jour. Mus. Godeffroy, Heft viii. 1875, pp. 53-63.]

Two specimens from New Britain given me by Dr. Willey. In one (hereafter called the first specimen) the tubercles and lobes are much ampler and more elaborately divided than in the other (or second specimen), so perhaps the two forms correspond to the typical species and variety described by Bergh. But the colour of both is the same—olive-green with a few white spots on the lower parts, and there is no difference to speak of in size. The length is 40 mm., the breadth 14, and the height 18. Down the middle of the back runs a ridge which bears obscure indications of being three ridges fused into one. It is about 6 mm. high in the first specimen, and 2 mm. in the second, and in both bears four tubercles. From the point where these tubercles arise, transverse ridges run at right angles to the side of the body and terminate each in a lateral lobe. The mantle-border is marked by a double ridge. There is a veil-like lobe over the head, which is trifid in both specimens, and another over the tail, which in the second specimen is small and simple, but in the first very large and studded with many accessory tubercles. At the sides of the body are four lobes, three in front of the branchiæ and one behind. The lateral and terminal lobes bear lamellæ on their underside in both specimens, but in neither are there any under the head-lobes. The branchial pocket is at the end of the dorsal ridge, raised and irregularly tuberculate. In the first specimen there is a very

large posterior tubercle. The openings of the rhinophores have slightly raised but smooth edges; the rhinophores themselves are long, straight, and thin, and bear about 30 perfoliations. The tripinnate branchiæ appear to be nine in number, but are so deeply cleft that it is hard to say how large a group should be taken as the unit. The foot is narrow and not very clearly marked off from the head; it is distinctly but not deeply grooved in front. The internal anatomy is as described by Bergh. Both the labial armature and the radula are bright yellow. The former consists of small rods, straight or bent, but in all cases hooked at the end and not bifid. The teeth of the radula are somewhat irregular in shape, but no denticulations are discernible; the innermost teeth close over the rhachis. The œsophagus widens out into a distinct dilatation before entering the liver.

EXPLANATION OF THE PLATES.

PLATE XXIII.

- Fig. 1. *Chromodoris reticulata* (p. 386). Anterior end, showing relations and proportions of head, foot, and mantle. *a*, ridge connecting head and foot; *b*, groove in anterior edge of foot; *m*, mouth.
- Diagram of the arrangement of the gills, the positions of which are shown by transverse sections of their bases: *a*, anus.
 - A single gill cut across, showing *r.*, rachis; *b.v.*, blood-vessels; and *p.*, portions of three of the pinnæ borne on the sides of the rhachis.
 - Portions of the radula. *a*, central teeth; *b*, the form of the majority of the teeth; and *c*, those intermediate in shape and position between *a* and *b*.
 - The alimentary canal. The liver is cut away and the stomach laid open.
- | | | |
|--|--|--|
| <i>b</i> . Buccal mass. | | <i>sal.</i> Salivary gland of right side. |
| <i>g</i> . Gills. | | <i>st.c.</i> Thin-walled anterior diverticulum of stomach. |
| <i>l</i> . Cut surface of liver. | | <i>st.m.</i> Muscles in stomach-wall. |
| <i>ld</i> . Ducts of liver opening into stomach. | | |
- C. sykesi* (p. 387). A living example.
 - C. cavæ*, from life (p. 388). *m*, edge of mantle; *f*, edge of foot.
 - Diagrams of the arrangement of the gills. *a*, from an example which had 16 gills; *b*, from one with only 12.

PLATE XXIV.

- Fig. 1. *Chromodoris annulata* (p. 389). Central teeth of radula.
- Diagram showing positions of bases of gills: *a*, anal papilla.
 - A living example. The purple border of the mantle is continuous all round, but is in this case hidden in places by the folding down of the free mantle-edge.
 - C. elizabethina*, var. *africana* (p. 392).
 - C. nigrostriata* (p. 394), dorsal view.
 - Side view of the same. (The number of branchiæ was in reality seven, not nine as here depicted.)
 - C. lineata* (p. 396). Teeth of radula: *a*, from outer, and *b*, from central part.
 - C. flava* (p. 399). Living specimen. *a*. Anterior corners of foot, which may or may not project beyond mantle-edge (*cf.* fig. 9).
 - Ventral view of the same showing narrow foot with its prolonged anterior corners and transverse groove, and proportions of head and mantle.



Crowland, del.

Huth sc et imp

1-5. CHROMODORIS RETICULATA. 6. C. SYKESI. 7, 8. C. CAVÆ.



C Crossland, del.

Huth, sc et imp.

1-3. CHROMODORIS ANNULATA. 4. C. ELIZABETHINA.
 5, 6. C. NIGROSTRIATA. 7 C. LINEATA. 8 9. C FLAVA

