

THE GENUS DOLABELLA

by

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With 16 text-figures

Diagnosis. Aplysiidae of conical form, narrower in front, wide and obliquely truncate behind. Integument more or less warty, the warts bearing villi; warts and villi being wholly retractile. Parapodia united, save for a dorsal slit; the free lobes covering the slit leave two conspicuous respiratory openings, one at the posterior and one at the anterior end. The posterior respiratory opening, corresponding to the mantle-siphon, lies about in the middle of the posterior disc, the anterior opening outside the disc, somewhat in front of the disc's anterior margin. Shell solid, hatchet-shaped, the free spire calloused. Penis armed or unarmed. Radula with inconspicuous, often reduced rhachidian tooth and many laterals with long simple cusps.

Short history of the genus

Though most authors consider it, with Cuvier (1804) a discovery of Péron, that Rumphius' animal of plate X belongs to the shell of his plate XL, this seems not true. If we compare the text on p. 38 on *Limax (marina) tertia* with that on p. 122-3 on the *Opercula callorum*, it is clear that Rumphius was speaking of the same species of mollusc, that the only mistake Schijnvoet, the editor of Rumph's M.S., made, was that he did not refer to p. 38 when Rumphius on p. 122 remarked: "zijnde een slach van den *Limax marina*". The "third operculum" lies in the flesh and looks like a ham ("schonkje van een varken", which may be a scapula, as some have interpreted it, or a ham, as Rumphius himself said on p. 38). All details on the taste and smell and on the habitat are the same on p. 38 and p. 123. We may conclude that Rumphius intended the same animal, though the description of the animal and that of the shell were each inserted in a separate chapter of the book by Schijnvoet. The further history of the genus will be clear from the following short summary, given while so many old types were so often renamed. Further literature will be found in the geographical section.

Limax marina tertia Rumphius, 1705, p. 38, pl. X no. 5 (animal from Ambon).

Derde slach van de Opercula callorum (resp. derde van de vijfde soort van klipkleevers) Rumphius, 1705, p. 122-3, pl. XL fig. N (shell from Ambon).

Doris verrucosa Barbut, 1783, pl. IV fig. 1 (this is Rumphius' pl. X fig. 5, the text (p. 36) describes a European *Doris*; non *D. verrucosa* Linné, 1758, p. 653, which is an *Oncidium*? and a *Phyllydia verrucosa*).

(*Patella*) *Scapula* Martyn, 1786, vol. III fig. 99 (a shell from Ambon; for the date see Dall, Proc. U.S. Nat. Mus., vol. 33, p. 187).

Patella auricularia Solander, 1786, p. 154 (name for Rumphius' shell pl. XL fig. N, fide Iredale, 1929, p. 292).

Dolabella callosa Lamarck, 1801, p. 62 (name for Rumphius pl. 40, fig. 12) (sic! I have only seen editions of the "Rariteitkamer" with the *Dolabella* shell on pl. XL numbered N, never 12).

Dolabella ... Cuvier, 1804, p. 437, pl. 29 fig. 1 (an animal, collected by Péron at Ile de France, described and figured).

Dolabella rumphii Cuvier, 1817, p. 398 (name for the foregoing animal, which Cuvier identified with Rumph's animal and shell, though he wrongly gives pl. X fig. 6, instead of fig. 5).

Dolabella peronii Blainville, 1819, p. 395 (name for Péron's animal after Cuvier's description, and for Rumph's shell which, on Péron's authority, Blainville considers identical with that of Péron's animal).

Dolabella rumphii Blainville, 1819, p. 395, non Cuvier! (name for Rumph's animal pl. X fig. E or 5, which Blainville does not regard identical with Rumph's shell, nor with Péron's animal as described by Cuvier).

Dolabella rumphii Van Hasselt, 1824, p. 54 (description of an animal from Peperbaai, Java. The drawing after the living animal was later reproduced by Rang and is still extant in the Leiden Museum. An animal collected by Van Hasselt and preserved in the same Museum could be examined).

Aplysia (Dolabella) hasseltii Rang, 1828, p. 49, pl. XXIV fig. 1 (after the drawing by Van Hasselt).

Aplysia dolabella Dufo, 1840, p. 202 (a name for Rumph's animal, after Lamarck's generic name).

Dolabella rumphii var. *maculosa* Bergh, 1905, p. 18 (new name for *D. hasseltii*).

etc. etc.

Aplysia (Dolabella) gigas Rang, 1828 (shell only, the animal is described hereafter).

The other specific names, as will be shown all synonyms of *Dolabella scapula* (Martyn), are given in the geographical section. The following authors have given a survey of the genus: Rang (1828), Sowerby (1868), Mazzarelli (1893), Pilsbry (1896), Clessin (1899), Bergh (1905), MacFarland (1918).

It is the author's opinion that the genus *Dolabella* contains only two species, viz., *D. scapula* (Martyn) and *D. gigas* (Rang).

The Species of the Genus *Dolabella*

Dolabella scapula (Martyn) (= *D. agassizi*, *andersoni*, *auricularia*, *callosa*, *dolabella*, *ecaudata*, *hasseltii*, *hemprichii*, *neira*, *peronii*, *rumphii*, *teremidi*, *tongana*, *truncata*, *variegata*). This species can be distinguished from the following by the shell, which here has a heavily calloused spire, and by the penis which is unarmed. The glans is rather short, foliate (bearing two folds of skin, a smaller and a broader, each on one side of the spermatic groove).

Dolabella gigas (Rang). This species was till now only known as a shell, which bears on the spire a very large, thin, erect, saucer-shaped accessory plate; only the apex of the shell bears on its inner side a small lump of callus. The penis of this species is armed, having small tubercles bearing spines, arranged on longitudinal folds of the praeputium, especially on the heavier folds bordering the spermatic groove. The glans penis has the same spine bearing tubercles till about half way its length and especially on the side opposite the spermatic groove. The glans is long, thin and conical and does not show the side flaps of the preceding species.

Material examined (A = Museum Amsterdam, L = Museum Leiden):

Dolabella gigas (Rang)

- 1 specimen, Moluccas, 1858, leg. Van der Hucht (A).
- 3 shells, idem, idem (A).
- 1 shell, Moluccas (A).
- 1 shell, Indian Ocean (A).
- 3 shells, without locality (1A, 2L).
- 5 shells, Mauritius (A).

Dolabella scapula (Martyn)

- 3 specimens, Telok Dalam, Nias, leg. Dr. J. P. Kleiweg de Zwaan (A).
- 1 specimen, Sabang, leg. G. Herman (A).
- 1 specimen, Java (probably Peperbaai 1823), leg. Van Hasselt (L).
- 1 specimen, Island Hoorn, Bay of Batavia, leg. Dr. J. Verwey et W. S. S. van Benthem Jutting (A).

- 1 specimen, Bay of Batavia, leg. Dr. C. Ph. Sluiter (A).
- 1 specimen, Island Kerkhof, Bay of Batavia, leg. Jhr. W. C. van Heurn, 31-VII-1927 (A).
- 1 specimen, Pulu Panggang, Thousand Islands, Java Sea, leg. Dr. J. D. F. Hardenberg (A).
- 1 shell, Tjilaut Eureum, S. Coast of Java (Geol. Inst. Amsterdam).
- 3 specimens, Sailus Ketjil, Paternoster Islands, close to reef (Stat. 37 Siboga Exp., cf. Bergh, 1905, p. 18) (A).
- 2 specimens, Bay of Bima, near South fort and Bima anchorage (Stat. 47 Siboga Exp., cf. Bergh, 1905, p. 13) (A).
- 1 specimen, Buka or Cyrus-bay, south coast of Rotti Island (Stat. 299 Siboga Exp., cf. Bergh, 1905, p. 18) (A).
- 4 specimens, Pepela-bay, east coast of Rotti Island (Stat. 301 Siboga Exp., cf. Bergh, 1905, p. 13) (A).
- 2 specimens, Sanana-bay, east coast of Sula Besi (Stat. 193 Siboga Exp., cf. Bergh, 1905, p. 18) (A).
- 1 specimen, Moluccas, 1858, coll. Van der Hucht (A).
- 5 shells, Moluccas, don. G. de Serière (A).
- 2 shells, Moluccas (A).
- 1 specimen, Ambon, leg. Forsten (L.).
- 1 specimen, Bay of Ambon, leg. Ludeking (L).
- 1 specimen, Ambon, leg. Bleeker (A).
- 1 shell, Ambon, leg. Hoedt (L).
- 1 specimen, Banda, leg. Van de Velde (A).
- 1 specimen and 1 shell, New Guinea, leg. Dr. H. Macklot (L).
- 1 shell, Waigeu, ex museo F. van Heukelom (A).
- 1 specimen, Biak Island, near New Guinea, 1915, leg. W. K. H. Feuilleateau de Bruyn (A).
- 2 specimens, Kaimana, Southwest New Guinea, 133° 44' E. 3° 41' S., reef, leg. L. Hendriks, 28-VIII-1910 (A).
- 4 specimens, Pulu Sanguisiapo, Tawi-Tawi Islands, Sulu Archipelago (Stat. 93 Siboga Exp., cf. Bergh, 1905, p. 19) (A).
- 1 shell, Philippine Islands (L).
- 1 specimen, probably Japan (Mus. Berlin).
- 2 specimens, Tiop, Bougainville Island, Solomon Islands, 3-4-XI-1909, leg. H. Schoede (Mus. Berlin).
- 1 shell, New Caledonia (A). N.B. This specimen was labelled: "*Dolabella sulcata* Bernardi, Nw. Caledonia, ab auctore". As far as I know this species was never published by Bernardi, the name is only a museum name. The shell is that of the common *D. scapula*.
- 2 shells, Indian Ocean (L).
- 4 shells, Mauritius (2A, 2L).
- 2 shells, Mauritius, coll. Schepman (A).
- 3 specimens, Island Inhaca near Lorenzo Marquez, July 1934, leg. Prof. Dr. C. J. van der Horst (A).
- 1 specimen, idem, no date (A).
- 6 specimens without locality (5L, 1A).

Dolabella gigas as a separate species

History of the species.

Aplysia (*Dolabella*) *gigas* Rang, 1828, p. 48, pl. III fig. 4, after the shell only, from the "Mer des Indes".

Dolabella gigas Deshayes, 1863, p. 53, mentioned from Ile de la Réunion.

Dolabella gigas Sowerby in Reeve, 1868, XVI, pl. I fig. 1 (new figures after specimens from "Indian Seas"; in Cuming's collection there were two young shells, probably this species, from the Red Sea).

Dolabella gigas Liénard, 1877, p. 53 (Mauritius).

Dolabella gigas Martens, 1880, p. 306 (Von Prof. Möbius lebend auf Mauritius gefunden. Bis 30 cm lang, violett und grau, mit konischen an der Spitze abgerundeten einfachen Warzen, während die folgende Art olivengrün ist, mit spitzen Warzen, worauf spitze Papillen stehen. Beide stossen violetten Schleim aus dem Mantelspalt aus).

Dolabella gigas Pilsbry, 1896, p. 152, pl. 65 figs. 4-6. These figures are new, but Pilsbry does not mention their locality.

Geographical distribution (see map, fig. 16): Mauritius (b), Red Sea (a), Moluccas (c) (described below).

Description of the animal of *Dolabella gigas*.

As mentioned above we could investigate one specimen of this species from the Moluccas (1858) in our Museum from the Van der Hucht collections. It was compared with MacFarlands beautiful description of his *D. agassizi*.

External characters.

General form and colour. As my figure 1 shows, the body in its preserved condition has the same outlook as *D. scapula*. The body carries a lot of tubercles, which in their centre clearly show the tip of the retracted part. According to Martens (1880, p. 306) these appendages are simple (not branching as in *D. scapula*).

They are more crowded on the disc than on the rest of the body. Like in *D. scapula* some parts of the skin are quite smooth and even. The skin between the nodosities looks like shagreen leather, a curious feature which I did not see in any specimen of *D. scapula*. In the smoother parts of the skin, however, these very small shagreen tubercles may disappear also; they may be present or not on the larger nodosities. The margin of the disc is villose, its villi are not all and not completely retracted. The surface of the foot is smooth; as usual in the genus, the foot shows no clearly defined margins, only in front there is a groove between the foot and the head, while its right anterior corner has a tentacle-like form, as the figure shows. The anterior tentacles are strongly contracted, ear-like. The likewise contracted rhinophores stand close together and only show a small groove on their top, not continuing along the whole length. The

body colour is that of all *Dolabella*'s after preservation in alcohol, a dirty yellow, but the remains of dark pigment blotches are clearly visible here and there, as the figure shows.

The length of the preserved body is 108 mm, its greatest transverse diameter 64 mm, its greatest height about 40 mm. The posterior disc is 54 mm broad and 51 mm long. The total length of the epipodial slit is

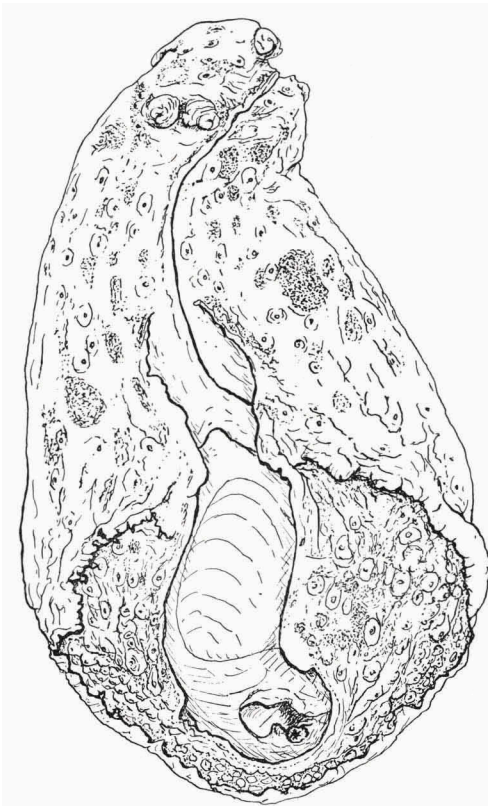


Fig. 1. *Dolabella gigas* (Rang) from the Moluccas, from above. Natural size.

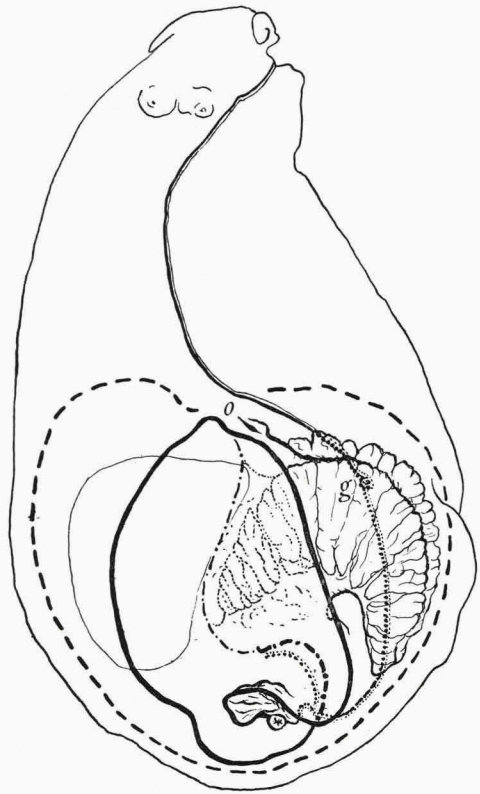


Fig. 2. *Dolabella gigas* (Rang), diagrammatically to show the pallial complex. For explanation see text. *o*, osphradium; *g*, genital pore.

60 mm (i.e., 0.5 of the body length), beginning about 41 mm (i.e., 0.38 of the body length) from the anterior end of the body and 26 mm from the rhinophores. My figure 1 shows the epipodial slit continuing far into the disc. In this figure the posterior part of the disc is shortened in perspective and, moreover, it is strongly contracted. Smoothing out as far as possible the corrugations one can measure a distance of 25 mm between

its posterior border and the posterior end of the body, so that we may say, that the posterior opening lies in the centre of the disc. The epipodial slit is widely open. I do not see anything of interlocking grooves and ridges, nor of the low sharp-edged fold round the posterior opening described by MacFarland.

The skin is not so very thick, in the middle of the foot $1/2$ mm, thickening in front till 2 mm and behind till 5 mm.

The pallial complex. This has been drawn in figure 2. Unhappily it was, of course, only after I had removed and studied the shell, that I recognized this animal to be *D. gigas*. So the triangular shell-foramen shown in figure 1 has been reconstructed after the traces it had left on the surface of the shell. Likewise, the mantle-flap, which encloses the shell, is shown in figure 2 shrunk after the removal of the shell. Originally it was larger. Here it is indicated by a heavy line, ending behind in the mantle siphon which contains the anal opening in its wall. A line of dots and stripes running over the middle of the mantle indicates the place where it is fastened to the bottom of the cavity. The right half is free and covers the ctenidium (especially when the shell is present, which in our figure is not the case), the left half's underside is one with the bottom of the mantle cavity. The triangular shell-foramen in the roof of the mantle, drawn in figure 1, has not been refigured in figure 2. The left half of the mantle contains in its widened hinder part the "saucer-like appendage" of the shell, which is typical for this species. The ctenidium, as may be seen in figure 2, has the common form (cf. MacFarland). Its osphradium (*o*) is seen, as a little slit, near its anterior end. The circumference of the mantle cavity is here indicated by a broken line. The left part of its floor (partly covered by the mantle) contains the kidney, indicated in figure 2 by a fine continuous line. I could not find the renal pore. The floor of the mantle cavity right of the ctenidium contains the genital pore (*g*), from which the genital groove runs forward to the right side of the head, where the penis lies invaginated into the body cavity. As is well known, this external genital groove consists of two small folds, which form a gutter, through which, as Hirase (1929, p. 110) observed, the sperma as well as later on the spawn take their way. Curiously enough a somewhat narrower groove runs from the genital pore backward. In figure 2 it has been indicated by two dotted lines. As can be seen this groove branches on the fold of the saucer-like appendage, one branch following its outer contour, one ending into the siphon. As MacFarland showed, the knob formed by the saucer-like

appendage (or in *D. scapula* by the callus) serves the purpose of shutting the siphon when necessary. The use of the described accessory grooves is not clear, they may serve the excretion of some genital waste product. The floor of the mantle cavity right of the groove is glandular, likewise the free right part of the mantle.

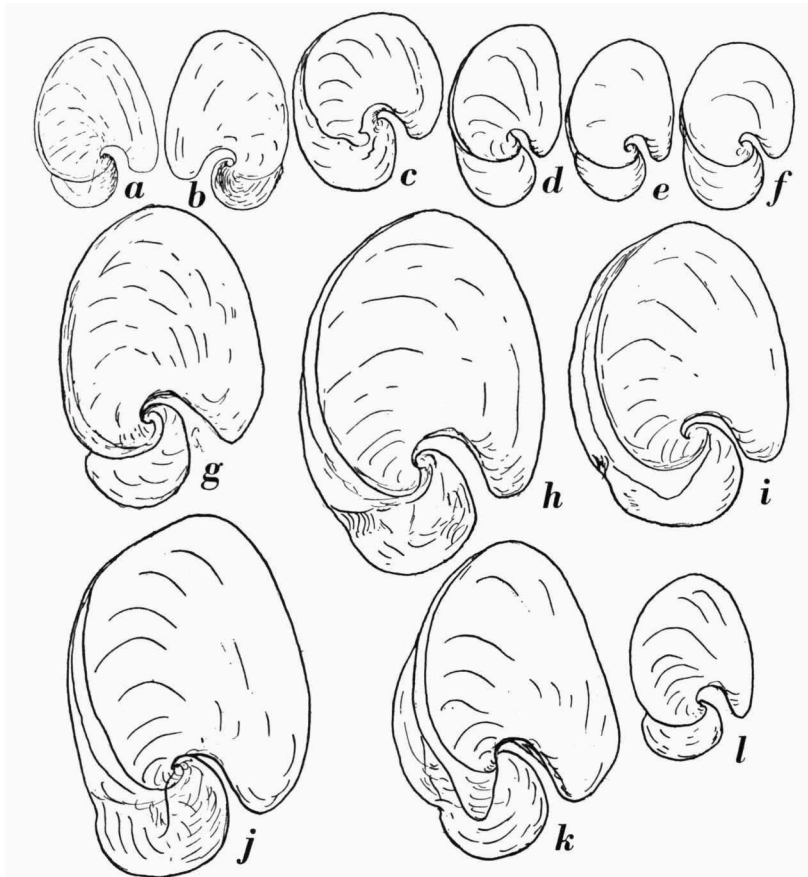


Fig. 3. Shells of *Dolabella gigas* (Rang). *a, b*, from the animal here described, Moluccas, 1858, Van der Hucht-collection; *a*, from above, *b*, from below; *c-f*, also from the Moluccas; *c-e*, belonging to the Van der Hucht-collection; *g*, without locality; *h-l*, from Mauritius. $\times 1\frac{1}{2}$.

The shell (see figure 3 *a* and *b*) is conspicuous in this species, because of the mentioned saucer-like appendage, instead of a callous knob. A small callus is present on the inner side of the apex. The calcareous layer is of the same size as the cuticular portion, it is more solid than in *D. scapula* and beautifully porcelain-white within. Pilsbry (1896, p. 152) gives a

very good description of it. Our shell (fig. 3 *a* and *b*) has a length of 46 mm and a breadth of 32 mm.

To show the great variation of this organ, the figures 3 *c* to *l* are given, after loose shells in our Museum.

The penis. As in all Aplysiidae the penis is invaginated at the right side of the head under the right anterior first tentacle. The genital groove runs from the genital pore (fig. 2 *g*), which, as said, here lies under the anterior part of the ctenidium, along the midline of the back and then to the right, entering the penial opening. The groove continues along the wall of the praeputium (fig. 4). The praeputium consists of a narrow, smooth, simple part and a widened part, which last contains the

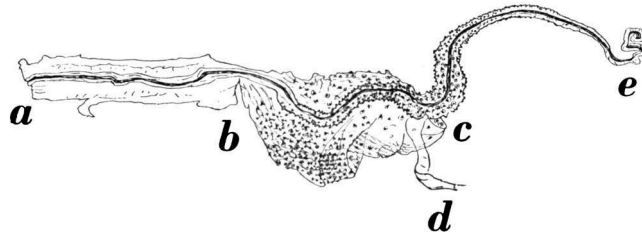


Fig. 4. *Dolabella gigas* (Rang). The penis and its praeputium. *a*, the opening in the body wall; *a-b*, the narrow, smooth part of the praeputium; *b-c*, the wider, folded and armed part of the praeputium; *c-d*, the retractor muscle; *c-e*, the glans penis. Natural size.

glans and ends in the retractor muscle. This wider part shows many longitudinal folds and is covered with tubercles bearing small conical spines on their top. This armature is especially strong on the two folds bordering the spermatic groove. It continues along the free glans to about half way its length, especially on the side opposite the groove. As the figure shows, the glans is long, thin and conical and does not show the side-flaps, which are described for the other species. The two parts of the penis sheath are each about 30 mm long, the glans has a length of 50 mm.

Internal characters.

Comparing this animal with the description given by MacFarland for his *D. agassizi*, I can only add:

The mandibles are 8½ mm long and 4½ mm broad, their microscopical structure as described by MacFarland.

The radula is more than 12 mm long and 14 mm broad. I counted more than 55 rows and till 203 teeth on one side in the 28th row. The form of

the teeth is best understood from fig. 5. It is clear that the middle tooth looks like that figured by Bergh for *D. rumphii*, but it shows no denticles. It differs somewhat in the different rows. This specimen is a good example of the variation in the radula. If we compare the first left and the first right tooth, we see that the first right resembles much more the middle tooth, while the left has a heavier denticle. It is likewise clear from our figure that each tooth, as might be expected, agrees with its

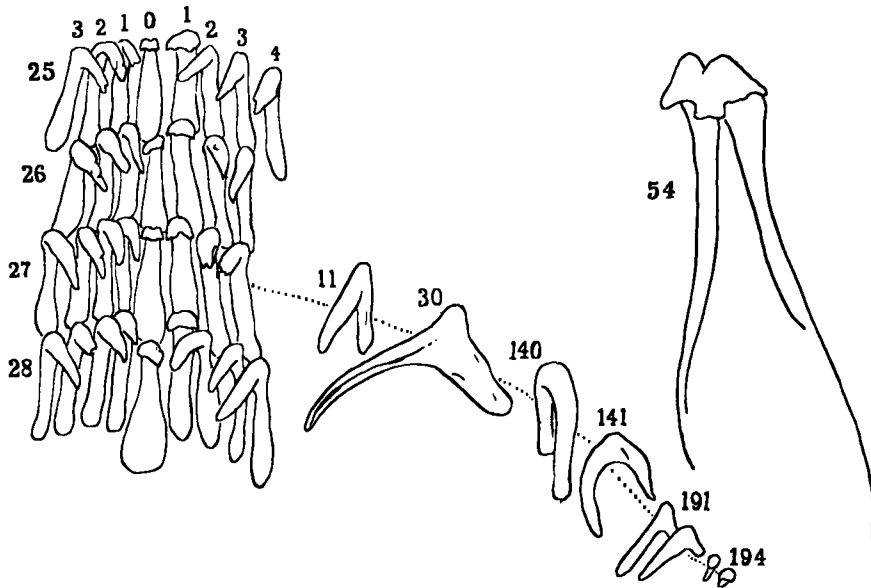


Fig. 5. *Dolabella gigas* (Rang). Radula. The median part of the 25th to the 28th row of teeth. Some of the side teeth of the 27th row, indicated by their number, are given to show their form in different aspects. As the middle tooth of *D. scapula* seems to form a point of discussion among the authors, I have given here the median tooth of one of the last (54th) rows, as this is the least worn, somewhat more enlarged than the others, to show the irregular form of the blade.

predecessors and its followers in a longitudinal direction. For comparison I have given a larger figure of one of the last, least worn, middle teeth, to show the exact form of the rather irregular blade.

The layer of palatal spines seems to detach quite easily from the palatal folds, for I could only find some traces of it, after much searching. These showed the same microscopical structure as that described by MacFarland.

The rest of the intestine agrees with MacFarland's description, though some features showed variations which most probably were individual, e.g., the form and the direction of the folds of the oesophagus and the form of the tooth bases in the stomach.

The species *Dolabella scapula* (Martyn)

History of the species.

For the earlier history see the first page of this article, where a short history of the genus is given. As it is the author's opinion, that, except for *D. gigas*, all the other animals form but one species, which must be called *D. scapula*, the names there mentioned, except *D. gigas*, can be regarded as synonyms of *D. scapula*. The further synonyms are found in the geographical section here after, they are: *D. agassizi*, *andersoni*, *auricularia*, *callosa*, *dolabella*, *ecaudata*, *hasseltii*, *hemprichii*, *neira*, *peronii*, *rumphii*, *teremidi*, *tongana*, *truncata*, *variegata*.

Description of the animal of *D. scapula* as compared with that of *D. agassizi* by MacFarland and of *D. gigas* here above.

External characters.

General form and colour. I am first describing here the three animals captured by Prof. Kleiweg de Zwaan at Telok Dalam, island Nias. They look like the figures given by Rang for *D. hasseltii* (1828, pl. XXIV fig. 1) and those of *D. hasseltii* in the Astrolabe Atlas (Quoy & Gaimard, 1832, Moll., pl. 23 fig. 1) both in the form and in the many fleshy processes. The animals are beautifully preserved. All three show brown blotches irregularly scattered over head, back and disc, as my fig. 6 shows. The tentacles are auriculate, the rhinophores have a slit along their upper outer half. The retractile cirrhi or villi are found everywhere, except on the foot, even on the tentacles and rhinophores. One can distinguish larger, often multiple or branched processes, mostly on tubercles, and smaller, simple ones, scattered between these and also on tubercles. In all three specimens I see a pair of large and conspicuous branched cirrhi to the right and the left of the anterior opening of the mantle slit, but their specificity seems very doubtful. For the rest I do not see any regularity. There are tubercles on the head, between the rhinophores, which are rather wide apart, and everywhere on the back. On the disc they seem to be more crowded. The discs are all three strongly corrugated by contraction. Comparing these specimens with that of *D. gigas* described above, which has a much thinner skin (here it ranges from 4 mm, in the middle of the foot, to 8 mm, in front, and till 12 mm and more, behind), it seems to me, that in *D. gigas* there are less small cirrhi, while the tubercles are more numerous and more conspicuous. Like in *D. gigas* the fringe of the disc here consists of many irregular lobes. In fig. 6 I have drawn the largest animal after the mantle cavity had been laid open. The white ring round this cavity

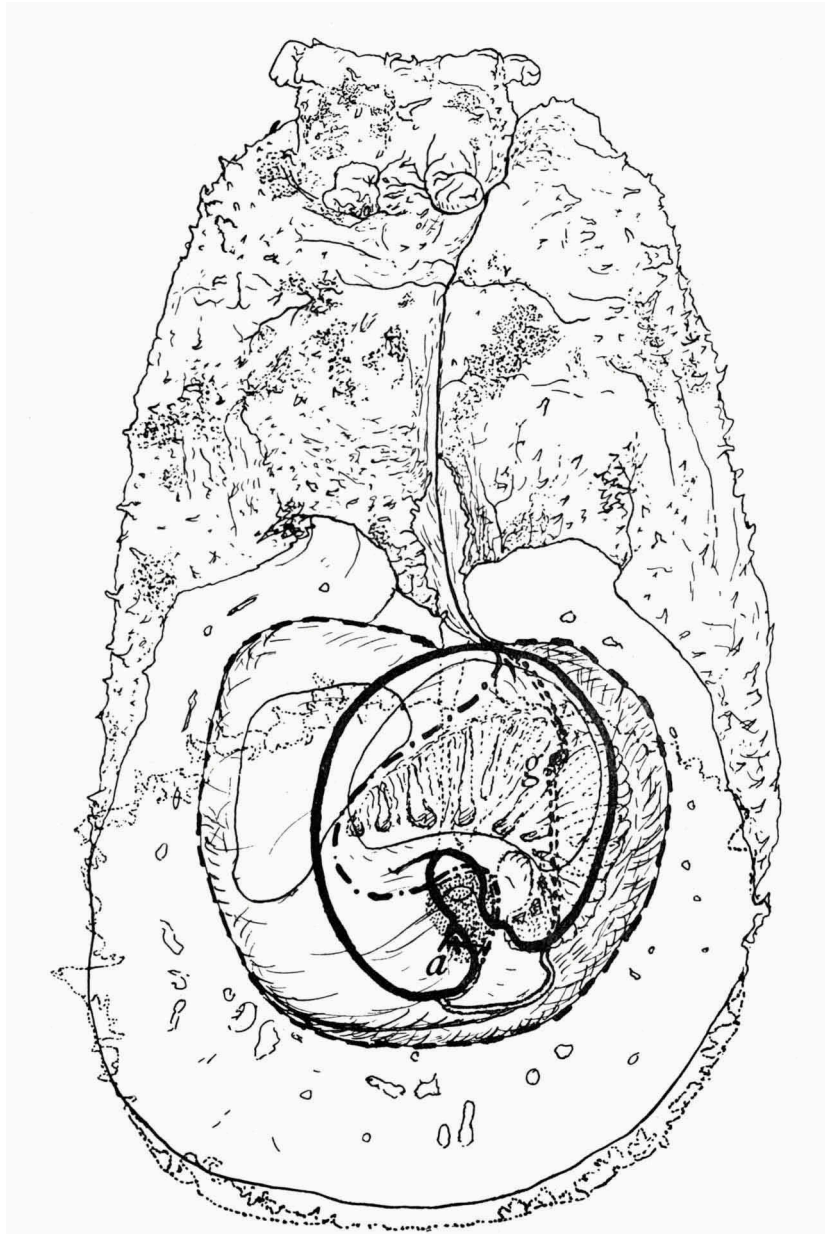


Fig. 6. *Dolabella scapula* (Martyn). The 153 mm long animal collected by Prof. Kleiweg de Zwaan at Nias. The disc has been cut away, so that the mantle cavity lies open. For further explanation see text. *a*, anus; *g*, genital opening.

shows the very thick skin in transverse section with its caverns. The contour of the disc, as it originally was, has been drawn in a fine dotted line.

The length of the three animals is 153, 131 and 120 mm respectively, their greatest breadth 100, 76 and 77 mm. The disc is long 67, 60 and 60 mm and broad 87, 72 and 64 mm. The total length of the epipodial slit is 60 mm (i.e., 0.39 body length), 47 mm (i.e., 0.36 body length) and 53 mm (i.e., 0.44 body length). The distance from the anterior end of the slit to the rhinophores is 38, 34 and 31 mm, and to the anterior tip of the body 55 mm (i.e., 0.42 body length), 57 mm (i.e., 0.43 body length), 46 mm (i.e., 0.38 body length). The posterior opening of the slit lies in the first species 23 mm from the anterior border of the disc and 43 mm from the posterior border. In the second specimen these measurements are 20 and 40 mm and in the third about the same. For closing the slit, the middle part of the left border lies obliquely with its smooth under surface over the smooth and oblique upper surface of the right border, exactly fitting together over a surface of about 50 mm breadth. The anterior opening is oval with narrow, somewhat upstanding borders. The thinner inner borders of the slit pass round the oval posterior opening, which they can close, as I see in my 131 mm specimen. This posterior opening lies exactly above the siphon of the mantle.

The pallial complex. In the same figure 6, I have drawn this, somewhat diagrammatically. The heavy broken line gives the limits of the mantle cavity. As the figure shows, the skin surrounding the cavity is very thick, from 7-23 mm, having a spongy texture, the principal holes of which were drawn. The heavy continuous line gives the contour of the mantle, which is fastened with its left half to the bottom of the cavity, from the thick continuous line to the line of dots and stripes. The part right of this line is free and covers the gill. This mantle contains the shell. The shell foramen has been drawn in a thin continuous line; through this opening the shell is visible. The callous spire of the shell is anchored in the bottom of the mantle cavity; above it I have indicated by a dotted area the "thickening in the floor of the pallial chamber", a disc or button, mentioned by MacFarland, with which the animal might close the posterior mantle opening. Above it the free mantle borders rise to form the siphon, which in its posterior portion contains the anal opening, here indicated by a small cross (*a*). The kidney lies in the left part of the floor of the mantle cavity, it has been indicated in the drawing by a thin continuous line; its right angle reaches under the left part of the mantle. I did not see the renal pore. Above the kidney, in the left anterior corner of the

mantle cavity, lies the pericard. The part of the mantle cavity under the mantle flap may be called the gill cavity; it is limited on the left by the heavy line of dots and stripes and on the right by the heavy broken line. Like in *D. gigas*, there is a system of grooves on the floor of the mantle cavity. These are limited by small folds of skin, here indicated by double lines. One of these grooves limits the "button". A second runs from the genital opening (*g*), which lies under the anterior part of the gill to the posterior border of the mantle. From the genital pore, the genital groove runs through the anterior opening of the mantle slit, along the back, to the right side of the head, where it enters the penis-opening. The free right part of the mantle, under the shell, is very glandular and of a dark brown colour. The floor of the mantle cavity, right of the grooves to the genital pore, is also very glandular (*Glandula Bohadschi*). Near the anterior entrance of the mantle cavity lies the osphradium, visible as a small cleft.

The other specimens here examined will be compared with each other and with the animals from the literature in the geographical section (see below), but a preliminary consideration of the variability of the external features may take its place here. According to me, the external characters show such wide variation, that it is impossible to distinguish species or even varieties among these animals. According to literature the colour is very variable and may change in the same animal from black or brown to green (Risbec, 1928, p. 45. See further under the heading: Figures and descriptions of living animals). The extraordinary thick and muscular skin allows of an endless variation in form and measurements in the same animal.

Figure 7 represents a section through the whole skin, not far from the disc, the section measuring 9 mm from the upper to the under surface. The upper surface, which is covered by an epidermis of cylindrical cells, shows large round glands, imbedded in the underlying tissue, resembling the glands described and figured by Froutin (1937, p. 78 seq. and pl. III fig. 31) and showing the same parallel fissures. The connective tissue is rather compact near the surface, becoming more loosely textured in the deeper layers. There is no regularity whatever, but the usual elements are present (cf. Hoffmann, 1939, p. 527 seq. and Froutin, 1937). Imbedded in the enormous mass of collagene fibres, the muscle fibres, often connected in bundles, are conspicuous. As the figures show, they may pass across the whole section, but this is not necessarily the case.

The under surface has no cylindrical epithelium, the cells seem to be rather of the flat type. Near it heavy transverse and longitudinal muscle

bundles are present. The lacunae shown in fig. 7 correspond to those figured in fig. 6 (on the cross section of the base of the removed parapodia).

It is clear, that such a thick layer (4-12 mm and more) of criss-cross fibres must be very elastic. The many muscles will allow for contraction in all directions. Moreover the water contained in the spongy texture must contribute to the elasticity and extensibility of the whole (cf. Jordan, 1901).

It will be necessary to know whether the presence or absence of the villi on the skin is a specific or subspecific character or so variable that it is of no importance. There have been described "species" of *Dolabella* with a smooth skin or with some small and low tuberculations as their specific character. Studying the many animals at my disposal, I did not find any without villi, tubercles or their remnants, which last both always gave the impression to be retracted villi. Of three animals from Inhaca, near Lorenzo Marques, two have clear and distinct villi, while the third has a smooth skin, on which only in some places rests of the villi can be found, especially on protected or less contracted parts of the skin.

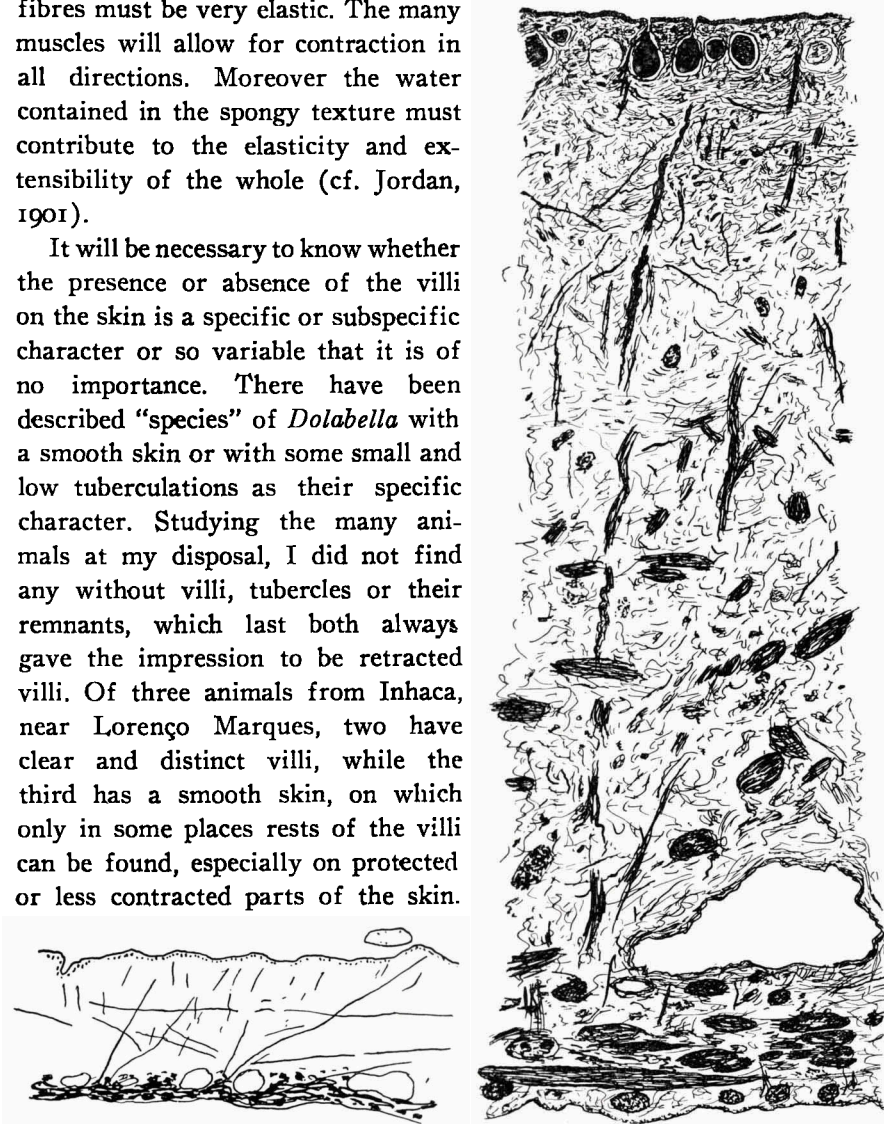


Fig. 7. *Dolabella scapula* (Martyn) from Kerkhof Island, Bay of Batavia. Left: section through the whole skin, not far from the disc (9 mm high); right: muscles in this part of skin (diagrammatical), at the right a villus-top, near the under surface lacunae and heavier transverse and longitudinal muscles.

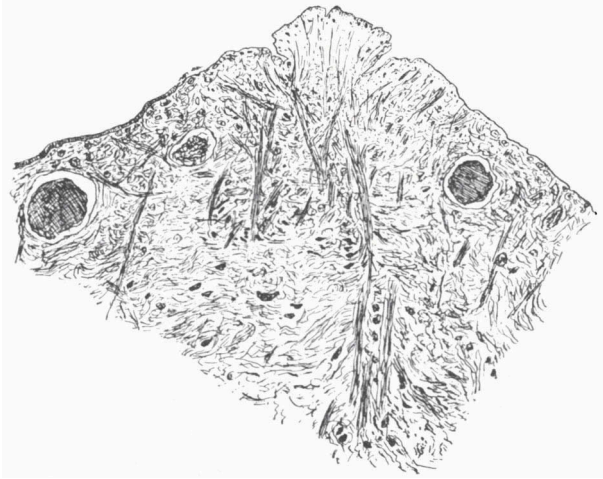


Fig. 8. *Dolabella scapula* (Martyn). Same piece of skin as fig. 7, section through a partly retracted villus.



Fig. 10. *Dolabella scapula* (Martyn). Same piece of skin as fig. 7, section through the skin in a place where obviously a villus was totally retracted.

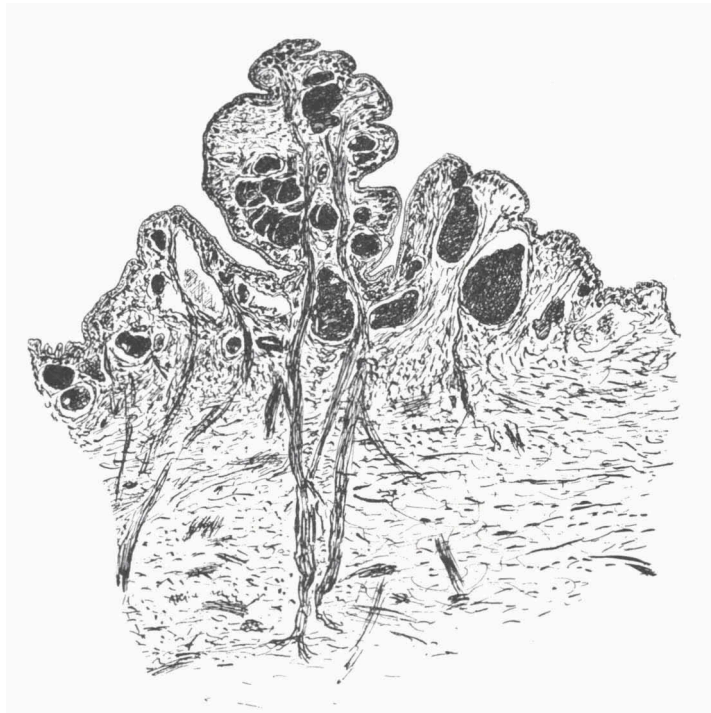


Fig. 9. *Dolabella scapula* (Martyn). Same piece of skin as fig. 7, section through a partly retracted villus.

It must be supposed, that some authors reporting a wholly smooth skin, have overlooked the indistinct and small rests of the tuberculations. I have the impression that, in the living animal, villi are always present, be it in greater quantity in one than in another animal (see below under the heading: The living animal; cf. Rang and Anonymus especially). These villi are very retractile, as has been reported already by the earlier authors (cf. Van Hasselt, Ehrenberg). On preservation they will be retracted more or less strongly, but, as said, even when very strong contraction takes place, remains are always visible. The question arises, however, whether these villi can be retracted so completely, that they disappear totally in the skin, which then looks quite smooth and even, in the places where they disappeared. Larger stretches of smooth skin in some animals suggest this question. Sections were made to find the answer. In fig. 9 a villus is shown in a partly retracted state. We see that it contains the common elements, some muscles extend through its whole length. The base of the villus, however, looks so narrow, that one doubts whether this "neck" really can extend in such a measure as to make room for the whole skin of the villus, which accordingly must smoothen out, leaving no wrinkles or folds in the epithelium. Jordan (1901) figures (fig. 3) a bubble of the skin which is suggestive of this possibility. Our fig. 8 gives another villus, more retracted, while in fig. 7 *b* a less retracted villus has been cross sectioned. The author awaited to see in the many sections through the skin the different stadia in the retraction of the villi, but he was disappointed in finding but one place in the skin, where one could suppose, that a villus had disappeared because of the compressed epidermis and the many muscles concentrated in that one place (fig. 10). In fig. 7 *a* the direction of the collagene fibres along the muscles in the upper part suggests their connection with the muscle in its inward and outward movement. In fig. 7 *b*, however, nor the invaginated part on the left, nor the villus on the right (in the sections where it meets the skin) are accompanied by strong muscles. Considering the very loose and changeable texture of the connective tissue, it seems possible, that the total disappearance of the villi really takes place: the elements of the tissue shifting until a sort of equilibrium or regular dispersement of the fibres is attained (cf. Jordan, 1901, fig. 3). Somehow, however, the form of the (often branched) villus must be preserved in the arrangement of the tissue, so that on relaxation of the muscles, or some other mechanical cause, the villus is formed again. This total retraction is yet a problem and the only way to solve it completely, is an investigation in the living animal.

We can only say, that we have no reason to suppose that the presence

or absence of villi is a specific character, tubercles are to be regarded as retracted villi. In the geographical section there are given more details about the many animals we could compare, there the variability of the villi in arrangement and state of preservation becomes very obvious.

The shell (fig. 11) is of the common form. In the 153 mm long animal from Nias it is 49 mm long and 38 mm broad. The cuticular portion is only some millimeters larger at the margin than the calcareous layer. The spire as usual with a heavily calloused smooth margin.

In figure 12 I have given the shells of most animals here examined, to

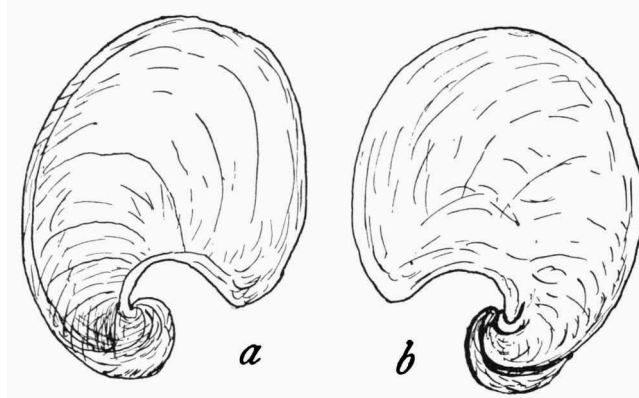


Fig. 11. *Dolabella scapula* (Martyn). The shell of the animal of fig. 6. *a*, from above, *b*, from below. Natural size.

show the variation. Figure 13 gives for the same reason the shells figured in literature under different specific names, but, according to me, all belonging to the one species *D. scapula*.

Internal characters.

Literature. Rumphius (1705, p. 123): shell lies in the flesh; Cuvier (1804, pp. 437-440): strong retractor muscles of the head region; Amaudrut (1886, p. 68): nervous system; Mazzei & Zuccardi (1892): first detailed anatomy; Gilchrist (1895, p. 264): pallial complex; Pilsbry (1896, p. 150): radula of *D. californica*; Eliot (1900, p. 516): some remarks; Thiele (1900, p. 251): radula; Farran (1905, p. 354): radula; Bergh (1905, pp. 13-20): detailed anatomy; Bergh (1907, pp. 15-19): detailed anatomy; Vayssi re (1906, p. 71): radula; MacFarland (1918): very detailed description; Risbec (1928, p. 45): important details, figures situs viscerum; O'Donoghue (1929, pp. 33-34): radula and mandibles; Hirase (1929, pp. 106-108): genital organs; Pruvot (1934, p. 45): buccal armature of

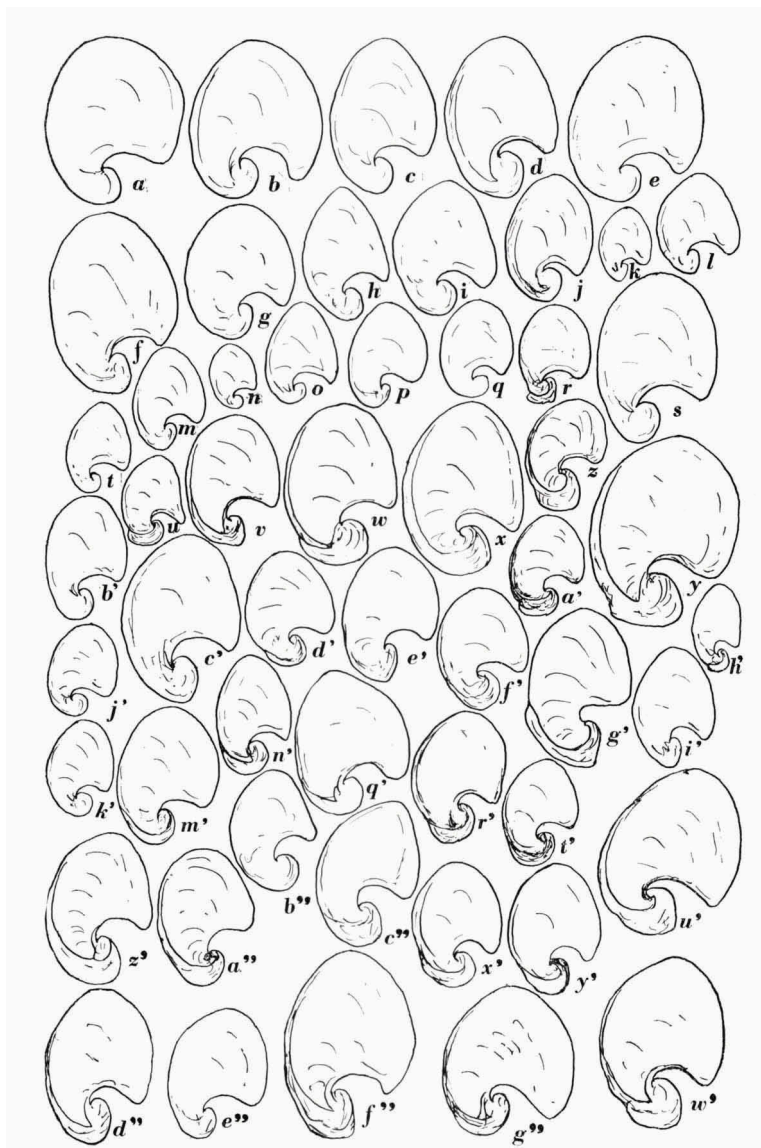


Fig. 12. *Dolabella scapula* (Martyn). Shells of the animals here examined, all seen from above, to show the variation. *a, b*, Telok Dalam (Nias); *c*, Sabang; *d*, Java (leg. Van Hasselt); *e*, Hoorn Island; *f*, Bay of Batavia (leg. Sluiter); *g*, Kerkhof Island; *h*, Pulu Panggang; *i, j, k*, Sailus Ketjil; *l*, Bay of Bima; *m*, Cyrus Bay; *n, o, p, q*, Pepela Bay; *r, s*, Sanana Bay; *t*, Moluccas (Van der Hucht coll.); *u, v, w, x, y*, Moluccas (De Serière coll.); *z, a',* Moluccas; *b',* Ambon (Bleeker); *c',* Ambon (Forsten); *d',* Ambon (Ludeking); *e',* Banda; *f',* New Guinea; *g',* Waigeu; *h',* Biak Island; *i',* Kaimana; *j', k', m',* Pulu Sanguisiapo; *n',* "Japan"; *q', r',* Tiop; *t',* New Caledonia; *u', w', x', y',* Inhaca; *z', a'', b'', c'',* Mauritius; *d'', e'', f'', g'',* without locality. $\times \frac{1}{2}$.

the *Astrolabe* animal is identical with that of MacFarland's animal; Baba (1936, p. 17): some details.

Internal anatomy of our largest specimen from Nias.

The skin of the foot is very thick, in front 9 mm, in the middle 6 mm



Fig. 13. *Dolabella scapula* (Martyn). The shells copied from literature. *a*, Rumphius, 1705, pl. XI fig. N; *b*, Martyn, 1784, III, fig. 99; *c*, Cuvier, 1804, pl. 29 fig. 2; *d*, Sowerby, 1820-'25, pl. 156; *e*, *f*, *h*, Quoy & Gaimard, 1832, pl. 23 Moll. figs. 5, 7, 3 (*D. rumphii*, *tongana*, *hasseltii*); *i*, *j*, *k*, Rang, 1828, pls. III, I, II (*D. teremidi*, *rumphii*, *ecaadata*); *m*, Deshayes, 1853, pl. 92 fig. 4; *n*, *o*, *p*, *q*, Sowerby, 1868, pl. II figs. 3c, 3b, 6, 4 (*D. rumphii* 2 ×, *guayaquilensis*, *ecaadata*); *r*, *s*, *t*, Mazzarelli & Zuccardi, 1892, pl. I figs. 1, 2, 3 (*D. hasseltii*, *teremidi*, *tongana*); *u*, *w*, *D. californica* (Pilsbry, 1896, pl. 66 fig. 17, and Stearns, 1879, pl. VII fig. 1); *x*, Clessin, 1899, pl. 10 fig. 1 (*D. neira*); *y*, Bergh, 1907, pl. XIV fig. 12; *z*, Thiele, 1929, I, p. 398, fig. 501; *a'*, O'Donoghue, 1929, pl. III fig. 33; *b'*, Baba, 1936, p. 16, fig. 6 B; *c'*, Allan, 1932, p. 422 (*D. andersoni*). × about 1/2.

and behind 20 mm. The pharyngeal bulb is 21 mm long and 16 mm broad. The oesophagus is only 5 mm wide. The mandibles (figure 14 *m*) are about 10 mm long and 4 mm broad, the posterior portion is covered by skin. In the two other specimens from Nias the measurements are nearly the same, perhaps the mandibles are somewhat broader and shorter.

Radula. The literature on this organ is interesting because the middle tooth forms a point of discussion: Mazzarelli & Zuccardi (1892, p. 5, pl. I figs. 11, 18, 19, 16, 20): middle tooth with a "cappuccio di tre cavità", (ibid., p. 8, pl. I fig. 12): idem, 33-40 rows, (ibid., p. 10, pl. I fig. 14): idem; Pilsbry (1896, p. 150, pl. 67 figs. 17, 18): median tooth a rudimental plate; Eliot (1900, p. 516): no central tooth or central space; Thiele (1900, p. 251, fig. 6 a, b): no rhachidian tooth, but the middle tooth is "obviously" a coalescence of the first side teeth of each side; Farran (1905, p. 354, pl. V figs. 16, 17): 44 rows of about 120-1-120 teeth, middle tooth is figured with a cusp and a bifid plate like Thiele's "coalesced" one; Bergh (1905, p. 15): 58-60 rows, till 200 teeth each row, (ibid., pl. VIII figs. 3-5): figures one rhachidian tooth with rudimental cusp and bifid plate and another with a beautiful 5-lobed cusp, (ibid., p. 18): 60 rows with about 200 teeth each row, (ibid., pl. VIII fig. 9): a beautiful middle tooth with a denticulated cusp, like fig. 4; (ibid., p. 19): 61 rows, (ibid., pl. IX figs. 1-3): only side teeth figured, but the text says, that the rhachidian teeth are like the preceding; Bergh (1907, p. 17, pl. XIV figs. 14-17): median tooth with beautifully denticulated cusp, 86 rows with about 200 teeth each; Vayssière (1906, p. 71, pl. I fig. 3): 40-50 rows, 120-160 teeth on each side, figures a median tooth with a small simple cusp; MacFarland (1918, p. 316): 62 rows with 198-230 side teeth on each side, (ibid., pl. IV figs. 3-4, 6-9): median tooth with a small irregular knob on the top or without this; O'Donoghue (1929, p. 34): 87 rows, 240-250 side teeth on each side, median tooth small recurved triangular blade provided with a number of denticles, but somewhat variable; Pruvot (1934, p. 45, fig. 11): median tooth as in MacFarland; Baba (1936, p. 17, fig. 6 E): 70 rows, 275-1-275, median tooth with a very small triangular cusp.

It is clear that the median tooth has a tendency towards reduction, though one may doubt Thiele's interpretation of his middle tooth as the coalesced first side teeth. It has been impossible to me to find a specimen with such beautiful cusps as Bergh figures them, and here also doubt arises, whether denticles are ever present on the cusp.

In the largest Nias-specimen the radula is 13.5 mm long, 17.5 mm broad. I counted till 213 teeth in one row on one side (about the 30th row) and

The palatal folds and spines are the same as described by MacFarland for *D. agassizi*.

The penis is unarmed in this species, giving an important difference from *D. gigas*, where it bears spines. As figure 15 shows, the glans is also much shorter here. The praeputium has a rather thick skin (fig. 15 a) and three retractor muscles, the hindermost inserts in the base of the glans, the other two more forward. The glans is very short, much shorter than in *D. gigas*, it is rather foliate, with a narrower and a broader fold of skin, each at a side of the spermatic groove. The praeputium is wrinkled, here the spermatic groove is very distinct, as it is bordered by two thick rounded folds of skin. The length of the praeputium in this preserved animal is 50 mm, that of the glans 23 mm (in *D. gigas* the glans is 40 mm long). In the two other specimens from Nias the relations are the same, the length is 40 and 30 mm respectively for the praeputium and 18 and 13 mm respectively for the glans. The penes of all the specimens at hand were

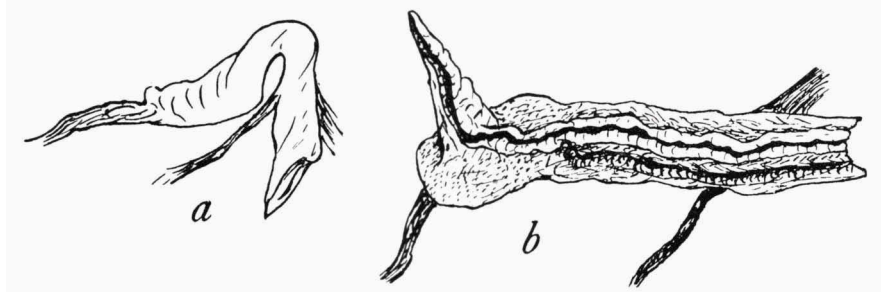


Fig. 15. *Dolabella scapula* (Martyn). Penis. a, unopened as it is taken out of the body cavity, with its three retractor muscles; b, praeputium opened, showing the short foliate unarmed glans to the left and the conspicuous genital groove, continuing along the praeputium.

examined and they all are built identically, none showing any vestige of armature, and all provided with the short conical glans.

A beautiful figure of the extended penis was given by Quoy and Gaimard (1832, Moll., pl. 23 fig. 1), from which it may be seen, to what length the praeputium may stretch. Hirase (1929, p. 108) gives for the length of the extended penis (i.e., the glans only) 42 mm, its breadth was 11 mm. The not extended praeputium was 90 mm long. On p. 109 the same author describes the mating; the penis reached till the base of the spermatocyst. This author figures the penis (pl. V fig. 4). Other descriptions and figures are given by Mazzairelli & Zuccardi (1892, pp. 7, 9, 11); Bergh (1905, pp. 17, 19, pl. VII figs. 38, 39, 40); Bergh (1907, p. 18); MacFarland (1918, pp. 328-9); Risbec (1928, p. 48, fig. 26); Adam (in litteris) tells me, that his animal (cf. Adam & Leloup, 1938, p. 199) had an unarmed penis.

The living animal.

The conical body form suggests a digging mode of life. The head region with its strong retractor muscles probably has a boring function. It can be retracted to invagination by these muscles and then probably protrudes again by force of the body fluid, which by the heavy musculature of the skin is pressed forward. The disc probably functions as a resistance and as a support for this movement.

Figures or descriptions of the living animals were given by: Van Hasselt (1824, p. 54): long branched villi are retractile; Rang (1828, p. 46 seq., pls. I-III, XXIV fig. 1); Lesson (1830, p. 293); Ehrenberg (1831): *areae posticae rotundae limbus membranaceus crispus expandi et contrahi potest*; Quoy & Gaimard (1832, pp. 303, 305, 306, pl. Moll. 23 figs. 1-7); Adams & Reeve (1848, p. 65, pl. XVIII fig. 4); Pease (1860, p. 22); Angas (1867, p. 228); Stearns (1879, p. 395); Martens (1879, p. 738); Eliot (1900, p. 515, pl. XIX fig. 3): admirably imitating a mass of old seaweed; Pilsbry (1896, p. 150 seq.): copies many old figures; Farran (1905, p. 354); Bergh (1905, pl. III fig. 1); MacFarland (1918, pp. 306-7, pl. I); Risbec (1928, pp. 45-6): on colour change, very important; Iredale (1929, p. 292); Hirase (1929, pp. 105, 109): copulation, egg depositing, (*ibid.*, pl. V fig. 1); Allan (1932, p. 422): figure, (*ibid.*, p. 423): description, animal, eggs; Hirase (1934, pl. 120 fig. 17); Anonymus (1935, II, pl. XCI fig. 11): beautiful figure; Baba (1936, p. 17, fig. 6).

Dr. J. Verwey (in litteris) was so kind to give me his annotations on an animal he observed in the Bay of Batavia, near the east of the island Purmerend on January 23rd, 1929; "Large violet animal. The animal creeps with a very regular movement, suggesting the use of a ciliated skin. There are no waves on the water".

Habitat: Rumphius (1705, p. 123): deep in the mud; Cuvier (1804, p. 439): thin covering of mud; Rang (1828, p. 46 seq.): on sand but most often in the mud; Quoy & Gaimard (1832, p. 305): on the rocks among seaweeds and zoophytes, can lay dry during low tide, (*ibid.*, 307): among rocks; Dufo (1840, p. 202): on and in the rocks; Adams & Reeve (1848, p. 65): feeding in groups in a small muddy inlet of the sea; Angas (1867, p. 228): on sandy mud; Stearns (1879, p. 395 and 1894, p. 342): dark places in pools left by the tide; Martens (1880, p. 306): in sand and mud; Eliot (1900, p. 515): among seaweed growing on the sand; Hirase (1929, p. 105): on sand with seagrass: *Hyponia*; Allan (1932, p. 423): crawl over the mud flats or bury themselves in the soft mud.

Purple fluid: Cuvier (1804, p. 438): glands are present, but Péron never saw an animal repanding some fluid; Van Hasselt (1824, p. 55): violet

coloured fluid; Ehrenberg (1831): saw no fluid; Quoy & Gaimard (1832, p. 307): purple fluid; Angas (1867, p. 228): purple fluid; Martens (1879, p. 738): purple fluid; Martens (1880, p. 306): purple slime; Eliot (1900, p. 515): copious purple fluid.

Embryology: Hirase (1929, p. 111).

Geographical section

(the numbers in heavy type refer to the map, fig. 16)

Malayan Archipelago.

Limax marina *tertia* Rumphius, 1705, p. 38, pl. X fig. 5: Ambon (1).

Derde soort der Opercula callorum (*Limax marina*), *derde van de vijfde*

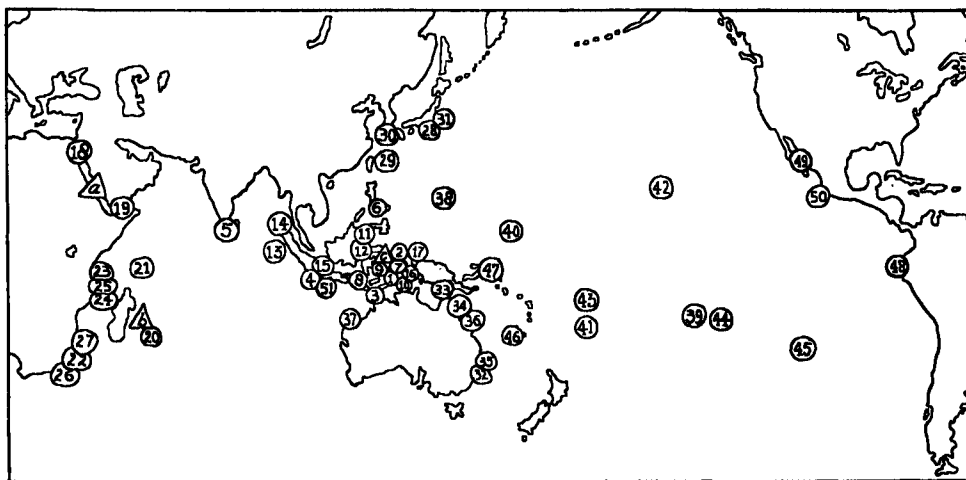


Fig. 16. Geographical distribution of the genus *Dolabella*. Δ a, b, c, *D. gigas*; ○ 1-50, *D. scapula*. For numbers see text: Geographical section.

soort Klipkleevers Rumphius, 1705, p. 123, pl. XL fig. N: Ambon (1). The animal of Rumph was called *D. callosa* by Lamarck (1801, p. 62), *D. rumphii* by Cuvier (1817, p. 398), who identified it with his animal collected by Péron at Mauritius. Blainville (1819, p. 395), however, named the last specimen *D. peronii* and preserved *D. rumphii* for Rumph's animal. According to Iredale the name *Patella auricularia* was given to Rumph's shell by Solander (1786, p. 154). Of the same year is the following name which is better known and therefore preferable; let us hope, that Martyn published his paper earlier in the year 1786 than Solander.

(*Patella*) *scapula* Martyn, 1786, vol. III, fig. 99: Ambon (1).

Dolabella spec. Quoy & Gaimard, 1824, p. 422: Iles Papous (Rawak) (2), Timor (3).

Dolabella rumphii Van Hasselt, 1824, p. 54: Peperbaai, West Java (coloured figure in Rang, animal preserved in Leiden and described here) (4).

Aplysia hasseltii Rang, 1828, p. 49, pl. XXIV fig. 1: coloured figure of Van Hasselt reproduced and described (4).

Aplysia rumphii Rang, 1828, p. 46, pl. I: Timor (Péron leg.), studied also the animals of Quoy & Gaimard (1824) from Waigeu and Rawak (3).

Aplysia ecaudata Rang, 1828, p. 47, pl. II: animals of Quoy & Gaimard (1824) from Waigeu and Rawak (2).

Aplysia truncata Rang, 1828, p. 47: animal of Quoy & Gaimard (1824) from Waigeu and Rawak (2).

Dolabella spec. M. E. Gray, 1850-4, pl. 270 figs. 1, 2: Ceylon (cf. Pilsbry, 1896, p. 160) (5).

Dolabella rumphii Thurston, 1887, p. 22: Ráméswarem (Adam's Bridge, Ceylon) (5).

Dolabella hasseltii Mazzarelli & Zuccardi, 1892, p. 3: San Jacinto (Philippines) (6).

Dolabella teremidi Mazzarelli & Zuccardi, 1892, p. 7: San Jacinto (Philippines) (6).

Dolabella tongana Mazzarelli & Zuccardi, 1892, p. 9: San Jacinto (Philippines) (6).

Dolabella rumphii Von Martens, 1894, p. 93: Ambon (1).

Dolabella neira Clessin, 1899, p. 27, pl. X fig. 1: Banda neira (shell only) (1).

Dolabella rumphii Bergh, 1905, p. 13: reef off Atjatuning (W. Coast New Guinea) (7); reef in Bay of Bima (8); reef of Haingsisi (3); reef of Pepela Bay (East coast of Rotti Island) (3).

Dolabella rumphii var. *maculosa* (= *Hasseltii*) Bergh, 1905, p. 18, pl. III fig. 1: reef of Sailus Ketjil (Paternoster Islands) (8); reef of Sasana-bay (East coast of Sula Besi) (9); reef of the Boeka or Cyrus-bay (South coast of the island Rotti) (3); anchorage of Tual (Kei-islands) (10); Pulu Sanguisiapo (Tawi-tawi-islands, Sulu-archipelago) (11).

Dolabella scapula Farran, 1905, p. 354: South-east Modragam and south of Adam's Bridge (Ceylon) (5).

Dolabella scapula Winckworth, 1927, p. 101: Krusadai-island in the Gulf of Manaar (5).

Dolabella tongana Adam & Leloup, 1938, p. 199: Palu-bay near Dongala (12).

Rumphius notes (p. 38) that his *Limax marina tertia* has a small bone on the back, not larger than a "dubbeltje" (i.e. about a threepence) with a projecting bent hook, in the form of a ham, and again (p. 122-3) notes, that pl. XII fig. N is the shell of *Limax marina* which lives rather deep in the sand near Castle Victoria and that it looks like the shoulder blade of a pig. From this and his drawing we may infer with certainty that his animal was a *Dolabella*. In the History of the genus at the beginning of this article, I have given the names, which succeeding authors gave to this animal of Rumphius and its shell.

Martyn also figured a shell from Ambon.

The second description from the East Indies was given by Van Hasselt, who notes, that the long branched appendages of the skin can shorten and lengthen themselves and are very sensitive like so many tentacles. His beautiful drawing of a living specimen was given to Rang for reproduction by the Director of the Leiden Museum. It is still there, Prof. Boschma was so kind to send it to me, Rang's reproduction is admirably good and exact. In this same Museum a *Dolabella* is preserved bearing the label: "Dolabella, Kuhl et Van Hasselt, Java". Its length in alcohol is 140 mm, its breadth 62 mm, its height 45 mm. The shell is 44×32 mm. According to Rang the length of the living animal was 190 mm, Van Hasselt (1928, p. 55) gives 0.69 (this is in "Amsterdam-feet") = ± 195 mm. For the breadth he gives 0.38, i.e., ± 107 mm and for the distance of the anterior tentacles 0.07, i.e., ± 19 mm. In the original drawing the animal's length is 182 mm, its breadth is 97 mm, the distance of the anterior tentacles 17 mm. In the preserved specimen, as said 140 mm, 62 mm and the distance between the tentacula 18.5 mm. Allowing for the strong contraction in the preserving fluid we may consider it very probable, that this preserved animal is the one Van Hasselt had drawn by the artist J. Th. Bik, who had been sent to him after Van Raalte had fallen ill (see Sirks, 1915, p. 106). On May 25th Van Hasselt wrote about this animal to Professor Van Swinderen. This letter was published in the *Alg. Konst-en Letterbode*. With the drawing was found a note in about the same wordings. Van Hasselt does not say, whether he found one or more animals, but he speaks of a *rara species*, while the following animal, *Bul-laëa alba* is called *rarissima*. So perhaps there were more than one, when Van Hasselt collected in the Peperbaai. He was then travelling in the West of Java staying only a short time on the sea coast. On Sept. 8th of that year he died. So, I think, there is some probability, that after writing his letter to Prof. Van Swinderen he collected no more *Dolabella's* and that the animal, that was figured, has been preserved and sent to

Leiden. We may say with more certainty, that it must have been from the same locality, and for that reason suppose, that this preserved animal, when living, resembled the drawing. The drawing (see Rang, 1828, pl. XXIV, fig. 1) shows an animal, with many and long appendages. In the preserved specimen, however, we find only some non-contracted branched villi (difficult to find, as they are lying flat on the somewhat ragged skin), some fine tips of retracted appendages, and many places, where the villi must have been wholly retracted. Our specimen had the penis expanded to a length of 52 mm, it is unarmed and conforms to the description given above.

With this knowledge and that furnished by our investigation of the villi (see above), as also with the informations on the variability given by Eliot (1900) and Risbec (1928), we must come to the conclusion, that we can regard the different species of Rang, viz., *A. rumphii*, *ecaudata* and *truncata*, as different states of preservation of one species. Rang only saw the living *A. rumphii* at Mauritius. For the rest he studied preserved specimens, while of *A. hasseltii* he only had a drawing. Even the "smooth skinned" *A. ecaudata* has small tubercles! A large collection of *Dolabella*'s, as I have at present at hand, clearly shows all degrees of contraction of the tubercles, from long branched villi to small point-like holes in the skin.

Likewise the two animals figured by Mrs. Gray (according to Pilsbry, 1896, p. 160 from Ceylon and by him regarded as *D. ecaudata* and *D. scapula*) only represent the common form. The fact, that Pilsbry regards her fig. 1 as *D. ecaudata*, while it clearly shows many pointed appendages, indicates, how little this author really holds to the nearly smooth skin as a separating character of *D. ecaudata*.

Mazzarelli & Zuccardi had six preserved animals from the Philippine Islands and brought them under three different species: three under *D. tongana*, two under *D. teremidi* and one under *D. hasseltii*. They ingeniously found as the difference between *D. rumphii* and *D. hasseltii*, the dark markings of the last and the absence of papillae on its tentacles, but curiously allow black markings and very distinct tubercles in *tongana*! In *D. teremidi* again small papillae were present on the tentacles. Studying a larger material we cannot follow the authors in these subtle discriminations, which on nearer investigation seem unimportant and partly differ principally from the characters given by the original authors.

Dolabella neira was founded only on a shell, which probably is a variety or an abnormality of the common form.

Farran had three specimens, which he regarded as *D. scapula*, though "the papillae were most numerous in the largest specimen... and almost

absent from the smallest" and though the living animals were "chestnut brown in general effect, yellowish basis mottled with red and brown, many yellow tags or spines all over".

Bergh, studying the rich Siboga material, came to the conclusion (l.c., p. 13): "Einige (Arten) sind nur nach der Form-variablen Schale aufgestellt, und die anderen sind vielleicht nur Varietäten einer weit verbreiteten Art". Accordingly, he describes *D. hasselti* as: *D. rumphii* var. *maculosa*. About the papillae he remarks, that they are "zum Theil in Grübchen retraktil".

Bergh had the bad custom, to dissect his animals to pieces, so that only part of his material is preserved. Of his *D. rumphii* I could study one specimen from Station 47 (reef Bay of Bima) (8) and 4 from Station 301 (reef of Pepela Bay, East Coast of island Rotti) (3). The specimen from Station 47 measures 75 mm in length, 41 mm in breadth, 27 mm in height, the shell measures 28 × 24 mm. The penis is of the common short and unarmed form. This specimen has its villi partly wholly retracted, but on the right dorsal part of the skin is a field with many beautifully preserved compound papillae. The four specimens of Station 301 measure in length 70, 70, 67, 41 mm respectively, in breadth 50, 48, 53, 28 mm, in height 28, 28, 23, 15 mm, the shell measures 27 × 21, 26 × 21, 28 × 20, 17 × 12½ mm respectively. The penis is of the common form. These specimens are all distinctly maculated and it is not quite clear to me, why Bergh did not count these to his variety though under that form he remarks: "Die Hautkegeln aber kleiner, mehr einfach und weniger zahlreich. Der Rand der Scheibe weniger hervortretend und weniger zackig". I cannot emphasize these differences. The villi are distinct and often compound, but partly contracted, so that large parts of the skin, especially in the two smaller specimens, may be smooth, as it is figured for *D. ecaudata* and *D. tongana*. The smallest specimen, however, has very distinct conical villi on its disc. The tentacles all bear papillae. The penis is of the common form.

Of Bergh's variety *maculosa* I could study 3 specimens from Stat. 37 (reef of Sailus Ketjil, Paternoster Islands) (8), 2 from Stat. 193 (Sanana Bay, E. coast of Sula Besi) (9), 1 from Stat. 299 (reef of Cyrus Bay, S. coast of island Rotti) (3). As stated above, it is not clear to me, why these specimens should form the var. *maculosa*, they do not differ essentially from the others, e.g., the animal of Stat. 299 is not maculated, while those of Stat. 301 are. I can neither verify Bergh's remark on the smaller and less numerous villae. The here named specimens measure: Stat. 37 length 118, 100, 53 mm, Stat. 193 length 160, 70, Stat. 299 length 79 mm respect-

ively, the breadth is 65, 40, 33, 80, 40, 45, the height 32, 34, 16, 30, 26, 33, while the shell measures 38×29 , 34×25 , 19×15 , 46×34 , 26×20 , 28×21 mm. The animal of Stat. 37 had been dry for some time and therefore had a peculiar outlook.

Four animals from Stat. 93 measure 88, 87, 64, 62 mm in length, 54, 57, 39, 42 mm in breadth, 34, ?, 23, 18 mm in height. The second is only an empty flat skin, the shell of the first animal measures 36×29 , that of the third 26×21 mm. The penis is of the common form.

The three animals from Nias island (13), coll. Kleiweg de Zwaan, were described above.

Sabang (14), 1 specimen, leg. G. Herman. Length 130, breadth 90, height 60 mm. A flesh coloured animal with dark markings, which has the head so strongly retracted, that it invaginates into the body. The villi are all retracted, only leaving here and there a tubercle, with a small hole, which sometimes yet shows the top of the retracted villus. Like in most specimens villi on the tentacles are present. The penis is large, unarmed, of the common form. The shell 41×27 mm.

Bay of Batavia (15), leg. C. Ph. Sluiter, 1 specimen. Also flesh coloured with dark markings. Villi here, however, numerous, especially on the disc, many of them partly retracted. Length 160 mm, breadth 80 mm, height 65 mm, shell 49×38 mm. Penis of common form.

Bay of Batavia (15), reef of Hoorn island, March 1st, 1930, leg. Dr. J. Verwey et Miss W. S. S. van Benthem Jutting. A beautiful animal with distinct villi, partly branching, partly half invaginated, and dark markings. Length 130, breadth 79, height 50 mm, shell 45×36 . Penis of the common form.

Bay of Batavia (15), Kerkhof island, July 31st, 1927, leg. Jhr. W. C. van Heurn. Length 117, breadth 74, height 30 mm, shell 38×35 mm. This flesh coloured animal is again interesting, as its back shows only some distinct villi and for the rest is tuberculated. These tubercles have no clear holes, but they are more or less tuberculated or bear very small conical elevations. The disc shows many branched villi in a well preserved state. Penis as usual.

Bay of Batavia (15), Pulu Panggang, Duizend-(Thousand) islands, leg. Dr. J. D. F. Hardenberg. Length 125, breadth 85, height 50 mm, shell 40×26 . This animal preserved in formaline remembers one strongly of Van Hasselt's drawing. Under magnification the greenish ground colour shows small white points. This animal is interesting because it shows the villi of a blue green lighter colour. Some of these are not yet wholly

retracted, others show themselves as a blue green button in the middle of the tubercle, other tubercles show a small blue green hole where the villum disappeared.

From all these animals from the Bay of Batavia, all in a different state of preservation, most of them showing a combination of the common villous appearance (*D. rumphii* and *D. hasselti* auct.) and the tuberculated form (*D. ecaudata*, *tongana*, *agassizi* auct.), we may again infer, that the presence of the villi is no specific character, as these appendages are all retractile into the skin.

In the Amsterdam Geological Institution a recent shell from Tjilaoeteureun (51) (South coast of Java) is preserved 48 mm long, 33 mm broad.

We now come to a group of animals from Ambon and vicinity. The first two are old specimens from the Leiden Museum and show the characteristics of a long stay in alcohol, the smallest curiously looks like Rumphius' drawing, though the villi are more conical and pointed, while many on the disc are richly branched.

Ambon (1), leg. Forsten. Length 138, breadth 63, height 38, shell 41 × 32 mm, villi numerous, more simple on the back, composed on the disc; dark markings are visible. Penis of the common form.

Ambon (1), leg. Ludeking. Length 38, breadth 46, height 35, shell 31 × 24 mm. Many pointed conical villi, some branching. Penis as usual.

Ambon (1), leg. Bleeker, Length 106, breadth 50, height 42, shell 33 × 22 mm. This is a flabby, faded specimen, large parts of the skin are quite smooth, only some villi are not contracted, there are some tubercles with a small pore.

Moluccas (9), 1858, leg. Van der Hucht. Length 75, breadth 38, height 30, shell 24 × 18 mm. A flabby animal with some rests of dark markings and some villi. Penis very fine, but of the common form.

Banda (1), leg. Van de Velde. Length 78, breadth 47, height 34, shell 34 × 25 mm. This is a strongly contracted specimen, flesh coloured, with a somewhat tuberculated skin, which on magnification shows many villi or the rests of these.

The following specimens from New Guinea cannot be distinguished from the preceding.

An old animal from the Leiden Museum was collected by Macklot (1828) on the coast of New Guinea (16). It is badly preserved, blackish brown, but clearly shows the villi and tubercles. Length 85, breadth 48, height 32, shell 32 × 25 mm.

Biak Island (17), near New Guinea, 1915, leg. W. K. H. Feuilleateau de Bruyn. Length 50, breadth 45, height 32, shell 23×25 mm. The head region is strongly retracted, rugose, invaginated. The body is swollen, short and broad, giving the animal a curious form. The foot is strongly contracted, rugose. The disc is clearly tuberculated, but the back only shows some indistinct tubercles. Rests of dark markings are present.

Kaimana (16), S.W. New Guinea, $133^{\circ}44'$ E, $3^{\circ}41'$ S., 28-VIII-1910, on the reef, leg. L. Hendriks. Two specimens measuring in length 102, 87, breadth 52, 50, height 42, 40 mm respectively, shell of the larger specimen 31×22 mm. Some simple or composed villi on the back and many on the disc. Rests of darker markings are present. Penis as usual.

All these animals from the Malayan Region only strengthen me in my opinion, that they all form but one variable species, variable especially in its body form and in its reaction on the preserving fluid. Composed villi are present, but they can be wholly retracted in the skin, leaving only indistinct traces.

Red Sea.

Dolabella hemprichii Ehrenberg, 1831: Cosseir (18) (quoted by Issel, 1869, p. 165).

Dolabella rumphii Vayssière, 1906, p. 69 (51): Gulf of Aden (19), two from Djibouti and one from a reef between Djibouti and Obock.

The only animal of Ehrenberg was pale green with darker markings. The "rugulose bands" on the back and the fact, that Ehrenberg gives no figures of the living animal, suggest a not quite fresh specimen. Important for our knowledge of the variability is Ehrenberg's remark: "Areæ posticae rotundae limbus membranaceus crispus expandi et contrahi potest". Vayssière got no notes on the living animal, he considers his three animals and the one of Ehrenberg as identical with *D. rumphii*. The villi were distinct, of different length and the colour variegated in lighter and darker green.

S. E. Africa.

Dolabella... Cuvier, 1804, p. 436, pl. 29 figs. 1-3: Ile de France (20), coll. Péron (= *Dolabella rumphii* Cuvier, 1817, p. 398 = *Dolabella peronii* Blainville, 1819, p. 395).

Dolabella spec. Quoy & Gaimard, 1824, p. 422: Ile de France (20).

Aplysia rumphii Rang, 1828, p. 47: Ile de France (20) (coll. Rang).

Aplysia hasseltii var. Quoy & Gaimard, 1832, p. 307, pl. 23 fig. 1: îlots aux cerfs (Ile de France) (20).

- Aplysia dolabella* Dufo, 1840, p. 202: Seychelles and Amirantes (21).
Dolabella rumphii Sganzzin, 1843, p. 14: Madagascar, Ile de France (20).
Dolabella rumphii Krauss, 1848, p. 72: Natal Bay (22).
Dolabella rumphii Adams & Reeve, 1848, p. 65: Mauritius (20).
Dolabella rumphii Deshayes, 1863, p. 53: Réunion (île de Bourbon) (20).
Dolabella teremidi Deshayes, 1863, p. 53: Réunion (île de Bourbon) (20).
Dolabella ecaudata Martens, 1869, p. 65: Zanzibar (23).
Dolabella elongata Sowerby (Reeve), 1868, spec. 2: Seychelles (this is probably only a monstrous shell, never found again) (21).
Dolabella rumphii Liénard, 1877, p. 53: Mauritius (not seen) (20).
Dolabella rumphii Martens, 1879, p. 738: Moçambique (24) and Querimba islands (25).
Dolabella rumphii Martens, 1880, p. 306: Mauritius (Möbius coll.) (20).
Dolabella rumphii Amaudrut, 1886, p. 68: Seychelles (21).
Dolabella scapula Thiele, 1900, p. 251: Zanzibar (23).
Dolabella rumphii Bergh, 1907, p. 15: East London (26).
Dolabella scapula O'Donoghue, 1929, p. 31: Inhaca (near Lorenzo Marques) (27).

Our data on the South African *Dolabella*'s are many, but we have only two coloured figures, viz.: Quoy & Gaimard (l.c.) (copied by Pilsbry, pl. 28 fig. 34) and Adams & Reeve (l.c.) (copied ibidem, pl. 26 fig. 28). The beautiful figure and description of Quoy & Gaimard seem to be the best. Some authors report, like the last, a dark green to dirty yellow body colour, resembling Rang's figure of *D. rumphii*. A critical survey of the literature shows a wide variation, as wide as in the Malayan specimens. Especially the Japanese authors (see below) have given us a good idea of the colour variation in the living animal and lead us to the conclusion that Quoy & Gaimard's *D. rumphii* and *D. hasseltii* are but one species.

I could examine four animals collected by Prof. Van der Horst, July 1934, at Inhaca (27), a small island near Lorenzo Marques. These are beautifully preserved, showing the dark brown and yellow patches on a greenish ground color. Where the skin is well preserved, and the villi only little contracted, they resemble Quoy & Gaimard's figure quoted above, but where in one specimen all appendages are retracted, it quite resembles Quoy & Gaimard's *D. tongana*. The animals measure in length 125, 94, 94, 93, in breadth 82, 55, 50, 48, in height 48, 42, 39, 30 respectively, the shell of the first animal 45 × 37, of the last 32 × 26 mm. The penis has the common form. The radula is like that described above.

Japan

Dolabella nov. spec.? Hirase, 1929, pp. 105-114, pl. V fig. 1: Misaki (Sagami Bay) (28); Okinawa-island (29); Nagasaki (Kiusu) (30); Amakusa (Kiusu) (30); Nabuto (Bosu) (31); Kominato (Bosu) (31).

Dolabella scapula Hirase, 1934, pl. 120 fig. 17 (without locality).

Dolabella spec. Anonymus, 1935, pl. XCI fig. 11: common in Central and Southern Japan.

Dolabella scapula Baba, 1936, pp. 15-17, textfig. 6: Okinawa islands (29); Nagasaki (30), Tomioka (on Amakusa-island) (30), Misaki (Sagami bay) (28), Kominato (Pacific coast, E. of Tokio) (31) and Nabuto (31).

Beautiful figures, two coloured and two in black and white, are given by these authors, the best we possess till now of the living animal. The colour variation is very large, the dark patches may be conspicuous or absent. There is no reason to distinguish subspecies, based either on the colour or on the villi. Baba mentions no transverse rows of villi, though Hirase as well as Anonymus figure them, arranged in that way.

I could examine one specimen from the Berlin Museum "angeblich von Japan", that showed no colour. The length is 77, the breadth 38, the height 32 mm, the shell 31×21 mm. The penis of the common form. The villi are retracted in the posterior part of the back, but distinct on the anterior part and on the head.

Australia.

Dolabella scapula Angas, 1867, p. 227: Paramatta river (32).

Dolabella rumphii Brazier, 1878, p. 88: Dungeness and Darnley islands, Torres Straits (33); Low Island, Trinity Bay, Home Islands, N.E. Australia, on the reefs under coral in small pools (34); Port Jackson (32) and Bellinger river (35).

Dolabella ecaudata Brazier, 1878, p. 89: Home Islands, N.E. Australia (34).

Dolabella rumphii Smith, 1884, p. 89: N.E. Australia (34).

Dolabella rumphii Martens, 1894, p. 93: Thursday island (Torres Straits) (33).

Dolabella scapula Hedley, 1910, p. 371: Queensland coast (36).

Dolabella ecaudata Hedley, 1910, p. 371: Queensland coast (36).

Dolabella auricularia Iredale, 1929, p. 292: Queensland coast (36) (Iredale curiously considers this Queensland animal identical with Rumphius' animal from as far as Amboyna, and calls it with the old synonym of Solander: *D. auricularia*, while he gives the New South Wales animals a new name: *D. andersoni*. Why then do the Queensland animals not deserve

a new name? As said above, *D. scapula* is of the same year as *D. auricularia*, but preferable while better known and more conforming Rumph's designation "schonkje".

Dolabella andersoni Iredale, 1929, p. 292: New South Wales Coast (Gunnamatta Bay, Port Hacking) (32).

Dolabella ecaudata Thiele, 1930, p. 586: Cossack (N.W. Australia, 20° 39' S., 117° 13' E.) (37).

Dolabella andersoni Allan, 1932, pp. 422 (fig.), 433: Gunnamatta Bay, near Sydney (32).

If we compare the beautiful figure given by Miss Allan (l.c.) with the figure and descriptions of the Japanese form, it is not possible to see any differences. The characters noted by Iredale: "posterior not so abruptly cut off, nor is the rim edged with branching papillae, nor are these so numerous or so long on the rest of the body" are of no value. Of course Aplysiidae are sometimes easily distinguished, while living, by characters, which they lose in alcohol. So we may hope, that the full description, promised by Iredale, will give these and will be accompanied by a critical comparative study of the figures and descriptions already extant. If, however, the New South Wales and the Queensland specimens really differ, we may presume, that the last also differ from the Ambon specimens, and these again from the Japanese animals. But we must add, that these differences will most probably be of subspecific value. As far as our present knowledge goes, I cannot distinguish geographical varieties. As long as no better characters are known, *D. andersoni* falls in the synonymy of the common species *D. scapula*.

Pacific Islands.

Dolabella spec. Quoy & Gaimard, 1824, p. 422: Marianne or Ladrone Islands (38).

Dolabella teremidi Lesson, 1830, p. 293 (*Aplysia teremidi* Rang, 1828, p. 48, pl. III fig. 1. Erroneously called *D. temnida* by Gray, 1857, p. 198, *D. termida* by M. E. Gray, pl. 136 fig. 1 (Rang's figure) and *D. temnida* by M. E. Gray, pl. 270 figs. 1, 2 (new very good figures of two well preserved specimens of the common form)): Society islands (O-Taïti = Tahiti, Borabora, îlot de Tubai dans la baie de Borabora) (39), Caroline islands (island Oualan-Kusaie) (40).

Aplysia rumphii Quoy & Gaimard, 1832, p. 303, pl. 23 figs. 4-5 (Pruvot, 1934, p. 44): island Pangai-Modou (Tonga-Tabou or Tongatabu) (41).

Aplysia tongana Quoy & Gaimard, 1832, p. 305, pl. 23 figs. 6-7 (Pruvot,

1934, p. 44; called *D. tongensis* by M. E. Gray, pl. 137 fig. 1): island Pangai-Modou (Tonga-Tabou) (41).

Dolabella variegata Pease, 1860, p. 22: Sandwich islands (42).

Dolabella hasseltii Eliot, 1900, p. 515, pl. XIX fig. 3: Apia (Samoa) (43). One of these specimens was used for comparison by MacFarland (1918, p. 301).

Dolabella rumphii Couturier, 1907, p. 174: Lagon de Hao (Paumotu island, Society Islands) (44).

Dolabella agassizi MacFarland, 1918, p. 306, pl. I: Easter Island (45).

Dolabella rumphi Risbec, 1928, p. 45: Peninsula Nouméa (New Caledonia) (46).

The question whether the non-villous species are only common animals with retracted villi, is very important for this region. *D. tongana* and *D. agassizi* both are destitute of villi, but the figures show animals, that look as if they were dead and somewhat corrugated, when pictured. Both authors mention tubercles and in *D. agassizi* they are of the common form, as the figure shows. Quoy & Gaimard say, that they disappear in alcohol, and continue: "Bien qu' elle habite avec la précédente (*D. rumphii*), on ne peut point la confondre avec elle". This of course is a remark, that must be taken into consideration and the only possible way of really solving this problem would be an examination in loco. We have, however, two authors, themselves specialists in this field of malacology, who collected on Pacific islands: Eliot (1900) remarks: "I am inclined to think that *D. hasseltii*, *D. variegata* and *D. teremidi* are all one species" and Risbec (1928): "Bergh décrit plusieurs variétés de *D. rumphi*, ...mais je crois, ...que le même individu change de couleur suivant les saisons. A Nouméa, ... à certaines époques, tous les exemplaires sont vert clair; à d'autres, ils sont tous bruns, presque noirs. De plus, ayant songé moi-même à une variété différente, j'ai constaté qu'en faisant couler de l'eau sur l'animal, la teinte noir disparaissait à la manière d'un mucus." Unhappily the author gives no observations about the villi or tubercles, but it is important, that both investigators stress the great variability.

I could study two animals from the Museum in Berlin, collected at Tiop, Bougainville (47) (one of the Solomon Islands), leg. H. Schoede, on the 3rd and the 4th of November, 1909. These beautifully preserved animals measure 93 and 110 mm respectively in length, both 60 mm in breadth, 40 and 43 mm respectively in height, the shell measures 36×31 and 34×26 mm respectively. Shell and penis of the common form. The smaller animal is greenish, beautifully maculated with brown, the larger animal has lost its colour. They both show distinct villi, though in some parts of the body

these have altogether disappeared. On the disc of the larger animal it was interesting to note again, how a branched villus can be wholly retracted, first appearing as a tubercle with a central conical cirrus and some smaller appendages around it, until these are all retracted, confirming Van Hasselt's remark: "The apendices cutanei which in Rumph's figure are simple warts, are long branched, pointed appendages of the skin, which shorten and lengthen themselves".

In our collections there is a shell, labelled: "*Dolabella sulcata* Bernardi. N. Caled.. ab auctore". As far as I know, Bernardi never published this name. The shell has nothing that might distinguish it from *D. scapula*.

West Coast of America.

Dolabella guayaquilensis Sowerby (Reeve) 1868, pl. II fig. 6 (shell only: Guayaquil (48) (Coast of Ecuador). Martini & Chemnitz erroneously give *guayaquilensis*.

Dolabella californica Stearns, 1879, p. 395: Mulege Bay (49), Gulf of California (= Stearns, 1894, p. 341, 1895, p. 158). Preserved specimens were examined by Pilsbry (1895, p. 73) and again Pilsbry (1896, p. 159, pl. 66 figs. 14-18).

Dolabella californica Pilsbry, 1895, p. 73 (and again 1896, p. 159, pl. 66 figs. 14-18) examined the preserved type specimens from Mulege Bay and also one from the West Coast of Mexico (50).

Pilsbry tends to regard his specimens as identical with the smooth *D. ecaudata* and *D. tongana*, yet he mentions "traces of sparsely scattered wartlike papillae", while Stearns on the authority of the collector Fisher says, that the surface is covered with wartlike papillae. While *D. ecaudata* and *D. tongana* were described as one-coloured green, Pilsbry's animals showed a more or less black maculation. We see, that all these distinctions are not regarded as very important by most authors, none of them is used as a constant character. The tuberculate specimens are considered identical with the smooth ones. The tuberculate specimens, however, may, as our investigations show, be regarded as villous animals with retracted villi; villi, tubercles and a smooth skin most often occur all at a time in the same animal.

Our conclusion must be, that all these *Dolabella*, form but one species: *D. scapula*, which can be easily and clearly distinguished from *D. gigas* by the shell and the penis.

Fossil species. Two fossil shells have been described under the genus *Dolabella*. Both were figured. Neither seems to belong to this genus. Even

not to the family Aplysiidae. A. Issel (Alcuni fossili nuovi del Savonese. Atti Soc. ligustica Genova, Sc. nat. geogr., 1922, 1, p. 123) described as *Dolabella* (*Sabaziella*) *texturata* a fossil (pliocene) shell from near Genua. The figure shows a shell (fragment ?) which though its general form is like that of *Dolabella*, has the spire on the right side, while *Dolabella* has it on the left side. Moreover the shell of *Sabaziella* shows a series of ribs, a structure which does not belong to the shells of the Aplysiidae, their direction and habitus is foreign to the structure of the Aplysiid shell. We can say with certainty that *Sabaziella texturata* Issel is no *Dolabella*.

Dall (where ?) described a *Dolabella aldrichi* from the tertiary of Florida. The shell was refigured by Cosmann (Essai de Paléconchologie comparée, I, Paris, 1895, pl. VII fig. 14). The shell fragment of this figure certainly shows no *Dolabella*.

Zoogeography of the Genus

The species *D. gigas* occurs in the Red Sea, Mauritius, and the Malayan Archipelago, so is a common inhabitant of the Indo-West-Pacific Region. But from a zoogeographical point of view the species *D. scapula* is remarkable, because it inhabits the whole tropical Indian and Pacific Oceans, even the Easter Island and the West Coast of tropical America, while it fails in the West Indies.

As Ekman (1935, p. 105) remarks, the time an animal has to spend to cross the Eastern Pacific Barrier forms an important factor in its particular distribution. We know nothing about the time a *Dolabella* lives as a free swimming larva. Hirase (1921, p. 113) gave us some data about the development. But he only cultivated the eggs during the 8 days of their first development, till they left the eggs as free Veligers. This time is twice that a *Philine* wants for that stage. Perhaps this is an indication, that the free swimming stage also lasts rather long here. Yet it may be doubted, whether it lasts long enough to help the animal across the broad stretch of Ocean between Middle and East Pacific.

The most probable explication, therefore, of the distribution of *Dolabella scapula* seems to be, that originally the species occurred in the West Indies and the whole Tethys-Sea, while afterwards, in the colder period of the Miocene, the species became extinct in the West Indies, but remained on the West Coast of Middle America and in the whole tropical Indian West-Pacific Region. The question rises whether the animal remained unchanged during that long time or only formed local varieties, which we cannot distinguish till now.

Species erroneously placed in the genus *Dolabella*

Dolabella dolabrifera Cuvier, 1817, p. 398, this is *Dolabrifera dolabrifera* (cf. Engel et Hummelinck, 1936, p. 30).

Dolabella rondeletii Cuvier, 1817, p. 398 (founded on Rondelet, 1554, p. 520, 1558, p. 376), i.e., *Aplysia depilans* (cf. Pilsbry, 1896, p. 160).

Dolabella laevis Blainville, 1819, p. 395, i.e., shell of *Aplysia depilans* (cf. Pilsbry, 1896, p. 160).

Dolabella fragilis Lamarck, 1822, p. 42, i.e., shell of *Aplysia depilans* (cf. Pilsbry, 1896, p. 160).

Dolabella lepus Risso, 1826, p. 44, pl. I figs. 1, 2, i.e., *Aplysia fasciata* (cf. Pilsbry, 1896, p. 160).

Dolabella unguifera Lamarck, 1836, p. 701, i.e., *Petalifera petalifera* (cf. Engel et Hummelinck, 1936, p. 43).

Dolabella petalifera Lamarck, 1836, p. 702, i.e., *Petalifera petalifera* (cf. Engel et Hummelinck, 1936, p. 43).

Dolabella ascifera Lamarck, 1836, p. 702, i.e., *Dolabrifera dolabrifera* (cf. Engel et Hummelinck, 1936, p. 30).

Dolabella ornata Deshayes, 1853, p. 57, pl. 89 fig. 5, i.e., probably *Phyllaplysia lafonti* (cf. Engel, 1936, p. 204).

Dolabella oahouensis Mazzarelli, 1893, p. 40, i.e., *Dolabrifera dolabrifera* (cf. Engel et Hummelinck, 1936, p. 30).

Dolabella maillardi Mazzarelli, 1893, p. 40, i.e., *Dolabrifera dolabrifera* (cf. Engel et Hummelinck, 1936, p. 30).

Summary

Our increasing knowledge of the genus *Dolabella* tends to show the great variability. Risbec (1928) pointed to the variability of the colour. Van Hasselt (1824) had already made two important remarks, one concerning the retractibility of the villi, that in the living animal cover the skin of the back, and the other his opinion, that Rumph's animal, with its tuberculate skin, is the same as his own *Dolabella* with the branching and long villi. We tried to show, that the villi are very retractile, even so that we came to the conclusion, that all species of *Dolabella* but one, form only one species, first described and figured by Rumphius and first named by Martyn: *D. scapula*, inhabiting the Indic and the Pacific from the Red Sea and S.E. Africa to Japan, Australia, Hawaii and Easter-Island, even to the West Coast of America. Only the shell described as *Dolabella gigas* by Rang (1828) is specifically different. It proved to belong to an animal that further differs from *D. scapula* in having the penis long, slender and

armed with small spines, while in *D. scapula* it is short and unarmed. It was recorded till now from Mauritius, the Red Sea and the Moluccas (see map).

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