

STUDIES ON THE FAUNA OF CURAÇAO AND OTHER
CARIBBEAN ISLANDS: No. 212

NOTES ON THE CARIBBEAN CROWN CONCH
MELONGENA MELONGENA

by

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Introduction. – Material and Methods (Figs 1–5)	148
Changes in shape during growth (Figs 6–7)	154
<i>Melongena melongena</i> (L.)	156
– – forma <i>dilatata</i> new form	157
– – forma <i>salinarum</i> new form	158
– – forma <i>nana</i> new form	160
– ‘ <i>margaritana</i> ’ Richards	161
Occurrence of <i>M. melongena</i> on Aruba, Curaçao and Bonaire . .	161
Sample measurements	164
Figures 8–23	166
APPENDIX: Annotated list of material studied (Figs 24–27)	177
Literature	188

INTRODUCTION

The interest of the second author in the variability of *Melongena melongena* (L.) was aroused by the discovery of a population of dwarf specimens living in shallow tidal pools connected with the mangrove lagoon of Lac, Bonaire, in 1976 (see Figs 1–4). Further collecting resulted in bringing together a rather large number of recent and subrecent shells from various Caribbean localities which served as a base for the present study (see Appendix).

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Fig. 1. *Salicornia* flat with shallow creeks (near 8 m high *Avicennia*) along the western border of Lac near Punta Wanapa. These small pools in which *M. melongena* fo. *nana* occurs may become brackish after (incidental) rains, and possibly rather saline in periods of drought.



Fig. 2. Three dwarf *Melongena* specimens (*M.m.* fo. *nana*) of about 35 mm long, crawling in a 10 cm deep muddy pool, formed by a solution hole of the limestone terrace near Punta Wanapa (Bonaire), the edges of which offer a firm substrate to *Batophora oerstedii*.



Fig. 3. *Rhizophora* pool near Palu Grandi, Lac, Bonaire. The difference between high and low tide at the time that most living *M. melongena* fo. *nana* specimens were collected (15/16 September 1967) was only about 20 cm; the chloridity varied between 22 and 25‰, the temperature between 26 and 37°C.

HUMMELINCK's material has been deposited in the ZOÖLOGISCH MUSEUM VAN AMSTERDAM (ZMA, Institute of Taxonomic Zoology) with a few exceptions.

Series of 15–20 empty *M. melongena* fo. *nana* shells, 3 specimens with animal, and a few samples of fo. *nana* occupied by *Clibanarius antillensis* and shells overgrown by *Batophora oerstedii* from the Palu Grandi region of Lac, Bonaire, have been presented to the Academy of Natural Sciences, Philadelphia — American Museum of Natural History, New York — British Museum (N.H.), London (BM) — Florida State University, Tallahassee — Museo del Instituto Oceanográfico de la Universidad de Oriente, Cumaná (MIOUDO) — National Museum of Natural History, Washington — Naturhistorisches Museum, Basel — Rijksmuseum van Natuurlijke Historie, Leiden (RMNH) — Tulane University, Louisiana — University of the West Indies, Trinidad,

while 2 specimens of fo. *salinarum* from Blauwe Pan, Bonaire, and of typical *Melongena* from Great Saltpond and the Arawak shell mound in Jamaica have been presented to BM, MIOUDO and RMNH.

The photographs of Figs. 5–23 were made with the expert aid of Mr. H. VAN KOOTEN and Mr. L. W. VAN VEENENDAAL of the Zoological Laboratory of Utrecht University. We are greatly indebted to Mrs. N. E. NANNENGA-BREMEKAMP for valuable comments and her correction of the English text.



Fig. 4. The Palu Grandi region as seen from the air towards the northwest, showing the shallow creeks between the mangroves in which *M. mel. fo. nana* still survives. The Isla di Juwana – in the middle – consists of limestone and is about 50 m wide. Compare Figs 26 and 27. (Phot. W. P. TER HART)

MATERIAL AND METHODS

Of each specimen the shell length (L), the shell width (W) and the height of the aperture (H, see below), and of many the weight, were measured. Furthermore the number of spine rows and the number of spines per row were counted; Sp 1,4,3-2 means that there are three apical rows, the uppermost one with 1, the middle one with 4 and the lower one with 3 spines, and one basal row of 2 spines. The presence or absence of an anal notch was noted. These characteristics and the average plus the deviation of the ratios H/L and W/L were compared per lengthclass. Each lengthclass covers 5 mm. So, for instance, the average H/L with its deviation for shells in the lengthclass 20-25 mm from population A, were compared to the average H/L and its deviation for specimens measuring 20-25 mm from population B etc. The results of many measurements can be found in the List of Sample Measurements and the Appendix.

H is the distance between the lowermost point of the columella and the point where the outer lip would meet the upper margin of the columellar callus, if there were no anal notch.

Subrecent shells from one and the same locality showing a great mutual resemblance have been treated as populations.

It is of importance to know, whether a specimen is recent or not, especially when no living population has been observed in the locality studied. However, it is often difficult to ascertain this. The coloration is not of much help. Fresh specimens, though usually dull purplish brown may vary from bright chocolate brown to, rarely, orange, pink or whitish. Subrecent shells often are still coloured, or they may be completely bleached. In some cases traces of periostracum in the grooves between the growing lines or in the suture channel prove that the shell is fresh. These traces may be hard to locate or dirt may be confused with them. Therefore, it is prudent to study the suture channel at a magnification of $40 \times$. Also helpful, if studied at the same magnification, is the structure of the outer surface of the shell: if it is still intact we can be fairly sure that we have a fresh specimen, if it is not, it does not prove much, as even living animals may have a corroded shell surface.

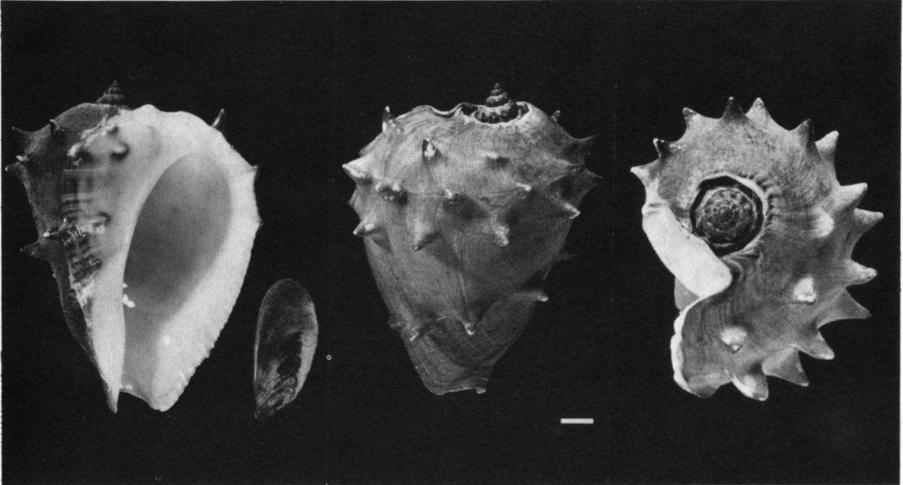


Fig. 5. *Melongena melongena* s.s. from Spaans Lagoen, Aruba, collected alive with an intact periostracum covering a spiral-banded purplish-brown design (L = 110 mm). This specimen has a well-developed anal notch and 4 rows of prominent spines, i.e. 3, 7 and 7 in the upper (apical) rows, and 5 in the lower row (abbreviated: 3,7,7-5). White scale bar in all figures = 10 mm.

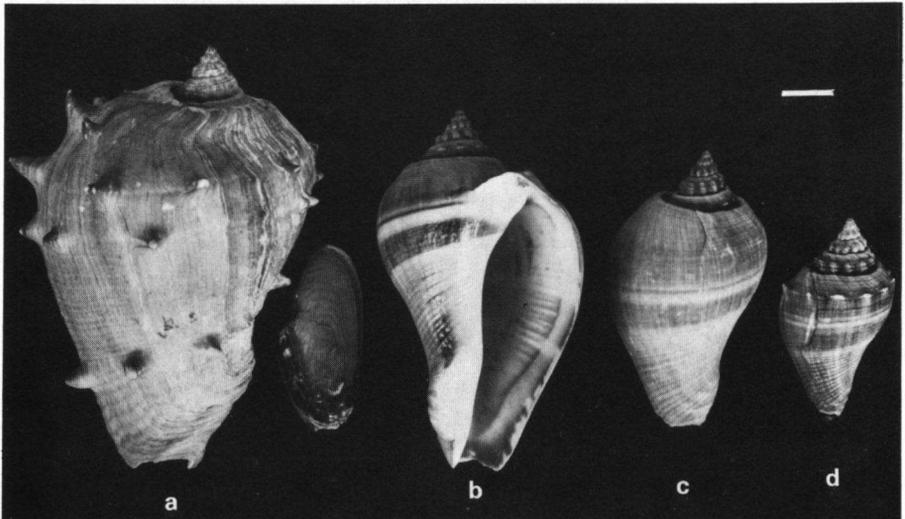


Fig. 6. Changes during growth in *M. melongena* s.s. from Haiti. Note that the smallest specimen (d) is exactly like fo. *nana* (compare Figs 18a, 19a, b and 20b, c). Compared with the shells from Spaans Lagoen (Fig. 8) and the Arawak conchs from Jamaica (Fig. 9) these shells are not very spinose. Only the largest one (a, L 83) has four rows of spines (Sp 3,6,7-5); b (L 68) has only one spine (not visible in the picture) and c (L 55) is spineless. See Appendix.

CHANGES IN SHAPE DURING GROWTH

Melongena melongena (L.) has been described and figured by CLENCH & TURNER (1956) in their monograph. In the following we will give some additional information.

M. melongena is a polymorphous species. For one thing there are great differences between small and large specimens (compare Fig. 6): for instance with increasing length it develops an anal notch, the aperture becomes relatively higher (the ratio H/L increases), the spire more depressed, the shell relatively wider (the ratio W/L increases) and more spinose (but in this respect there are great differences between different populations, compare for instance Figs. 9 and 11). We have the impression that at a length of about 9 cm the increase in W/L comes to a standstill or, possibly, continues, but at a much slower rate. Because of these gradual changes during growth only shells with (about) the same length can be compared. If we do so we find that the H/L value for each length-class is normally rather constant per population, but that populations often differ from each other in this respect. Other differences that can be found between populations are in the average weight per length-class, the length at which the first spines arise and the number of spines. In most cases shells with a high H/L value are heavier than those with a lower H/L value. There is no reason to name the different populations as they are rarely sharply differentiated and as there are many transitional populations. Besides, if we consider the species as a whole, the variability of these characters is continuous.

We have the impression that differences between populations in H/L disappear at a length of about 8.5 cm. Longer shells usually have a H/L of (.78–) .85–.95 (–.98). This means that about this length *Melongena* reaches, with regard to the H/L, its ultimate shape and that this is nearly identical for all populations, recent as well as subrecent. The length at which the ultimate shape is attained differs per population: in populations with a relative high H/L it is, of course, reached at a lower length than in populations with a low H/L value.

With regard to the weight we see something similar: in shells with a length of 5.5–10 cm there are usually differences in weight between populations when length-classes are compared. Whether there are differences in weight between populations when shorter shells are compared, we have

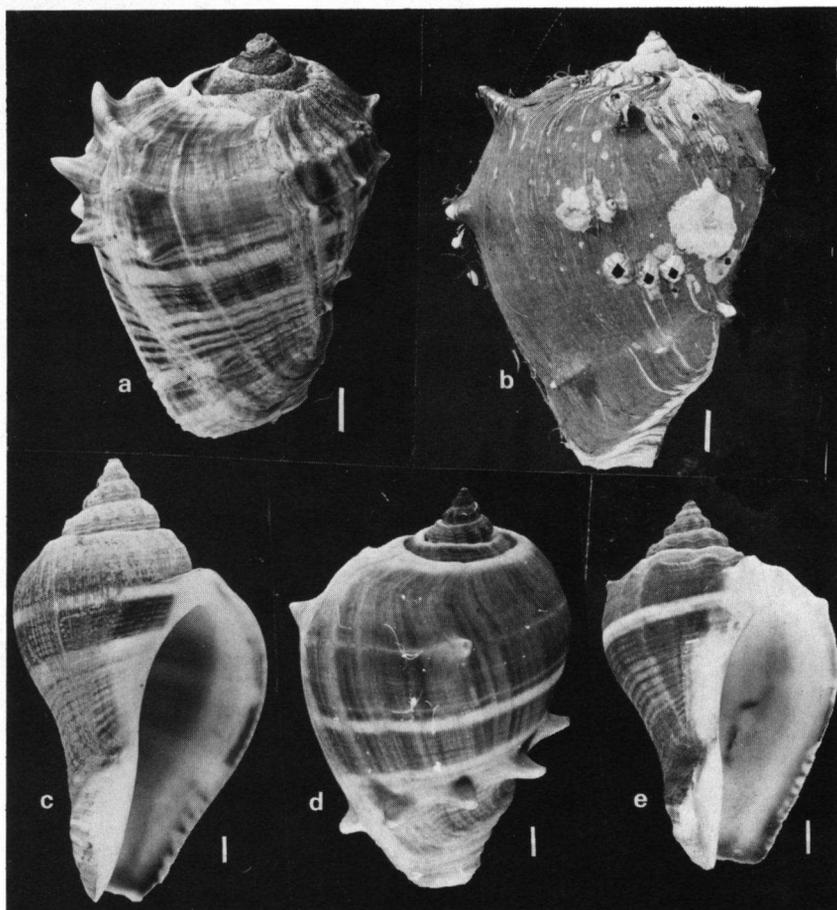


Fig. 7. A blunt basal angle is often found in large specimens, such as in those of Cayenne (a, L 108) and Trinidad (b, L 104). The smaller shells having a less blunt basal angle, are from three distant localities in the Caribbean: Belize (c, L 53), Santo Domingo (d, L 60) and Aruba (e, L 55).

not been able to ascertain as the error of our measurements is too large. In shells longer than 10 cm the difference in weight per length-class between populations seems to vanish. However, we have not seen enough large shells to be sure that this is always true. Of course, with increasing length the shells continue to gain weight. In the end they may become very heavy. We found a subrecent Jamaican (Palisados) specimen of 15.5 cm that weights 530 grams (Fig. 10d), while an "indian conch" of 14.5 cm length from Curaçao (Tafelberg) was estimated at 650 grams.

A recent population with a high weight and a high H/L that reaches its ultimate shape early is found in Venezuela, at Irapa, Gulf of Paria. It is very spinose with blunt spines, massive and very heavy. A recent population with a relatively low weight and a low H/L is found in Spaans Lagoen, Aruba (Fig. 8).

A remarkable population is that of Esparki, Los Roques. These shells are off-white with pale inconspicuous light brownish or orange-brown and pale yellow bands. Older parts of the same shell may have a darker, more normal coloration. Apart from the paler colour they do not differ from *M. melongena* s.s.

We did not study *Melongena melongena* subsp. *consors* (Sow.), but would call attention to the fact that of both recent and subrecent specimens observed by us, a few showed certain similarities with this subspecies as described and figured by WOODRING (1964, p. 263, pl. 44) in having a "thick parietal callus filling space between apex of anal notch and suture on later part of mature body whorl".

***Melongena melongena* (L.)**

M. melongena s.s. usually attains about 10 cm, but may reach a length of 18.2 cm (fide CLENCH & TURNER 1956). The largest recent specimen seen by us measured 15 cm. Subrecent specimens are often somewhat larger: many 12–13 cm, a few 15–16 cm long. Specimens of 5 cm and more have (0) 1–3 (4) rows of solid spines, (0) 1–2 (3) above and (0) 1 below; if there is only one row, this is usually one of the uppermost ones. Specimens longer than 8 cm as a rule have 2 or 3 spine rows above and 1 below. With increasing length the spire becomes more depressed. Large shells always have an anal notch.

CLENCH & TURNER (1956, p. 168) described the range of this species as "From Tampico, Mexico south and east along the coast of Central and northern South America as far as Dutch Guiana. In the West Indies it occurs only in Cuba, Isle of Pines, Hispaniola, Jamaica and some islands off the coast of South America." We can extend this range with French Guiana (Cayenne), Grenada, Barbados (subrecent) and Martinique. Taking into account the curious fact that the species is unknown from Puerto Rico, and has not been found in the mangrove habitats of St. Martin, Barbuda, Antigua and Guadeloupe, an old museum record from the Virgin Islands (see Appendix) needs confirmation.

Though we are convinced that a more thorough study of this polymorphous species will result in discerning a number of formae – already justified by practical reasons, notably with regard to the large subrecent shells from Curaçao and Bonaire – we confine ourselves, with a view to the limited scope of this study, to the description of three new forms, which can be identified with the following KEY.

- 1a Shell rarely more than 4.5 cm long (dwarfforms) 2
 1b Shell larger 3
- 2a Shells longer than 3.2 cm always with three or more rows of prominent spines (smaller specimens often less spinose); H/L relatively high (see Table) *M. melongena* fo. *salinarum*
 2b Shells as a rule with only one (upper) row of inconspicuous spines; H/L relatively low (see Table) *M. melongena* fo. *nana*
- 3a Aperture expanded, shell thin *M. melongena* fo. *dilatata*
 3b Aperture not expanded, shell not conspicuously thin *M. melongena* s.s

Forma dilatata, new form (Figs. 17, 21f)

Shell length 1.6–4.9 (–6.6) cm in Laguna Maritas (on Margarita) and 8.9–10.4 in Laguna de Chacopata (on the adjacent mainland), shell width 0.9–2.9 (–4.3) cm and 5.8–7.2 cm respectively. H/L relatively high. Small specimens without, larger ones with an anal notch. Shells not very spinose:

0–2 upper spine rows of 1–10 (12) spines. The large shells (almost) aspinose with 0–1 row of 2 spines. Coloration probably dull purplish brown (hard to judge because of the periostracum). The inner enamel layer is, except for in very large shells (10 cm), thin so that the colour of the shell shines through. (In the other formae the inside is generally white and not transparent.)

Holotype. Venezuela: Edo. Nueva Esparta, Margarita, Laguna de las Maritas, Punta e'Perra. Collected alive on muddy sand in mangrove area, 11.VI.1969, MIOUDO; 6.6 cm long, with operculum. — **Paratypes:** same locality, 5.7 and 5.7 cm long.

Distribution. Venezuela: Margarita island, Laguna de las Maritas (Punta e'Perra and near Punta Mosquito), and Laguna de Chacopata, on the opposite mainland of the Peninsula de Araya (see Appendix).

Fo. dilatata differs from *M. melongena* s.s. in the more expanded aperture (hence the name) and the thin shell. Its H/L is relatively high, but not exceptionally so. What is unusual, however, is that, due to the thin shell, the high H/L is not coupled with a high weight.

The 30 specimens from the Laguna Maritas seen by us are small, up to 6.6 cm long; the 3 specimens from the Laguna de Chacopata are longer, 8.9–10.4 cm, and less spinose. Yet, both are clearly very thin *M. melongena*; they have an expanded aperture and are therefore *fo. dilatata*.

Forma *salinarum*, new form (Figs. 18c, d; 19c–e; 21c)

Shell length (15–) 22–44 mm, width (6–) 11–28 (–31) mm. Usually with a rather high H/L (see Table), small specimens without, larger ones usually with an anal notch. There may be 1–4 rows of usually very prominent spines. In shells of 32 mm or more there are (almost always) 3, rarely 4, rows of spines, 2 (3) upper ones and 1 below. The number of spines per row varies from 1–10. This form is subrecent and the shells are either completely bleached or have bright orange-brown bands on a white fond and then look rather fresh.

Holotype. Bonaire: Pekelmeer, N of Witte Pan. Collected from saltlake deposits 1–3 m deep, 21.IX.1969; 4.4 cm long (Fig. 18c, d). **Paratypes:** Pekelmeer, Blauwe Pan, dug up, about 2 m deep, 2.III.1970; 4.1 and 4.0 mm long (Fig. 19d, e).

Distribution. Bonaire: a) in sandy lagoon deposits of Pekelmeer (at Blauwe, Witte and Oranje Pan), abt. 1–2 m deep; b) as empty and often subrecent shells along the northwestern border of Lac, sparsely mixed with fo. *nana*, while a single subrecent specimen has been collected from sandy beach deposits in the southeastern part of the Lac. (See Appendix.)

This form is about the only *M. melongena* which has 3 or even 4 rows of spines at a length of 32–44 mm. (We have seen only one other specimen belonging to *M. melongena* s.s. in which this was the case: a shell from St. Jorisbaai of 44 mm; see Appendix.) Because of the well-developed spines and spine rows, and because of the rather high H/L fo. *salinarum* looks like a miniature *M. melongena* s.s.

Fo. *salinarum* differs from fo. *nana* in its greater spinosity and its higher H/L (see Table). However, the H/L value found in fo. *nana* and fo. *salinarum* both fit in the variation displayed by *M. melongena* s.s.

On several occasions fo. *salinarum* has been collected mixed with fo. *nana*, e.g. in the Lac at Palu Grandi and Punta Wanapa. Fo. *salinarum* shells from these samples are old and bleached, whereas most of the fo. *nana* shells are distinctly coloured. Some bleached shells are hard to place, because they have a high H/L (typical for fo. *salinarum*), but yet, even though they are over 32 mm long, only 1, though prominent, spine row.

TABLE 1

Differences in H/L between *M. melongena* fo. *nana* and fo. *salinarum*

lengthclass	<i>nana</i> H/L (deviation)	intermediate H/L (deviation)	<i>salinarum</i> H/L (deviation)
10–15 mm	.71 (.02)		—
15–20 mm	.69 (.03)		.75 (.02)
20–25 mm	.70 (.03)		.78 (.01)
25–30 mm	.74 (.03)		.80 (.04)
30–35 mm	.75 (.02)	.78 (.02)	.81 (.03)
35–40 mm	.76 (.03)	.80 (.00)	.81 (.04)
40–45 mm	.77 (.03)		.84 (.03)
45–50 mm	.77 (.04)		—
50–55 mm	.79 (0)		—
55–60 mm	.78 (0)		—
60–65 mm	.80 (0)		—

They give the impression of being fo. *salinarum*. However, short bleached shells from these localities are often impossible to identify, as in short shells the only difference between fo. *nana* and fo. *salinarum* is in the higher H/L of the latter, and for this character there is an overlap (see Table 1).

Forma *nana*, new form (Figs. 18a, b; 19a, b; 20a–d, f, g; 21b)

M. melongena (small form), WAGENAAR HUMMELINCK & ROOS, 1969, p. 20–21, figs. 11, 51.

Shell length (10–) 25–45 (50) mm, width (6–) 10–26 (–29) mm. Usually with a relatively low H/L (see Table 1). Small specimens without, larger ones as a rule with a weak anal notch. Large specimens as a rule with one upper row of 5–9–10, not very prominent spines, and mostly no basal row. Small specimens often devoid of distinct spines. Groundcolour whitish with dull purple-brown spiral bands of varying width. The white under-ground is only visible as a few narrow spiral bands and lines. Periostracum inconspicuous, greyish (probably brown, but decolorized by the alcohol in which it has been conserved), often partly worn off, even in living specimens.

Holotype. Bonaire: Lac, Boca Jewfish. Collected alive in shallow mangrove lagoon, 24.VIII.1967; 4.3 cm long (alcohol cons.) (Fig. 18a, b). **Paratypes:** Lac, Palu Grandi, muddy sand near *Rhizophora*, 6.III.1970; 1) 4.1 cm long with one (upper) row of 6 spines (Fig. 19a); 2) 3.9 cm, with one row of 6 spines (Fig. 19b); 3) 3.8 cm, spineless.

Distribution. Bonaire: abundant along the muddy borders of the mangrove lagoon of Lac as empty shells; still living in the northwestern creeks and pools from Rooi Pedro, Palu Grandi and Punta Wanapa, sparsely mixed with empty fo. *salinarum* shells. A single fragment, very probably a fo. *nana*, was collected from a drilling in the southeastern part of Lac, in shelly sandstone, abt. 1 m deep. (See Appendix and Fig. 27.)

Morphologically this form is indistinguishable from young *M. melongena* s.s. It differs in staying small. Only a few somewhat larger specimens were collected (length 5.4, 6.1 and 7.6 cm, see Fig. 20) amongst many hundreds of “normal” ones. It is probable that environmental factors (e.g. the increased degree of salinity, cf. WAGENAAR HUMMELINCK & ROOS 1969) play a role in producing this form. Food may play a role as well.

According to BANDEL (1976) *M. melongena* feeds on bivalves, preferably thinshelled ones like *Tagelus* and *Tellina*, and probably also fishcarrion. In the Lac at the localities where living fo. *nana* is found the only living bivalve is the very small *Gemma purpura* Lea. Other molluscs found living with fo. *nana* are *Batillaria minima* (Gmel.), *Cerithidea costata* (Da Costa), *Cerithium variabile* C. B. Adams and *Persicula lavalleeana* (Orb.).

We have not been able to prove that the individuals are sexually mature. However, this seems highly likely as not a single large living specimens was collected in Lac, whereas the population of small individuals there maintains itself.

Though empty shells can be collected by the hundred, living specimens are not very common. Similar shells that may be fo. *nana* or young *M. melongena* s.s. have been collected in Bonaire (Lagoen), Martinique and the Venezuelan peninsula Paraguaná. See also Appendix.

Melongena "margaritana" (Figs. 22, 23)

Melongena margaritana Richards, 1943, p. 120–123, figs. 1, 2

A Holocene dwarfform from a limestone cliff near San Juan Griego on Margarita has been described as *M. margaritana* by RICHARDS (1943) and reduced to young *M. melongena* (L.) by CLENCH & TURNER (1956, p. 168). We have studied the holotype (Fig. 22) and two paratypes, as well as several other shells from the type locality (Fig. 23), which have been identified as *M. melongena* by VAN BENTHEM JUTTING 1945, p. 81. They differ from fo. *nana* in their mostly higher H/L, in this they are like the larger fo. *salinarum*. They are very small and without distinctive features. Therefore it is hard to place them.

REMARKS ON THE OCCURRENCE OF MELONGENA ON ARUBA, CURAÇAO AND BONAIRE

On ARUBA the species is common in Spaans Lagoen (Fig. 5), where it may reach a length of about 10 cm (average length 6.7 cm, deviation 1.2 cm), and has been recorded on several other places along the sheltered

southwest coast of the island, from the Lagoen of Oranjestad as far as the Baby Beach of Lago Colony.

On several occasions empty, small to medium-sized shells without a periostracum, but often looking fresh, were collected. Subfossil conchs which might be "indian" are rare. A small shell mound in the mangroves of Spaans Lagoen may not be indian as it is situated at a place which probably served as a landing for the long-abandoned gold mill of Balashi.

On CURAÇAO (Fig. 25), according to K. M. DE JONG (*in litt.*, see also DE JONG & KRISTENSEN 1965, p. 38), the species has not been found alive since 1961, when 6 small specimens were collected in the mouth of St. Jorisbaai. We have seen two fresh looking (but without periostracum) specimens from this locality. Fresh shells with periostracum have been collected in a muddy lagoon at Rif, between Willemstad and Piscaderabaai. Dredging in the Piscaderabaai yielded a number of specimens with a not-corroded surface.

Small, mostly not over 5 cm long, subrecent *Melongena* are washed ashore in many places. They differ from the above mentioned shells from this island in the usually higher H/L, the greater weight, and in that often the lowermost spine row has more spines than any of the upper rows and is more prominent than these. They are very much like the, also rather small (average length 5.85 cm, longest specimen 7.5 cm), subrecent shells that have been dug up from deposits of the former lagoon of St. Kruis (northwestern Curaçao, Fig. 15).

Apart from the above mentioned specimens, many, often very large "indian conchs" have been collected at several sites on the island. The large specimens from the Tafelberg of Santa Barbara (up to 14.5 cm long) very probably came from the Spaanse Water, those of the site of Kintjan (up to 15 cm) from the Schottegat area.

On BONAIRE (Fig. 26, 27) typical *M. melongena* was thought to be extinct until Brother M. ARNOLDO discovered a medium-sized living specimen at Playa p'Abau, northern Kralendijk (Fig. 20e) – a locality from which the species hardly would be expected. Large subrecent shells have been collected at several places (see Appendix and Fig. 16).

M. melongena fo. *nana* lives in the shallow pools in the northwestern and southernmost parts of the mangrove lagoon of Lac (Figs. 1–4, 26 and 27). Here, empty shells can be found in abundance, and also along the

abandoned saltponds of Cai, while a single fragment came from a shallow bore-hole northeast of Sorobon.

Subrecent fo. *salinarum* was dug up from the Pekelmeer: an imposing saltlake – evidently once a shallow lagoon – which has been transformed into condensers and crystallizers of the Antillean International Salt Company (Aisco). Typical fo. *salinarum* was also found along the northwestern shore of Lac, as empty shells mixed with fo. *nana* and a few intermediate specimens (see Table 1), while a single subrecent specimen was collected from beach deposits in the most southeastern part of Lac.

TABLE 2

SAMPLE MEASUREMENTS

(+ alive specimens)

	n	L	H	W	H/L	L ₁ /H	W/L	L ₂ /W	W/H	H/N
ARUBA										
+ Spaans Lagoen	49	54-68-99	57.5	43.5	0.85	1.18	0.64	1.56	0.76	1.32
Balashi (indian?)	6	84-99-135	89	71	0.89	1.12	0.71	1.40	0.80	1.25
CURACAO										
St. Kruis (dug up)	25	50-58-75	52	43	0.89	1.12	0.74	1.35	0.76	1.20
Piscaderabaai (dredged)	17	28-47-60	39	30	0.83	1.20	0.64	1.57	0.77	1.30
Kintjan (indian)	12	65-100-150	88	75	0.88	1.14	0.75	1.33	0.85	1.17
New Haven (indian?)	9	70-110-135	88	76	0.80	1.25	0.69	1.45	0.86	1.16
Tafelberg (indian)	13	56-112-145	98	91	0.88	1.14	0.81	1.23	0.93	1.08
St. Jorisbaai (mud flat)	9	72-95-110	84	75	0.89	1.13	0.79	1.13	0.89	1.12
BONAIRE										
Punta Palu Calbas (indian?)	8	65-74-90	70	56	0.95	1.05	0.76	1.31	0.80	1.23
+ Palu Grandi, 1601 (<i>nana</i>)	8	24-32-36	25.5	19	0.79	1.26	0.60	1.66	0.76	1.32
+ Palu Grandi, 1601A (<i>nana</i>)	12	22-35-41	25.5	20.0	0.73	1.37	0.57	1.75	0.79	1.28
Palu Grandi, 1602B (<i>nana</i>)	12	30-34.5-39	26.0	20.0	0.75	1.33	0.58	1.73	0.77	1.29
Palu Grandi, AB (<i>nana</i>)	15	32-35.5-38	26.5	20.5	0.75	1.34	0.58	1.73	0.78	1.29
+ Wanapa, 1604 (<i>nana</i>)	12	30-40-43	30.6	23.8	0.76	1.30	0.59	1.68	0.78	1.29
Wanapa, 1604 (<i>nana</i>)	45	38-41-48	30.5	24.0	0.75	1.34	0.58	1.70	0.79	1.27
San José, 1607 (<i>nana</i>)	8	41-44-46	33	25	0.75	1.34	0.57	1.75	0.76	1.32
Bacuna, 1608 (<i>nana</i>)	10	37-38.5-41	30.0	21.7	0.78	1.28	0.57	1.76	0.72	1.38
Bacuna, 1609 (<i>nana</i>)	10	36-38.5-41	30.0	21.5	0.79	1.27	0.57	1.77	0.70	1.39

Bacuna, 1609A (<i>nana</i>)	5	36-37.5-40	29	22	0.77	1.29	0.59	1.70	0.76	1.32
Palu Grandi, 1602B (<i>salinarum</i>)	13	32-33-34	26.0	21.0	0.79	1.27	0.64	1.57	0.80	1.24
Palu Grandi, 1602B (<i>salinarum</i>)	13	30-35-39	28.4	22.3	0.81	1.23	0.64	1.56	0.78	1.27
Blauwe Pan, N (dug up, <i>salin.</i>)	15	22-30-40	24.2	19.0	0.80	1.24	0.62	1.59	0.78	1.27
Blauwe Pan, Cryst. (dug up, <i>sal.</i>)	8	26-29.5-34	23.6	18.8	0.80	1.25	0.64	1.57	0.79	1.26
LOS ROQUES										
+ Esparqui	6	50-80-120	67.5	53	0.87	1.85	0.66	1.51	0.78	1.27
MARGARITA										
Juan Griego (cliff, <i>margaritana</i>)	8	16-22.5-32	17	13	0.75	1.32	0.58	1.72	0.77	1.37
+ Maritas, 1217A (<i>dilatata</i>)	15	28-41-49	33	25	0.80	1.24	0.61	1.64	0.76	1.32
+ Maritas, Perra (<i>dilatata</i>)	3	55-60-64	50	38	0.83	1.20	0.63	1.58	0.76	1.31
SUCRE										
+ Chacopata (<i>dilatata</i>)	3	89-95.5-104	83.5	68.5	0.87	1.14	0.72	1.40	0.82	1.22
+ Barbudo	3	83-91-100	80.5	63.5	0.88	1.13	0.72	1.38	0.82	1.22
+ Irapa	6	57-76-97	66	60	0.87	1.15	0.79	1.27	0.91	1.10
TRINIDAD										
+ Caroni	16	58-82-115	69	54	0.84	1.19	0.66	1.52	0.78	1.28
JAMAICA										
+ Great Saltpond	7	41-55-63	40	30	0.73	1.37	0.55	1.83	0.75	1.33
Arawak Museum (indian)	23	42-67-100	55	43	0.82	1.22	0.64	1.56	0.78	1.28
Palisados (indian?)	8	122-142-160	130	106	0.91	1.1	0.75	1.34	0.81	1.23
HISPANIOLA										
+ Haiti, Brown	4	40-61.5-83	51	39.5	0.83	1.2	0.64	1.56	0.77	1.29

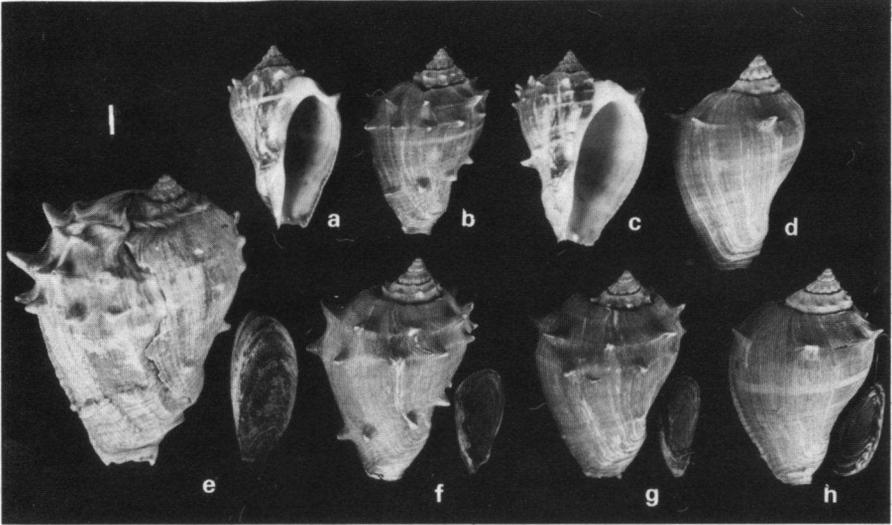


Fig. 8. Variability in a sample of *M. melongena* s.s. from Spaans Lagoen, Aruba. But for the two shells (d, h) with only one (upper) row of spines, this picture gives a fairly good impression of the "average" Spaans Lagoen *Melongena*: Only 10% of the shells larger than 5 cm has only one row of spines. The other 90% has two or more rows; in shells longer than 8 cm, there are often 4 rows (e, L 99).

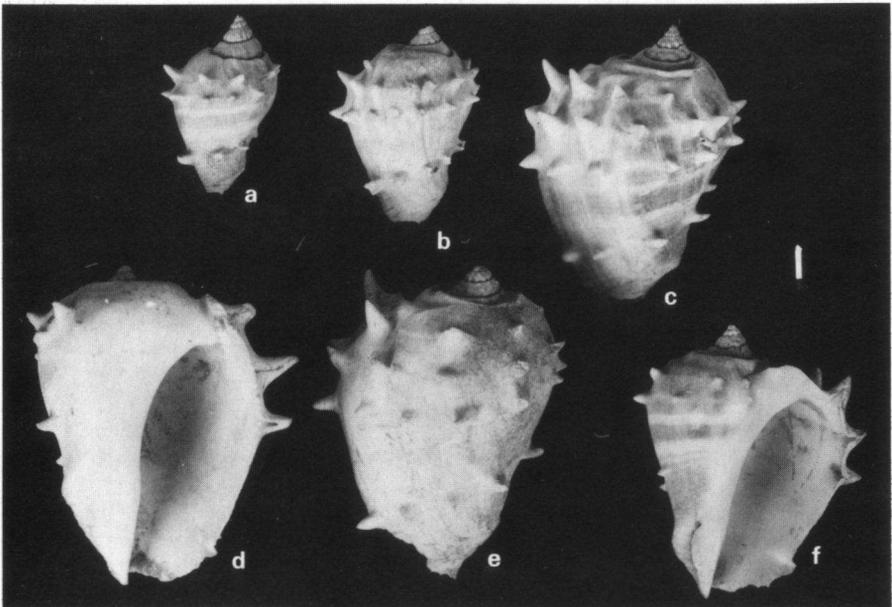


Fig. 9. Uniformity of *M. melongena* s.s. in a sample from the shell mound of Arawak Museum in Jamaica. This is – apart from the specimens from the gulf of Paria (Venezuela) – the most spinose *M. melongena* s.s. seen by us: about half of the specimens (and only two of these are longer than 8 cm!) have four rows of spines. Apart from being more spinose these subrecent conchs are remarkably like the recent ones from Aruba (compare Fig. 8). Note the two tipped spines in b (lower row). Two tipped spines are found in this sample only, though there is a tendency towards them in some fo. *salinarum* specimens.

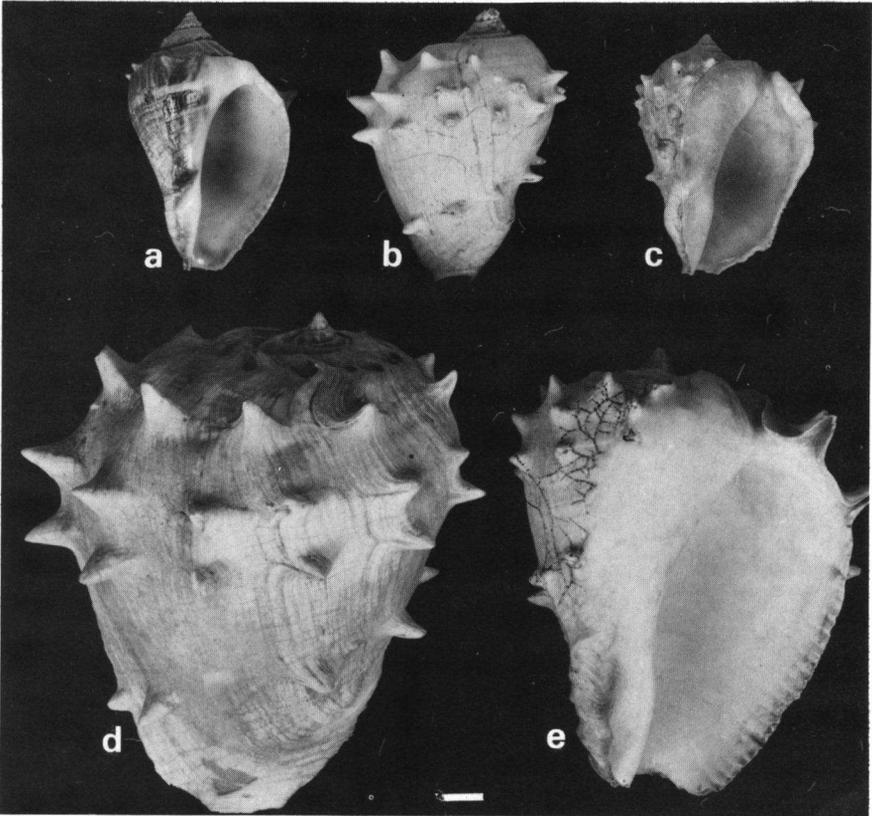


Fig. 10. Differences and similarities in Jamaican *M. melongena* s.s.: a, alive specimen from the entrance of Great Saltpond (L 74); b-c shells from the Arawak Museum site; d (L 155) and e from a pile of subrecent conchs on the Palisados.

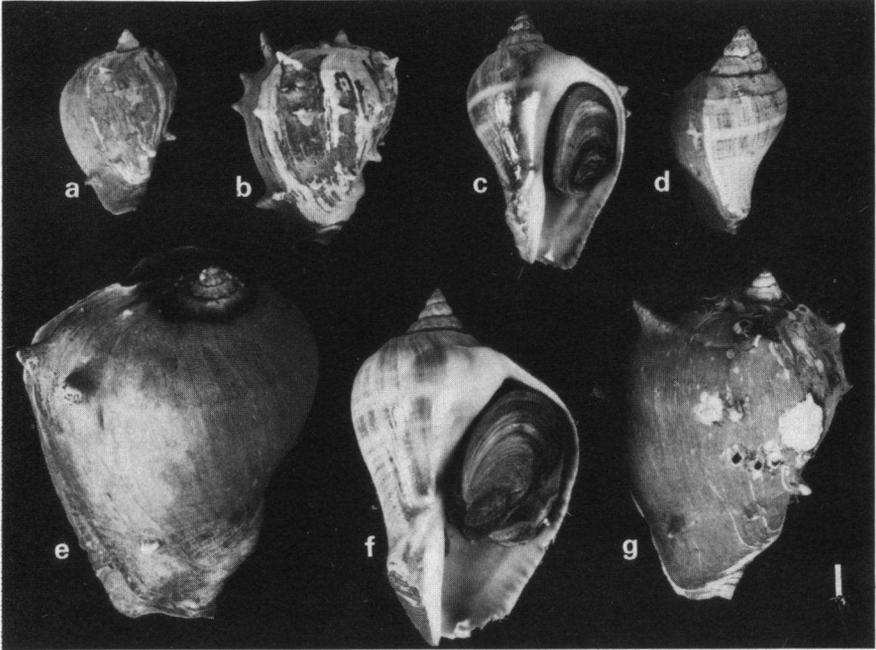


Fig. 11. Not very spinose *M. melongena* s.s. from the Caroni Swamp in Trinidad, the periostracum of which is coming off in axial fibres (g = Fig. 11b), together with a large conch from a sandy locality in Tortuga (e, L 120). The specimens from the Swamp show a remarkable variability, as they include large smooth shells (f, L 115) as well as small specimens with four spine rows (b).

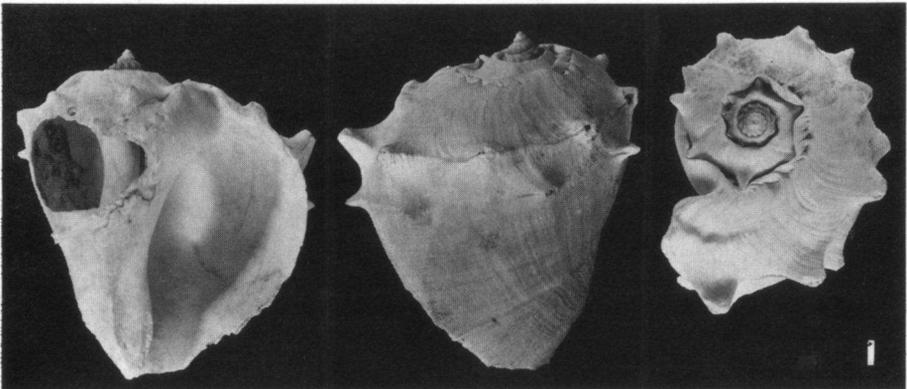


Fig. 12. A large "indian conch" (L 135) with artificial hole from the northern slope of the Tafelberg of Santa Barbara near Spaanse Water, Curaçao.

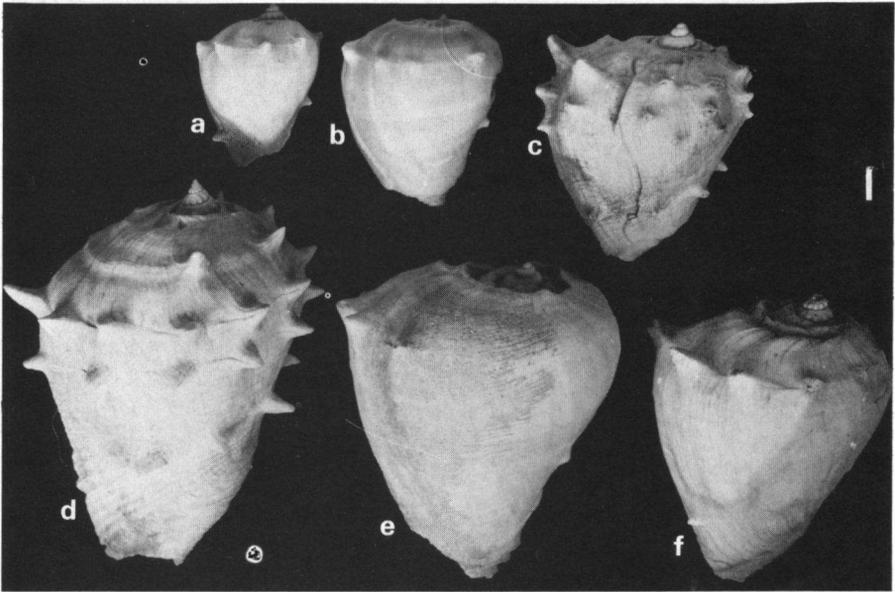


Fig. 13. "Indian conchs" from localities near Spaanse Water and St. Jorisbaai: New Haven, c (L 98) and Tafelberg, d and f (L 165 and 125), and St. Jorisbaai, a and b (L 50 and 58) and Seroe di Boca, e (L 135). These shells differ from typical *M. melongena* in being often topshaped and less spinose (a, b, e, f), compare Fig. 14 and 16 where similar shells are figured. Note the repaired fracture in c. Such repaired fractures are not at all rare (see also Fig. 15a and 20f).

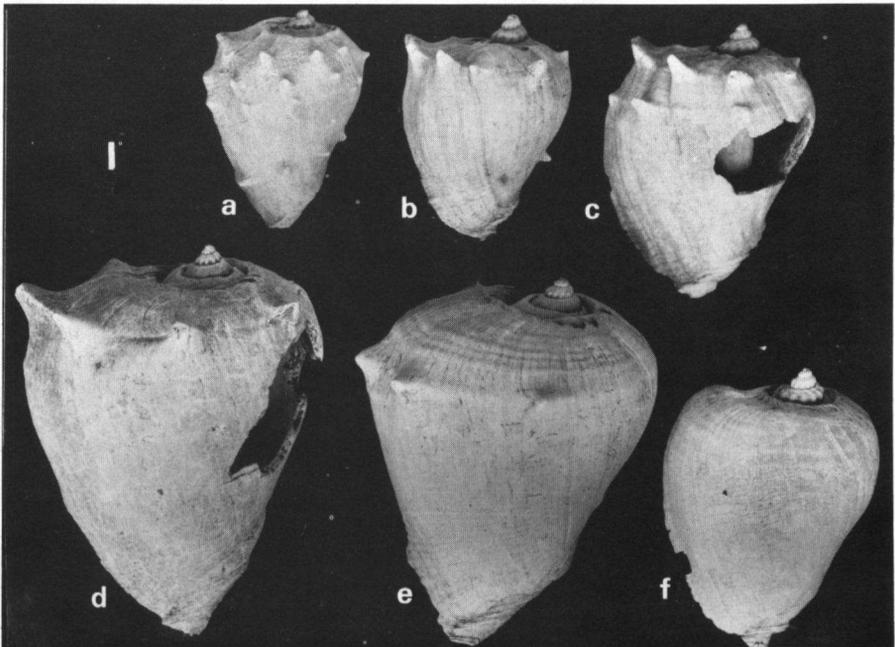


Fig. 14. "Indian conchs" from the site of Kintjan, near Willemstad. Note the similarity of these shells with those of Figs 13 and 16. Largest two specimens: L 140 and 135; smallest L 75.

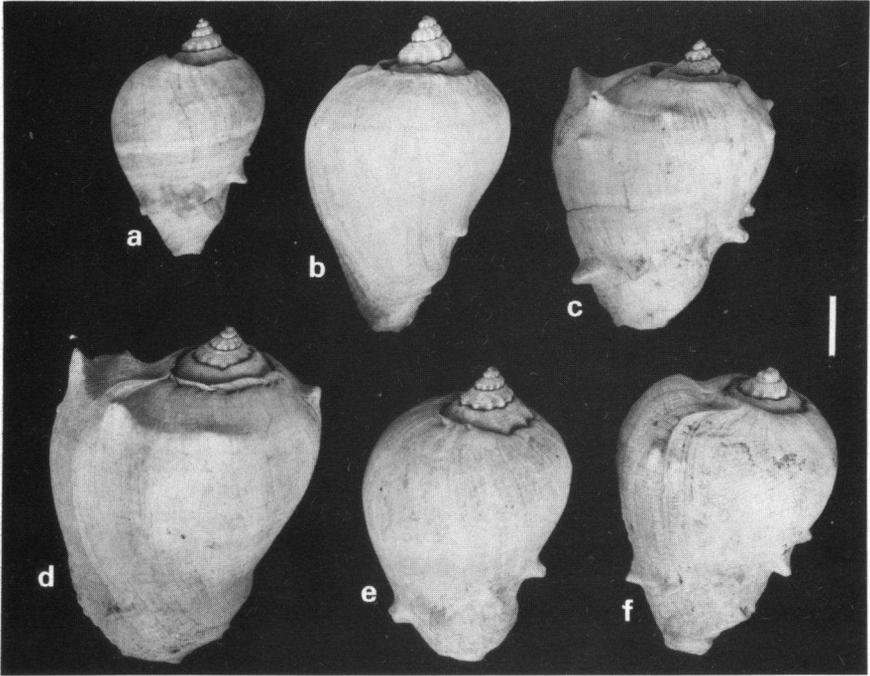


Fig. 15. Subrecent *M. melongena* from the lagoon deposits of St. Kruis (Santa Cruz) in western Curaçao. The specimens of this locality are remarkable because of the domination of the lower row of spines. Note the similarity of d with Figs 13a, b and 14b, and also that of 15a and 16a.

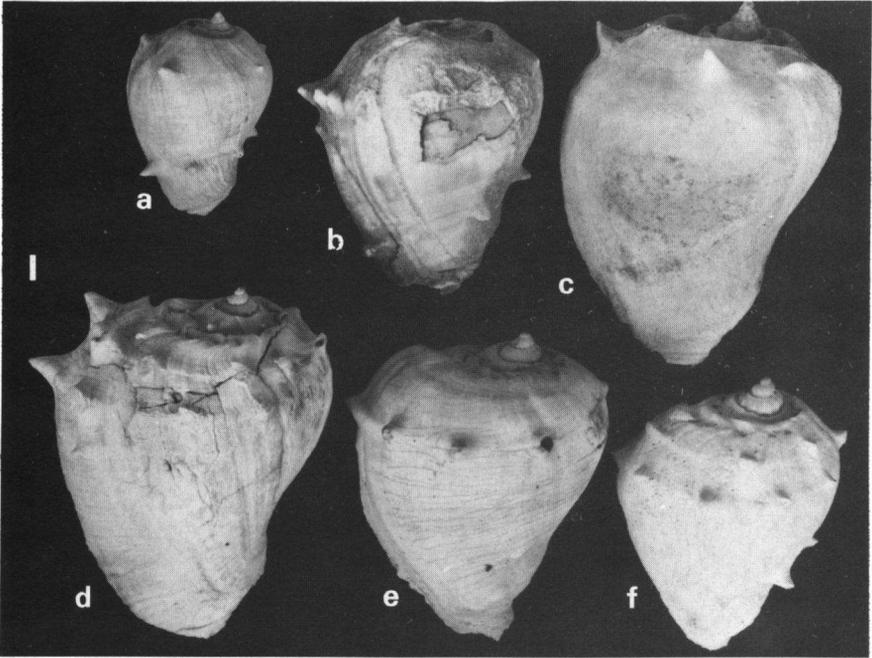


Fig. 16. Subrecent *M. melongena* from Bonaire: from the Lac region (Punta Calbas, a, b, f, and Isla di Pedro, c) and from the entrance of the saltlake of Goto (d, e). Note the artificial hole in b which, evidently, has been repaired. See also captions of Figs 13 and 15.

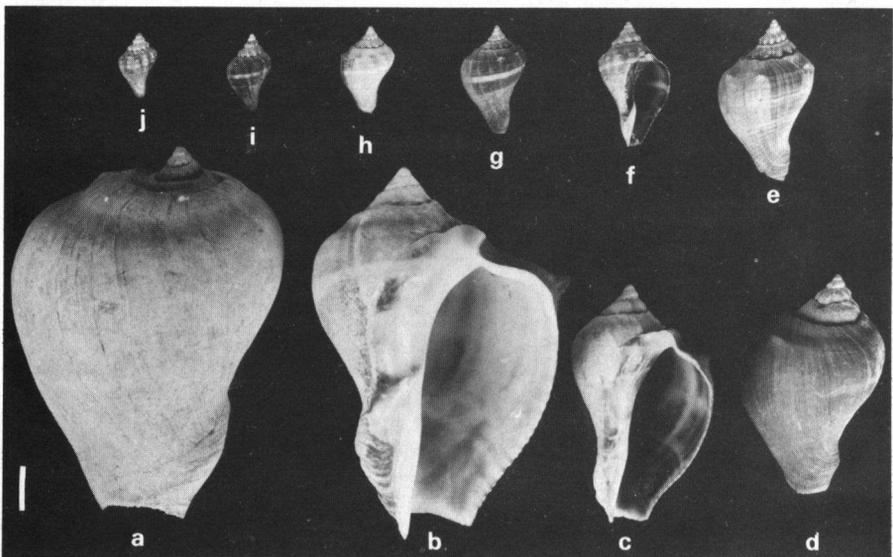


Fig. 17. Changes during growth in *M. melongena* fo. *dilatata* in samples from the Laguna de Chacopata, Peninsula de Araya (a, L93, and b) and the Laguna Marites, Punta e'Perra, on the neighbouring Margarita island (c-j).

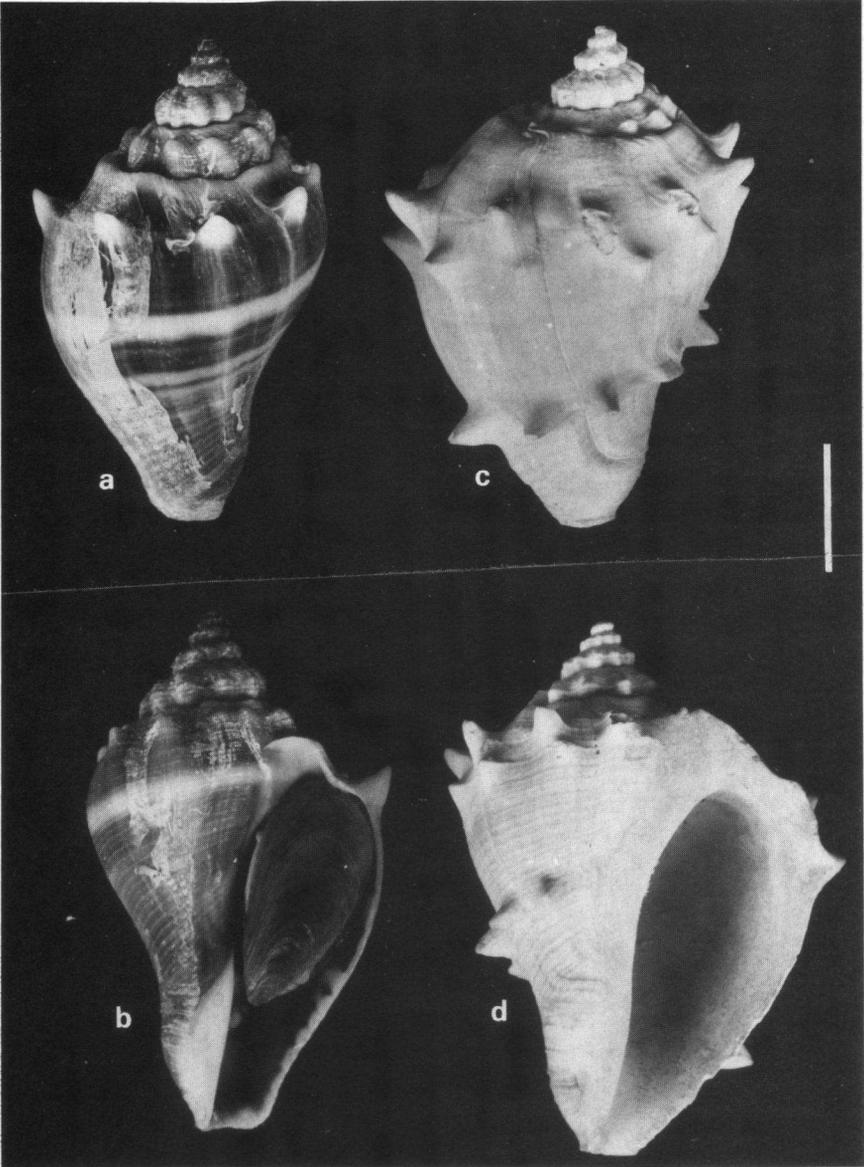


Fig. 18. Holotypes of *M. melongena* fo. *nana* (a, b) from Lac (Boca Jewfish), and fo. *salinarum* (c, d) from the Pekelmeer deposits (Witte Pan). Note that fo. *nana* is undistinguishable from young *melongena* s.s., and that fo. *salinarum* is far more spinose and, except for its size, more like large *melongena* s.s. Measurements of *nana*: L 43 H 33 W 24 Sp 9-0; of *salinarum*: L 43.5 H 37 W 30 Sp 9,8-7.

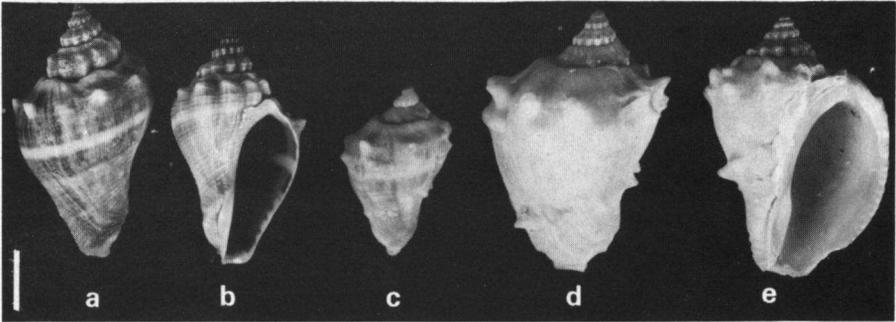


Fig. 19. Paratypes of *M. melongena* fo. *nana* from Palu Grandi (a, b) and of fo. *salinarum* from Blauwe Pan (d, e) together with a small subrecent specimen of fo. *salinarum* (c, L 27, recognizable by the presence of two upper and one lower spine rows) from the Palu Grandi region.

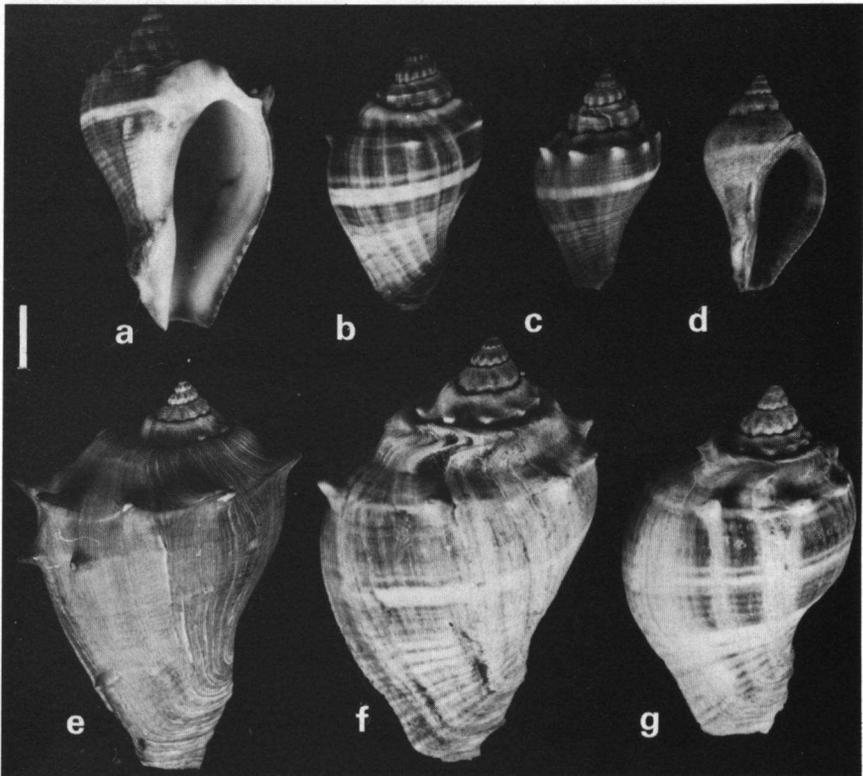


Fig. 20. A specimen of *M. melongena* s.s. from the collection of Brother M. Arnoldo, found alive at Playa p'Abau, Bonaire (e, L 66), compared with fo. *nana* of normal (b, L 46; c, L 39 and d, L 38), large (a, L 54) and exceptionally large (f, L 74, M. Beerman coll.; g, L 61) size. In the largest two *nana*'s the growth pattern in the last part, viz. the "extra" part, is irregular. In g this can be seen in the two white axial bands on the bodywhorl (centre), which were formed in periods of very slow growth; in the largest specimen, f, several growth-stops (these can be seen near the suture) as well as two repaired fractures (centre and left of the centre) can be seen. This irregular growth-pattern seems to indicate that this, for *nana* abnormal size, was only laborously obtained.

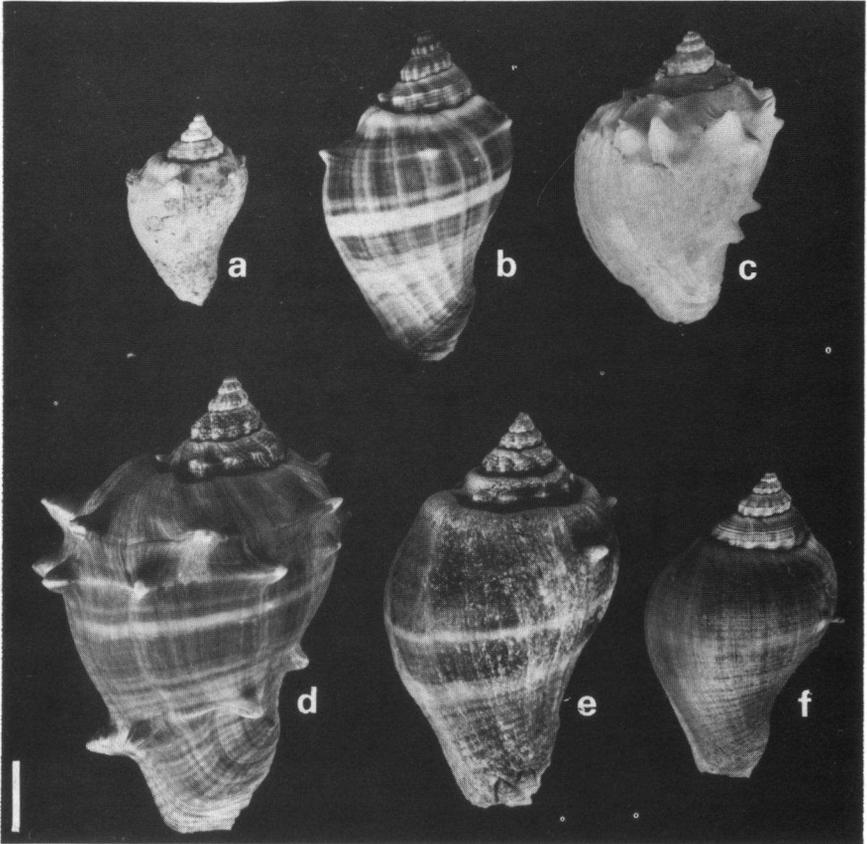


Fig. 21. *M. melongena* s.s. from Spaans Lagoen, Aruba (d, L 63) and Great Saltpond, Jamaica (e, L 56), compared with specimens of fo. *dilatata* from Margarita (f, L 44), fo. *nana* (b, L 46), fo. *salinarum* (c, L 41) and "*M. margaritana*" (a, L 28).

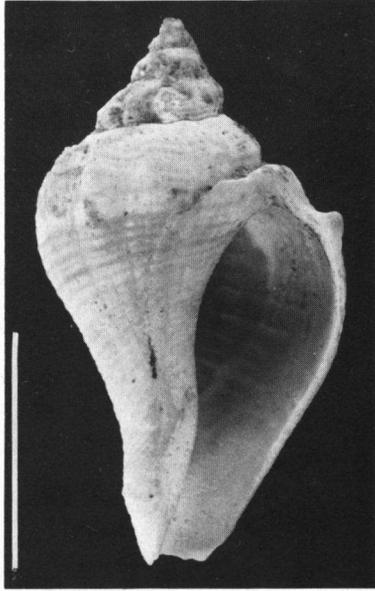


Fig. 22. Type specimen of *M. margaritana* Richards from a cliff of marly limestone in San Juan Griego, Margarita (Acad. Nat. Sci. Philadelphia 14931, L23).

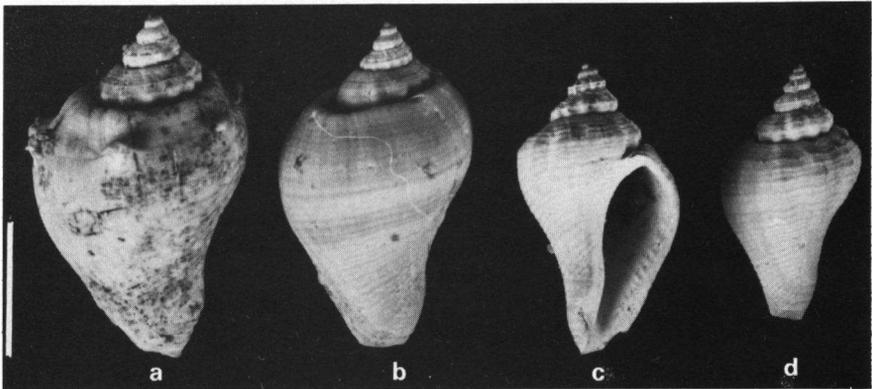


Fig. 23. Specimens from the type-locality of *M. margaritana* Richards, which could equally well be juveniles of *M. melongena* s.s. or of fo. *salinarum*.

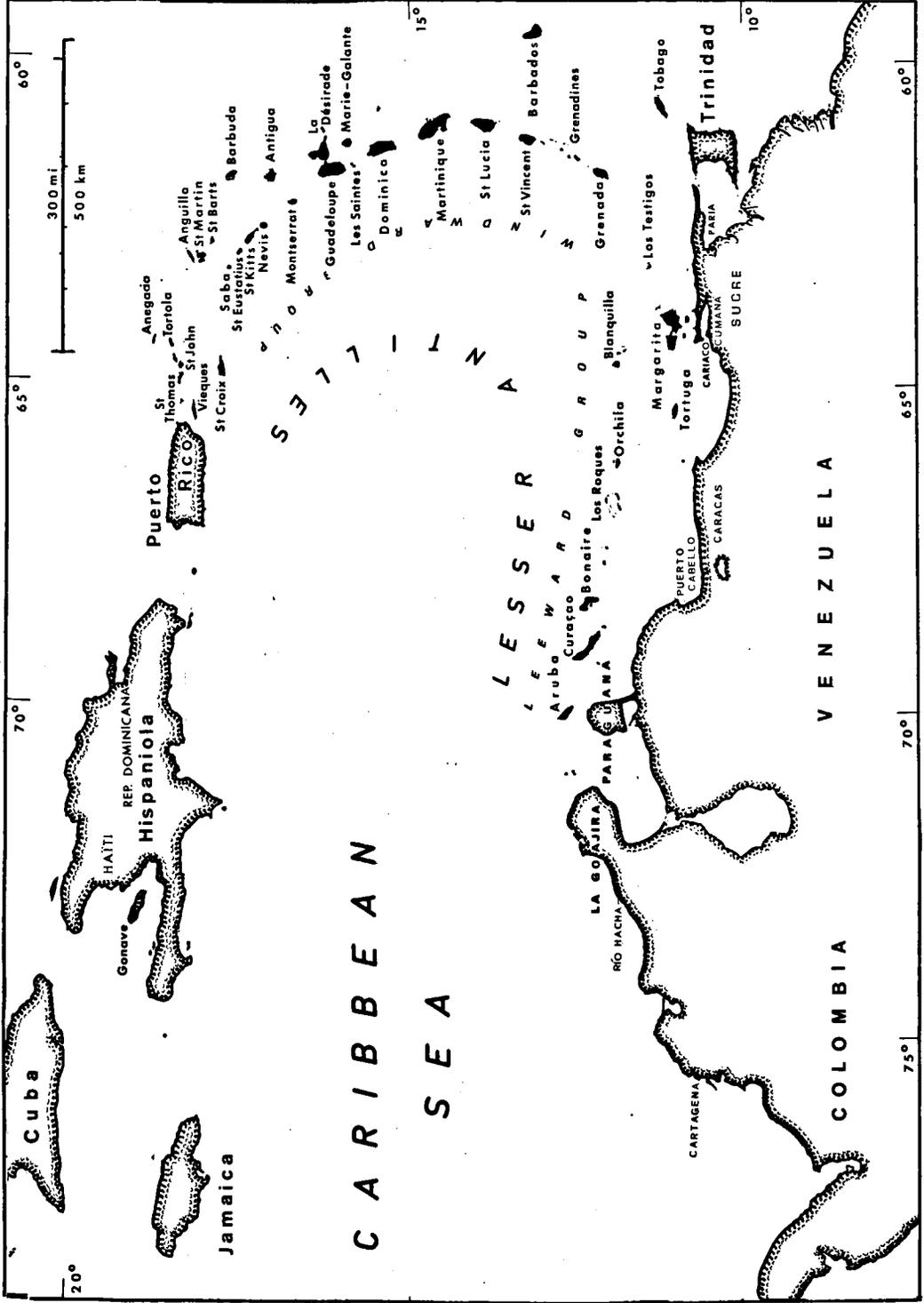


Fig. 24. Sketch-map of the Lesser Antillean region.

APPENDIX

MATERIAL OF *MELONGENA MELONGENA* STUDIED

including measurements of specimens

All specimens were collected as empty shells unless otherwise indicated: AB = by brother M. ARNOLDO (A. N. BROEDERS); HC = by H. E. COOMANS. When no collector is mentioned the specimens are collected by P. WAGENAAR HUMMELINCK, who has given a description of all localities indicated by a station number in *Studies fauna Curaçao 51*, 1977. His material has been deposited in the Zoölogisch Museum of Amsterdam (a few small samples excepted, see Introduction).

ZMA = Zoölogisch Museum, Amsterdam; RMNH = Rijksmuseum van Natuurlijke Historie, Leiden.

L = length, H = height of aperture, W = greatest width at right angles to shell axis, all in mm and estimated in case of damage. Average values in *italics*. White scale bar on Figs 5–23 = 10 mm. Sp = number of spines in upper row(s)–and lower row.

ARUBA

- Spaans Lagoen, Sta. 1008, 1.I.1949; weak design, L 80 H 73 W 55 Sp 8–3.
 — 1008a, 24.III.1970; fresh-looking, L 103 H 92 W 73 Sp 2,8,9–6 and 54 41 31 Sp 10–0; subrecent, L 88 Sp 10,7–6.
 — 1673, 24.III.1970; 2 alive, ca L 90 H 80 W 60 Sp 8,7–4 and 2,6,7–6.
 — 17.II.1967 (J. Berkhout); alive, L 101 H 93 W 76 Sp 4,7,8–6 (ZMA). — 23.II.1968 (Berkhout); alive, L 90 H 77 W 56 Sp 6,2–0 (ZMA).
 — V.1968 (AB, frère Fredericus Verberne); 2 alive, ca L 36 H 28 W 19 Sp 6–1 (ZMA).
 — VIII.1969 (AB, Verberne, C. de Jong); 6 alive, L 80 (ZMA).
 — X. 1969 (AB); 49 alive, L 54–69–99 H 57.6 W 43.6 Sp 3–10.5–20 upper 0–2.5–6 lower; 5 with 3 upper rows, 10 without lower row; 17 spec. L 65–76–92, 21–36–110 g. — Fig. 9a: L 99 H 87 W 73 Sp 3,8,8–5, 70 g (ZMA). [Figs. 5, 8, 21]
 — 21.VII.1982 (Verberne, R. G. Moolenbeek); 4 alive, L 41–46–55 H 37 W 27 Sp 6–0 (ZMA).
 — (N. E. Jacobs); ca L 150 H 140 W 110 Sp 4,7,7–5 max. 11.5 mm long (ZMA).
 — (Jim Branham); fresh, L 55 H 46 W 33 Sp 1,1–0 (ZMA). [Fig. 7]
 — (K. M. de Jong); alive, L 114 Sp 3,9,9–7 and L 114 Sp 1,6,7–4 (ZMA).
 Balashi landing at Spaans Lagoen, low mound of old shells, 1.I.1949; L 135 and 81.
 — 12.XII.1959; ca L 100. — 22.X.1967; 6, without design, L 84–100–135 H 89 W 71 Sp 0–12–24 upper 0–4.5–8 lower, mostly 3 upper rows, 2 smooth; much weathered, ca L 145 H 135 W 105 Sp about 3,4,2–7.
 Seroe Canashito, N slope, V.1949 (A. D. Ringma); indian, L 103 H 90 W 76 Sp 17,8,17–4.
 — 1.X.1968; fragm., L 150 or more.
 Seroe Canashito (?) (coll.?): fresh-looking, L 92 H 91 W 70 Sp 5,7,7–5 (ZMA).
 Cas di Paloma, 21.X.1967; subrecent, L 105 Sp 7–0.
 Bucuti, from coral rampart, 24.III.1970; beach-worn and weathered, ca L 160 and 120.

- Oranjestad harbour, dredged, VI.1947 (P. H. M. Boumans); weak design, L 53 H 49 W 40 Sp 1,6-0 and 49 43 31 Sp 6-5 and 40 33 26 Sp 7-0 (ZMA).
 Malmok Beach, 1954 (J. G. van den Berg); beach-worm, L 69 and 54 (ZMA).
 Malmok beach at Bakval, 1967 (Berkhout); L 38 H 34 W 36 Sp 8-6 (ZMA).
 Malmok mudflat, 1.X.1968; indian?, L 87 Sp 8,6-4 and L 34 Sp 3,5-6. — 15.III.1970; L 123 H 86 W 74 Sp 6,7-6 and 34 28 20 Sp 3?-0.
 Boca Prins, dunes, 26.VIII.1949; indian?, ca L 79 Sp 2,5,2-3.
 Baby Beach near Lago Colony, 1965 (Mieke Beerman); egg string.
 Spaans Lagoen 6.X-15.XI.1965 (M. Beerman); numerous embr. spec. from aquarium.

CURAÇAO [Fig. 25]

- Boca Grandi, Savonet, 30.VI.1967 (HC); old fragm., L 43 (ZMA). — 26.IV.1959 (HC); 2 old spec., L 52 Sp 7-8 and 0-4 (ZMA). — 7.II.1960 (HC); subrecent, L 41 Sp 6-4 (ZMA). — 24.II.1970; with *Coenobita clypeatus*.
 Westpunt (A. J. van Koolwijk); indian?, L 52 Sp 1?-3 (RMNH).
 St. Kruis (Santa Cruz), entrance of salina, dug up, 20.II.1970; 6, L 63. — Near sugar mill, 20-50 cm deep, with *Crassostrea* and *Chione*, 27.III.1970; 24, many of them damaged by traffic, L 48-58.5-75 H 40-52-68 W 35-43-55 Sp 0-2-8 upper 0-4-6 lower, up to 6 mm long, 5 sp. with 2 upper rows, 1 sp. smooth. — Fig. 15a: L 48 Sp 1-4; 15b: L 64 Sp 0-1; 15c: L 62? Sp 3,3-5; 15d: L 70 Sp 5-3; 15e: L 62 Sp 0-4; 15f: L 61 Sp 2-5. [Fig. 15]
 Playa Chiqui, XI.1968 (AB); slightly coloured, subrecent, L 51 W 38 Sp 5-4 (ZMA).
 Playa Spaño, III.1969 (AB); subrecent, sl. col., L 50 Sp 2-3 (ZMA).
 Santa Marta beach, 1957/1960 (HC); 3 subrecent, L 48-54-63 Sp 0-3-6 upper 0-1-4 lower (ZMA).
 St. Jansbaai, 19.IV.1959 (HC); subrecent, L 75 H 63 W 52 Sp 2,4-1 (ZMA).
 Playa Manzanilla, sta. 0136, 29.VII.1973; subfossil, L 48 Sp 1?-4.
 Piscaderabaai, Rooi Carmabi, 5.XI.1968; subrecent, L ca 70.
 Piscaderabaai, landfill N of Carmabi, dredged from entrance of inner bay, 20.VI-20.VII.1972 (J. A. van Duren); 17 fresh-looking subrecent, L 28-47-60 H 21-39-50 H 15-30-39 Sp 0-4.5-10 upper 0-1-5 lower, 3 spec. showing a second upper row of 2-4 low tubercles, 3 smooth spec.; weight of 11 spec. L 46-54-69 10-16.5-25 g.
 — IX.1972 (AB); fresh-looking, L 53 W 32 Sp 0-0 and L 42 W 27 Sp 2,3-0 (ZMA).
 Zaquito, 18.VI.1957 (HC); subfossil, L 47 H 38 W 30 Sp 0-0 (ZMA).
 Rifwater, VIII.1935 (J. Butot & L. J. Butot); 2 subrecent, L 72 H 60 W 48 Sp 6-0 and 59 49 37 8-0; 5 subrec. L 38-42-45 Sp 10-0; 4 fresh-looking L 24-34-41 H 25.5 W 19.5 Sp ca 10-0; 1 subrec. looking like fo. *salinarum* L 31 H 26 W 20 Sp 8,10-4 (ZMA).
 Schottegat, dredged, 21.II.1960 (HC); fragm., L ca 95 (ZMA).
 — dredged at Dok, VIII.1969 (AB); L 48 H 42 W 33 Sp 2-3 (ZMA).
 Kintjan, E of Willemstad, indian site, 12.I.1960 (Rijksdienst Oudheidkundig Bodemonderzoek, Amersfoort); L 84 H 76 W 62 Sp 5,6-0.
 — 6.X.1968; 12, indian, L 65-100-150 H 88 W 75 Sp 0-6-15 upper 0-5 lower, 9 without lower row, 1 smooth. Fig. 14a: L 75 H 70 W 55 Sp 5,5,4-5; 14b: L 76 Sp 7-3; 14c: L 92 H 81 W 69 Sp 6,4-0; 14d: L 140? H 125 W 110 Sp 6-0; 14e: L 135 Sp 3-0; 14f: L 100 H 88 W 72 Sp 0-0. [Fig. 14]



Fig. 25. Sketch-map of Curaçao indicating most localities in which *Melongena melongena* has been collected. See also Appendix.

Between Willemstad and Jan Thiel, 1929/30 (D. H. de Koning-Eilers); subrec., L 43 H 36 W 27 Sp 0-0 (ZMA).

Spaanse Water, Jan Sofát island, 17.IX.1968; subrec., L 70.

— Santa Barbara, 10.VII.1969 (AB); L 15.5 and 12.5 H 10.5 and 8 W 8 and 7, ca 12 ridges (ZMA).

— New haven and shore of Sta Barbara, 21.V.1970 (H. A. ten Hove); 9, indian?, L 70-110-135 H 88 W 76 Sp 6-12-19 upper 3-4.5-6 lower. Fig. 13c: L 98 H 88 W 82 Sp 6,7,4-5. [Fig. 13]

Tafelberg, Santa Barbara, NW slope, 23 & 29.X.1967; 13, indian, greater part with artificial holes, a few with traces of design, L 56-112-145 H 98 W 91 Sp 8-12-21 upper 0-3-7 lower, max. length 4-10-16 mm, estimated weight 280-350-650 g. — Fig. 12: L 135 H 125? W 110? Sp 8,6-3; 13d: L 165 H 145 W 110 Sp 4,9,8-5; 13f: L 125 Sp 9-2. [Figs. 12 & 13]

- easternmost escarpment, Cueba dos Placa, 29.X.1967; indian?, L 80 Sp 3,9?,7–5?
- Klein St. Joris, Oranjeberg, 30.III.1970; subrecent, L 80 Sp 2,3,3–4; in phosphate of limestone, L ca 60.
- near cave, 21.IX.1968; subrecent, L 47; in phosphate, L ca 94 and 75 H 83 and 70 W 65 and 60 Sp 2,1,1–2? and 2–2.
- Seroe di Boca, NE corner of St. Jorisbaai, ca 20 m high, 25.II.1970; 4, indian?, L 70–100–142 H 93 W 78 Sp 1–5–8 upper 0–3–4 lower. — Fig. 13c: L 135 H 130 W 105 Sp 3–2. [Fig. 13]
- St. Jorisbaai, SE salina, mudflat, 23.X.1968; 9, few traces of design, L 72–95–110 H 84 W 75 Sp 3–4–6 upper 0–3–4 lower, max. 6 mm. [Fig. 13]
- shore N of Isla Macuacu, 1963 (J. A. van Duren); fresh-looking, L 44 H 37 W 27 Sp 7–5 and L 33 H 28 W 20 Sp 6,3–4, the smaller one looking like *salinarum*.
- northwestern inlet, XII.1962 (A. S. H. Breure); fresh-looking, L 45 and 32.5 H 36 and 27.5 W 27 and 20 Sp 7–7 and 5–5 (ZMA).
- beach, 23.X.1968; subrecent?, L 78 H 70 W 58 Sp 1,3–5.
- near entrance on terrace, 21.IX.1958; subfossil, L 98 Sp 2,3–2?
- Rooi Rincón, Hato, 11.VIII.1949 (A. D. Ringma); indian, L 71 and 66 Sp 2,4–2 and 8,7–5.
- Mahoema, 25.I.1960 (Rijksdienst Oudheidk. Bodemond.); L 72 H 56 W 50 Sp 4–4.
- San Pedro, cultivated area, 7.XI.1968; fragment, L 40?
- Salinja Asunción, 22.X.1968; weathered fragm., L 50?
- Curaçao, 1874 (A. J. van Koolwijk); indian? L 60 and 50 Sp 5–6 and 2–5 (RMNH).
- 1888 (Epp); L 104 Sp 0–0 (RMNH).
- 1923 (G. J. H. Molengraaff); beachworn, L 80 H 74 W 59 Sp 8–2 (ZMA).

BONAIRE [Fig. 26–27]

- Pekelmeer, NE of Blauwe Pan, dug up, 14.III.1970; in marly limestone, L ca 100.
- Playa p'Abau, Kralendijk N, XII.1968 (AB); alive, L 67 H 59 W 45 Sp 7,2–2 (ZMA). [Fig. 20]
- Goto, small pile of conchs SE of saltlake, 15.IX.1948; 5, corroded, L 80?–100–120 H 90 W 80, Sp 0–6–15 upper 0–1–2 lower, 1 without. Fig. 16d: L 120 H 108 W 94 Sp 9,4,1–1. [Fig. 16]
- Between Salinja Slagbaai and Sal. Wayacá, 15.III.1970; 5 indian?, damaged, without design, L ca 60–110 Sp 4 rows.
- Lagoen, XII.1968 (AB); weak design, looking like *nana*, L 35 H 19 W 13 Sp 8–0.
- Rooi Grandi, N of Lac, dug up, 9.VIII.1967; fossil from shelly limestone, L ca 120.
- 2.III.1970; from well-hardened shell deposits, L? 65.
- Salinja di Cai, Lac, 13.III.1970; subrecent, L 125 H 90 W 67 Sp 3,1?–0.
- Isla di Chico, Lac, 17.VIII.1967; subrecent, traces of colour, L 105 H 95 W 76 Sp 2–1.
- Isla di Pedro, Lac, 18.VIII.1967; subrecent, L 126 H 110 W 96 Sp 3,0?–0. Fig. 16c: L 126 H 110 W 96 Sp 3,1?–0. [Fig. 16]
- Punta Pedro, Lac, small shell mound, 3.III.1970; 3 weathered and damaged, largest L 135.
- Punta Palu Calbas, pile of old shells at border of Lac, 5.IX.1967; 8, almost decolorized, L 65–74–90 H 80–70–87 W 45–56.5–69 Sp 4–6.5–11 upper 0–3.5–5 lower. Fig. 16a: L 66 H 62 W 49 Sp 1,5–5. [Fig. 16]

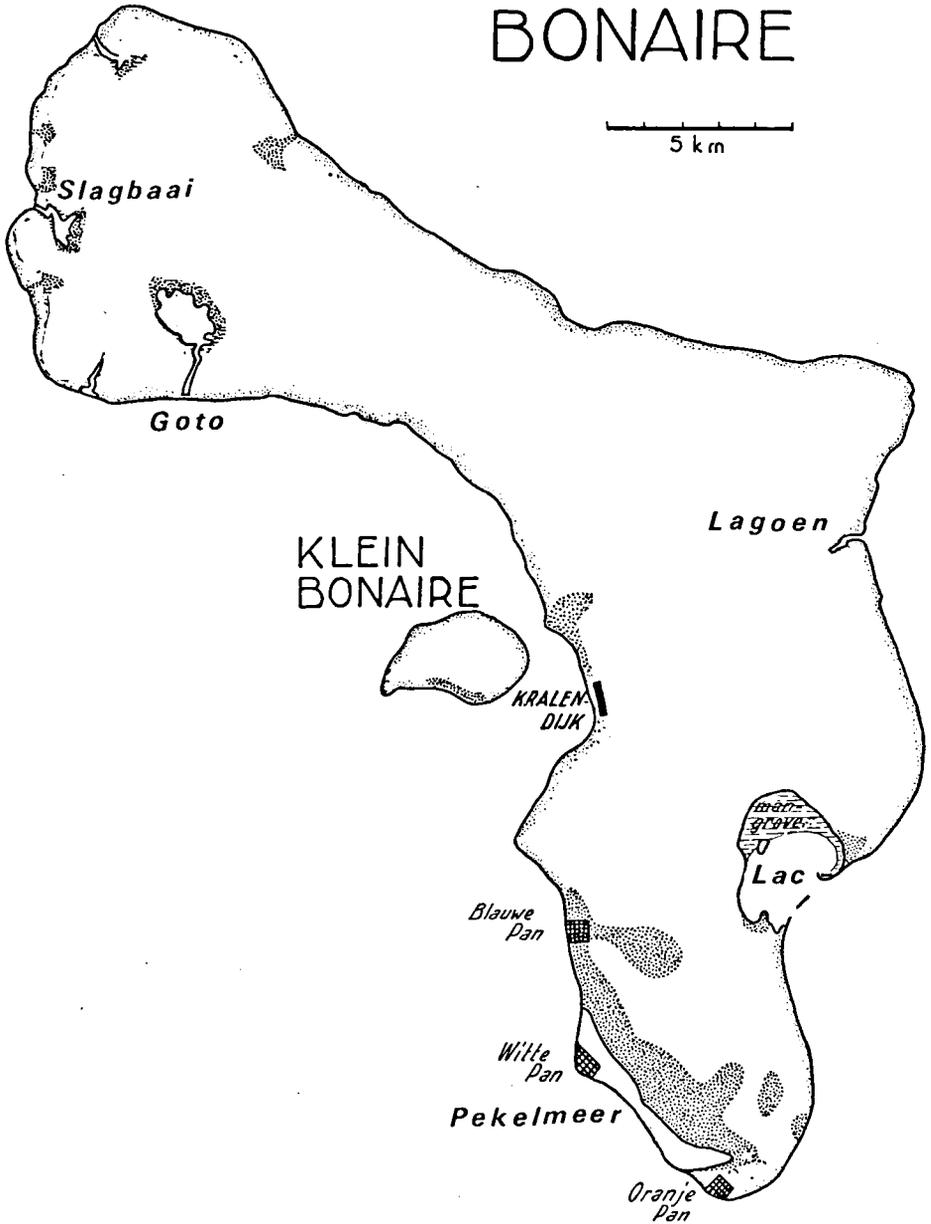
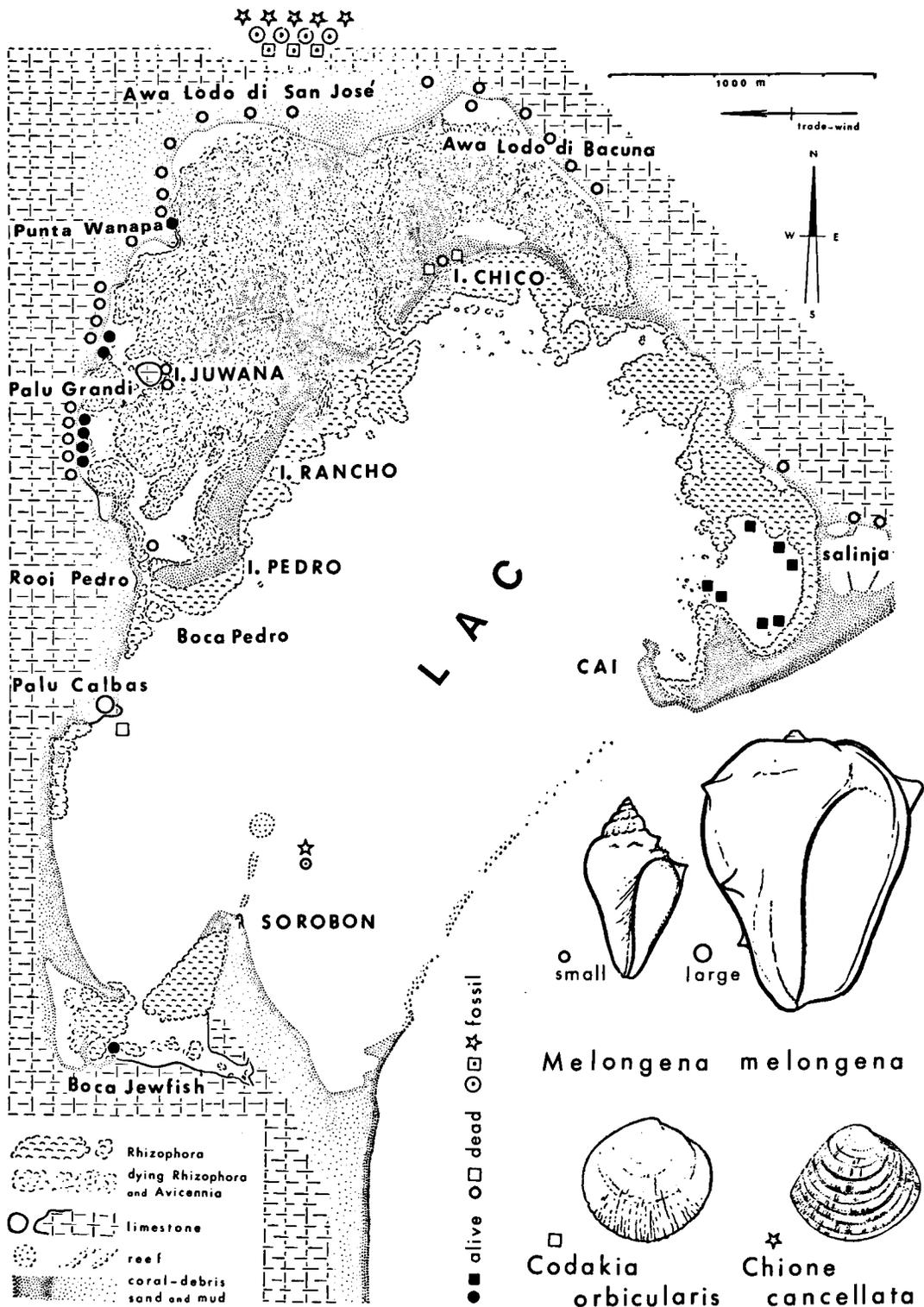


Fig. 26. Sketch map of Bonaire, indicating the localities in which *M. melongena* has been collected. See also Appendix.



M. melongena fo. *nana*

Lac

- Boca Jewfish, sta. 1596, 24.VIII.1967; alive, holotype, L 43 H 33 W 24 Sp 9-0. [Fig. 18]
 — 1598, 22.VIII.1967; L 43.
 — southeastern part, 1970 (H. A. ten Hove); 15.
 Sorobon beach, I. 1969 (AB); L 41 H 30 W 25 and L 29 H 21 W 16, Sp ca 10-0 (ZMA).
 Boca Pedro, with hermit crab, 6.III.1970 (Mieke Beerman-Paul); with periostracum, L 74.5
 H 58 W 46 Sp 9-0, 35 g, extremely large. [Fig. 20]
 Rooi Pedro, III.1969 (Lemmens); 4 alive, L 39 H 30 W 24 Sp 3-11 upper 0 lower (ZMA).
 — I. 1970 (AB); 2 alive, ca L 37 H 28 W 21 Sp 9-0 (ZMA).
 Awa di Pedro, sta. 1600, 4.IX.1967; L 39.
 Awa di Palu Grandi, sta. 1601, 31.VIII.1967; L 39.
 — 1601A, sandy mud, 0-0.5 m deep, with *Batophora* and some *Thalassia*, 31.VIII.1967;
 many, of which 12 alive, L 34, largest 61 and 56; 9 alive: L 34-36-42 H 26 W 20
 Sp 2-9-10 upper, 0 lower; 15 empty: L 31-35.5-41 H 26.5 W 20.5 Sp 3-9-10 upper, 0
 lower. — Fig. 19a: L 41 H 30 W 23 Sp 9-0; 19b: L 37 H 27 W 20 Sp 10-0. Fig. 20a:
 L 54 H 44 W 34 Sp 9-0; 20b = 21b: L 46 H 36 W 26 Sp 7-0; 20c: L 39 H 26 W 22
 Sp. 9-0; 20d: L 38 H 28 W 21 Sp 0-0; 20g: L 61 H 48 W 40 Sp 7-0. [Figs. 19 & 20]
 — 1602, sandy mud, 0-0.5 m, with *Acetabularia* near *Rhizophora*, 30.VIII.1967; 8, of which
 1 alive, largest L 44 H 33 W 26 Sp 5-0.
 — 1602A, soft mud, with *Bat.* and *Acet.*, ca 0.5 m, 30.VIII.1967; 8, of which 2 alive, L 30.
 — 1602B, 30.VIII.1967; many alive, and with *Clibanarius* crabs; 12 alive: L 30-33.5-38 H 25
 W 19 Sp 2-9-10 upper 0 lower; 15 empty: L 31-33.5-40 H 25.5 W 20. — Mixed with
 several fo. *salinarum*.
 — 25.IX.1968; 3, L 34 H 25 W 20 Sp 3-10 upper 0 lower.
 Palu Grandi, 6.III.1970; 50, of which several alive, L 38, one spec. L 51; 30: L 33-36-42 H 27
 W 21 Sp 0-7-10 upper 0 lower.
 Isla Juwana, sta. 1603, 13.VIII.1967; 3, L 31.
 — shore, 13.VIII.1967; 71, L 34.
 Punta Wanapa, sta. 1604, *Salicornia* flat, with *Bat.* and *Ruppia*, 18.VIII.1967; many, of
 which 9 alive, L 36. [Figs. 1 and 2]
 Awa Lodo di San José, sta. 1607, 28.VIII.1967; 31, empty, with operc., L 37; largest 3 spec.:
 L 46 H 35 W 27 Sp 8-0.
 Awa Lodo di Bacuna, sta. 1608, 28.VIII.1967; 48, empty, with operc., L 32; largest 3 spec.:
 L 40 H 31 W 23 Sp 6-0.
 — 1609A, 15.VIII.1967; 9, L 34.

Fig. 27. Map of the mangrove lagoon of Lac, showing the distribution of *M. melongena* (adapted from WAGENAAR HUMMELINCK & ROOS, 1969). — The lagoon is separated from the sea by a barrier of coral debris and sand. It has vast *Thalassia* flats, often with abundant *Halimeda*. *Ruppia* is found in the muddy creeks and pools of higher salinity (which occasionally may become rather brackish after rains). These shallow waters along the north-western border of the Lac are connected with the basin by a narrow channel (Boca Pedro) only. Formerly, the sandy barrier separating the basin from the mangrove flat in the north had several large openings. When, in recent times, the channels between Isla di Pedro and Isla di Chico became closed, part of the northern mangrove swamp was silted up.

Isla di Chico, 17.III.1967; damaged, L ca 45 Sp 5-0.

Awa di Salinja di Cai, 9.IX.1967; L 35 Sp 9-0.

Salinja di Cai, N part, 9.IX.1967; 11 incrustated, L 36. — One like fo. *salinarum*.

— 12&13.III.1970; 3 damaged spec.

Lac, 1969 (AB); L 50 H 38.5 W 30 Sp 8-0 max. 4 mm long; L 43 H 34 W 26 Sp weak.

200 m NE of Punta Sorobon, depth of water abt. 1 m, from boring 3'-4' deep in shelly sandstone with *Bulla*, 13.IV.1967 (H. J. M. Bussmann don.); apical part of probably large fo. *nana*, L ca 50.

M. melongena forma *salinarum*

Pekelmeer

North of Blauwe Pan, dug up from saltlake deposits, abt. 2 m deep, 2.III.1970; 16 spec., some of them still somewhat coloured; L 22-30-40 H 17.5-24-33.5 W 14-19-28 Sp 1-9.5-16 upper 0-3-7 lower; paratypes L 41 H 34.5 W 28 Sp 8,7-6 and L 40 H 33 W 27 Sp 10,8-4. [Fig. 19]

Blauwe Pan, from trench, 1-1.5 m deep, 4.III.1970; 8, four of them slightly coloured.

North of Witte Pan, dug up from saltlake deposits, 1-3 m deep, 21.IX.1967; 14, white, of which 10 measured: L 23-32-45 H 25 W 20 Sp 5-13-17 upper 0-4-9 lower; smallest spec. L 15 H 10 W 8 Sp 11 knoblike; holotype: L 43.5 H 37 W 30 Sp 9,8-7; max. length 5 mm. [Fig. 18]

Oranje Pan, dug up from salty mud, 2.III.1970; 2, of which one coloured, and 3 fragm., L 32.5.

Lac

SE of Punta Sorobon, from sandy beach deposits, 28.X.1968; subfossil?, L 33 H 26 W 22 Sp 3?,9,6?-8, last three upper spines triplicated.

Palu Grandi, sta. 1602B, 30.VIII.1967; 22, mostly decolorized, mixed with fo. *nana*, and 13 intermediate spec.; L 32.4. — Fig. 19c: L 27 H 22 W 16.5 Sp 7?,7-6 in part knob-like. [Fig. 19]

Punta Wanapa, sta. 1604, 18.VIII.1967; 2, subrecent?, mixed with many fo. *nana*, L 40 H 33 W 25 Sp 7,2-6 and L 37? W 24.

Lac, 1970 (H. A. ten Hove); one, decolorized, L 34, and 2 shells intermediate between fo. *nana* and fo. *salinarum*, mixed with fo. *nana*.

COLOMBIA

El Rodadero, ca 200 km NE of Cartagena, sandy bottom with seagrass, 1 m deep, 10.III.1978 (P. L. van Pel); 2 alive, L 85 H 74 W 61 Sp 5,6-5 and 2,6,6-5 (coll. van Pel).

Río Hacha, NE beach, 20.I.1937; recent, dark-coloured, L 74 H 64 W 49 Sp 0-0.

LA GOAJIRA, Laguna de Tucacas, W of Puerto López, yellowish-brown marly limestone, 28.I.1937; weathered, L 54 H 48 W 43 Sp 4,7-5 and L 52 H 45 W 38 Sp 5,6-5.

— lagoon deposits, 28.I.1937; subfossil, almost decoloured, L 88 H 74 W 63 Sp 2,1-3 (heavy, 140 g).

— muddy shore, 15.I.1937; subrecent?, weak design, L 70 H 59 W 45 Sp 6-2.

— muddy shore, 28.I.1937; recent, weak design, L 70 H 54 W 51 Sp 2,5-2.

With regard to the material of La Goajira and Paraguaná see VAN BENTHEM JUTTING 1945.

VENEZUELA

- PARAGUANÁ, Escarpment near Carirubana, 17.II.1937; from marly limestone, L 95 H 84 W 70 Sp 5–5 up to 5.5 mm long.
 — 21.II.1937; weathered, L ?41 H 34 W 27 Sp 5–6 ridged.
 — near Bahía de las Piedras, at salina, 24.II.1937; marly shell bed N of Carirubana, weak traces of design, L 67 H 59.5 W 45 Sp 4–0 and L 67? W 45 Sp 2,2–4 up to 4 mm long.
 — salina near Bahía de las Piedras, 24.II.1937; 4, subrecent, L 26–28–29 H 20.5 W 15 Sp 0–5 upper, 0 lower, knobby.
- LOS ROQUES, Esparquí-Oeste, clear water on fine-grained sand, 0.5–2 m deep, 6.VIII.1963, Colección Museo del Instituto Oceanográfico de la Universidad de Oriente (MIOUDO); 4, alive, light yellowish brown or sand-colour without distinct design, L 50–61–72 H 51 W 32–40–49 Sp 9–22–16 upper 1–3–5 lower, max. 6 mm long, 11–28–49 g.
 — clear sand, 6.VIII.1963, MIOUDO; 2, fresh, sand-colour, with remnants of periostracum, almost without design, L 120 H 11 W 88 Sp 9,8–6 and L 96 H 90 W 70 Sp 8,7–4, max. 12 and 9 mm, 295 and 120 g.
- TORTUGA, SW Uespén, sta. 1211, sandy debris and muddy sand with *Thalassia* near *Rhizophora*, abt. 1 m deep, 1.VIII.1936; alive with intact periostracum, beige-brown, L 120 H 110 W 96 Sp 2–1 up to 10 mm long. [Fig. 11]
- Puerto Cabello (L. de Priester); recent, L ?54 H 48 W 39 Sp 3,5–6, heavy, 39 g. (ZMA).
 “Caracas” (coll.?): 4, recent, L 67–90–101 H 80 W 60 Sp 0–4 upper 0–2 lower (ZMA).
- Bahía de Mochima (Edo. Sucre), Ensenada Matacual, muddy bottom in mangrove area (26°C), 12.V.1965, MIOUDO; alive, almost without periostracum, light-coloured, slender spec. L 137 H 121 W 90 Sp 6–0.
- Golfo de Cariaco, El Barbudo, muddy bottom, 27.II.1966, MIOUDO; alive, L 100 H 87 W 68 Sp 2–0 and L 90 H 80 W 63 Sp 7–0 and L 83 H 74 W 60 Sp 9,2–0.
- Golfo de Paria, Irapa, mangrove area (28°C, sal. 23.5‰), 20.IV.1971, MIOUDO; 6, fresh, in part covered by balanids; L 57–76–97 H 49–66–87 W 44–60–73 Sp 11–17–25 (33) in 3 upper rows (excl. one case in which the 3rd row is duplicated), 2–5–7 lower row, 7–10–13 mm long; 46–100–180 g. Thick-set, heavy specimens with numerous, often claw-like spines.

M. melongena forma *dilatata*

- Península de Araya, Laguna de Chacopata, sandy mud, 0,7 m deep (27.5°C), 21. VI.1967, MIOUDO; 3 alive, largest L 104 H 92 W 76 Sp 0–0; Fig. 17a: L 93 H 83 W 70 Sp 0–0; Fig. 17b: L 89 H 75 W 60 Sp 2–3.
- MARGARITA, Laguna de las Maritas, near Punta Mosquito, soft mud with *Ruppia* near *Rhizophora*, ca 1 m deep, 13.I.1964; 15 alive, L 28–41–49 H 22–33–39 W 17–25–29 Sp 0–1–2 upper 0–2–2? lower. [Fig. 21]
- Laguna Marites, Punta e’Perra, muddy sand (33.5°C), 11.VI.1969 (MIOUDO); 15, alive: L 34; holotype: L 66 H 57 W 43 Sp 4–0; paratypes: L 57 H 49 W 36 Sp 1–0 and L 57 H 48 W 36 Sp 1–0. [Fig. 17]

M. melongena "margaritana"

- MARGARITA, San Juan Griego, low coastal cliff of marly limestone, 16.V.1936; 8, L 16.5–22.5–31.5 H 13–17–22.5 W 10–13–17.5 Sp largest spec. 6–0, other knobbed or ridged 6–9, or smooth. — Fig. 23a: L 27 H 22 W 17.5; 23b: L 25.3 H 20.4 W 16; 23c: L 22 H 16.5 W 12.5; 23d: L 19.7 H 14.6 W 11.1. See VAN BENTHEM JUTTING 1945. Type-locality of *M. margaritana*. [Fig. 23]
- Juan Griego, Pleistocene bluff along the shore, VIII.1939 (Horace G. Richards); ANSP 14792, holotype and two paratypes; 1 paratype now in ZMA: L 22 H 16.5 W 13. [Fig. 22]
- TRINIDAD, Caroni Swamp, 1969 (Peter Bacon); 16, alive, L 58–82–115 H 51–69–97 W 38–54–88 Sp 0–3–11 upper 0–2–6 lower, up to 10 mm, 2 smooth. — Fig. 11a: L 58 H 52 W 41 Sp 2–5; 11f: L 115 H 95 W 95 Sp 0–0; 11g = 7b: L 104 H 94 W 78 Sp 3,3–e. [Fig. 7b & 11a–d, f, g]
- (coll. J. Mulder); remnants of periostracum, L 116 H 103 W 85 Sp 8,3–0 (RMNH).
- SURINAME, Galibi (H. ten Kate); L 53 H 40 W 30 Sp 3–0 (RMNH).
- Matappica beach, VII.1946 (D. G. Geijskes); L 60 H 40 W 30 Sp 0–0 (RMNH).
- Suriname (Cab. Dalen); 2, subrecent, L 123 & 115 H 111 & 101 Sp 1,9,1–0 & 8–4; 6, L 53–80–102 H 70 W 56 Sp 11–17–24 upper 0–5–7 lower; 7, L 61–82–113 H 72 W 55 Sp 0–1–2 upper 0–1–4 lower (RMNH).
- CAYENNE, (coll.?): L 108 & 38 H 96 & 29 W 76 & 22, Sp 2,5,6–4 & 11–0 (ZMA). [Fig. 7]
- BARBADOS, "Coralrock fm. Barbados; Nr. 48113 (Bedeutung unbekannt); Coll. S.L.(?)" Naturhistorisches Museum Basel, Nr. 10133; courtesy of Peter Jung. — A subrecent, decolorized fragment from muddy lagoon deposit; width 43.5 mm, distinct notch, one upper row with 4 (or more?) spines, up to 6 mm long, lower row with 1 or more distinct spines.
- GRENADA, Point Salines, Portici Bay, 1967 (Mrs V. G. Groome); L 66? H 58 W 48 Sp 6,5–5; subrec., L 56 H 49 W 39 Sp 4,3–5, max. 5 mm.
- MARTINIQUE, 1972 (A. Delatte); remnants of periostracum, L 58 H 48 W 40 Sp 2,5,4–5 (ZMA).
- (coll.?): L 38.5 H 26 W 19 Sp 7–0 incl. ridges. Looking like f. *nana* (ZMA).
- VIRGIN ISLANDS, "Sa Cruz, St. thomas, St. John" (C. F. Kraepelin & M. Holm); 3, weak design, L 95 & 88 & 82 H 87 & 80 & 73 W 70 & 65 & 57 Sp 1,3–5 & 9–3 & 2,6,7–6 (RMNH). [Locality needs to be confirmed.]
- HISPANIOLA, Santo Domingo, Monte Christi, 20.VII.1937 (Clench, Russell, McLean – M.C.Z. 373); 2, recent, L 65 & 60 H 55 & 48 W 42 & 37 Sp 5–6 & 7–4 (ZMA). Same; 2, L 63 H 54 W 42 Sp 2,5–4 & 5–3 (RMNH). [Fig. 7]
- Haiti (Brown); 4, alive, L 83, 68, 55 & 40 H 74, 55, 45 & 30 W 64, 40, 32 & 22 Sp 3,6,7–5 & 0–1 & 0–0 & 10–0 (ZMA coll. M. M. Schepman 1920). [Fig. 6]
- Haiti, 1914 (coll.?): fresh-looking, L 59 & 53 H 54 & 45 W 39 & 33 Sp 6,4–5 & 3–3, max. 7 mm.
- JAMAICA, Kingston Harbour, Myrtle Bank beach, 31.III.1926; recent?, L 112 H 103 W 77 Sp 7,3–3.
- Great Saltpond, entrance near Fort Clarence, sandy inlet recently closed off by sandbar, 0–1 m deep, 15.9 g Cl⁻/l, crawling on mangrove roots and decaying wood covered by balanids and serpulids, with small algae, sometimes above water surface, a few

- occupied by hermit crabs, 8.V.1973; 7, L 41-55-63 H 32-40-48 W 25-30-36 Sp 0-3-8 upper, only once a single lower spine, two largest spec. smooth. — Fig. 10a: L 74 H 65 W 47 Sp 7-0. [Figs. 10 & 21]
- Louzy Bay, near Great Saltpond, 8.V.1973; subrecent, fragm., Lca 65?
 - Shore at Port Royal, 15.V.1973, fragm., L 50 Sp 0-0.
 - Palisados near Port Royal Cemetry, low pile of conchs between scrub on sandy peninsula, 20.V.1973; 8, subrecent, rather corroded and decoloured, L 122-142-160 H 114-130-145 W 90-106-115 Sp 7-16-26 upper 0-3.5-7 lower up to 16 mm long; 260-365-530 g. — Fig. 10d: L 155 H 135 H 109 Sp 7,5,8-7; 10e: L 130 H 115 W 95 Sp 9,9,7-6.
 - Indian site at Arawak Museum, W of Spanish Town, an enormous shell mound containing a great number of different shells obviously derived from a mangrove habitat, 11.V.1973; 23, often palely but mostly distinctly coloured, very spinose, sometimes with a few spines of the lower row two-tipped, L 42-67-100 H 55 W 43 Sp 3-18-28 upper 0-4-6 lower; lower row lacking in two spec.; weight of 15 spec. L 51-72-87 mm, 10-60-120 g. — Fig. 9a-f resp. L 50, 54, 78, 84, 86 & 73 H 41, 49, 66, 77, 77 & 64 W 31, 39, 55, 63, 64 & 53 Sp 7,5-4 & 2,9,8-5 & 5,9,10-6 & 4,7,7-6 & 4,7,9-6 & 3,6,6-5. Fig. 10b: L 80 H 68 W 55 Sp 3,9,9-6. [Figs. 9 & 10]
- CUBA**, Santiago Harbour, Oriente (José A. Freire); L 48 H 42 W 32 Sp 9,9-6 (BMNH).
- Bahia de Gibara, Oriente, 193 (L. M. R. Rutten); recent, L 64 & 55 H 60 & 50 W 47 & 42 Sp 5,5,5-7 & 2,3,6-6 (RMNH).
- BELIZE** (British Honduras) Rocky Point, Stann Creek, 18.VII.1938 (Th. L. J. Vreugde); 2, alive, L 101 & 53 H 81 & 41 W 62 & 31 Sp 6-1 & 0-0 (ZMA). [Fig. 7]
- Coast of northern British Honduras, 2. VII.1938 (Vreugde); alive, L 102 H 79 W 63 Sp 4-0 (ZMA).
- GUATEMALA**, Puerto Barrios, 9.XII.1929 (W. Visser & H. v.d. Maaden); subrecent from mud, L 53 H 43 W 35 Sp 10-3 (RMNH).

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