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CARIBBEAN SCYPHOMEDUSAE OF THE GENUS CASSIOPEA

by

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When the author beheld the tranquility and the magnitude of a Caribbean mangrove-lagoon for the very first time, he was so much impressed by the wealth and the complexity of this habitat that he could not but devote his special attention to a number of simple Cassiopeas, lazily pulsating amidst the turtle-grass. Moreover these Bonairean animals challenged him to further research, because at first view, their appearance showed some striking differences from a description given some years before by STIASNY, with reference to Cassiopeas collected by VAN DER HORST on Curaçao.

The result was a lengthy paper "Zur Kenntnis der Scyphomedusen-Gattung Cassiopea" (1933). The present article may be considered as a continuation, except for one thing; several subjects discussed in the first publication will here be omitted. Special attention, however, has been given to the number & shape of radial vessels, and to a few striking characteristics of oral arms & vesicles, which may be considered as being of supra-specific and infra-specific taxonomical value respectively. – Thanks are due to H. C. OBREEN (1958) and MIEKE GODERIE (1966) for their kind assistance within the scope of their student's practical course in taxonomy.

In the Caribbean region only two species of *Cassiopea* are found: *C. frondosa* and *C. xamachana*. The genus has an almost circumtropical distribution, and its representatives are, at first sight, strikingly uniform. They are usually to be found in shallow lagoons and marine pools lined with mangroves, where they lie with oral arms uppermost, scattered, or sometimes closely together on the

sandy or muddy bottom. The surface of the exumbrella is adapted to this peculiar mode of life: the central part being, as a rule, slightly concave, while on the more peripheral part an inconspicuous raised ring has developed which enables a firmer contact with the bottom. From closer examination, however, it appears that in the genus *Cassiopea* two groups may be distinguished, which, according to the present author – who still is of opinion that "ein Unterschied in der Grundzahl der Rhopalien nicht als Detailmerkmal des Baues aufgefasst werden kann" (1933, p. 487) – deserve to be given the status of at least subgenera, although he named them, for practical reasons, *Frondosae* and *Andromedae*, "um nicht durch Wiederaufnahme des in viel Bedeutungen gebrauchten Namens *Polyclonia* neue Verwirrung zu stiften".

The *Frondosae* are characterized by having – in general principle – 12 marginal sense-organs, and consequently 12 rhopalial canals and 24 radial vessels, whilst the *Andromedae* have basically 16 rhopalial canals and 32 radial vessels. The club-shaped small-vesicles of the *Frondosae*, associated with the oral arms, are usually strikingly different from the more ovate small-vesicles (Kleine Kolbenblasen) and the lanceolate, ovate or ribbon-like large-vesicles (Grosse Kolbenblasen, filaments, appendages) which may be distinguished in the *Andromedae*. Other more or less obvious differences between both groups are e.g. to be found in the structure of the canal systems, marginal sense-organs, mouth-arms and the colour design of the living animals (cf. HUMMELINCK 1933). From the publications of several authors, above all SMITH 1936 and GOHAR & EISAWEY 1961, we may assume a fair number of rather basic differences between FRONDOSAE and ANDROMEDAE, which should be shown on close examination of life cycle and development of *C. frondosa* and *C. xamachana* by the same investigator at the same time.

Until now, all *Frondosae* – which appear to be restricted to tropical northwestern Atlantic waters – have been identified without hesitation as *Cassiopea frondosa* (Pallas, 1774). The *Andromedae*, on the other hand, comprise quite a number of different forms which often are very difficult to distinguish from *Cassiopea andromeda* (Forskål, 1775). The Caribbean *Andromedae* are generally considered as belonging to one and the same species, *Cassiopea xamachana* R. P. Bigelow, 1892, described from Jamaica.

The author (1933, p. 498) admits the presence of many difficulties in separating *Cassiopea xamachana* from *Cassiopea andromeda* and other related species, but would still strongly recommend maintaining a separation of Caribbean and Indopacific Cassiopeas: „Wir dürfen keinesfalls, bei aller Unsicherheit der morphologischen Merkmale, die geographische Selbständigkeit dieser Gebiete übersehen".

LOCALITIES AND MATERIAL OF CASSIOPEA

A = Zoölogisch Museum, Amsterdam; L = Rijksmuseum van Natuurlijke Historie, Leiden; U = Zoölogisch Museum, Utrecht.

Florida

DRY TORTUGAS, Garden Key, Fort Jefferson, IV. 1913.
xamachana: 6 specimens, 104–137 mm in bell-diameter (Paul Bartsch coll.; USNM 32952/3). [Fig. 40]

DRY TORTUGAS, 1931. [Fig. 5, 20–21, 40]
xamachana: 13 spec., 17–100 mm (John W. Mills coll.; L).

DRY TORTUGAS.
xamachana: 1 spec., 86 mm (MCZ 1524).

MIAMI
frondosa: 2 spec., 118–136 mm (J. E. Benedict coll.; USNM 33119).

KEY BISCAYNE, northwestern part (Sta. 1412), 31. VIII. 1963; creek, about 10 m wide, with scanty *Rhizophora* and *Avicennia*, on muddy sand, about 1 m deep.
xamachana: 9 spec., 30–225 mm (5 A, 2 L, 2 U). [Fig. 38, 41, 45; Pl. VI]

Bahamas

NORTH BIMINI, northeastern lagoon, 8. XI. 1963; *Thalassia* flat.
xamachana: 22 spec., 120–180 mm (Ingvar Kristensen coll.; 11 A, 11 L). [Fig. 40; Pl. III-4]

SOUTH BIMINI, northern lagoon, Massy Creek (Sta. *1150 A*), 17. VIII. 1949; near *Rhiz.*, on sandy mud, among *Thal.*, 1–1½ m.
xamachana: 20 spec., 26–185 mm (5 A, 10 L, 5 U). [Fig. 28, 40]
frondosa: 8 spec., 37–186 mm (2 A, 3 L, 3 U). [Fig. 11, 34; Pl. V-1]

Jamaica

PORT ROYAL, 1300 m to the East, where a little channel crossing under the road enters a broad lagoon which is an arm of Kingston Harbour, 19. X. 1958; about ½ m.
xamachana: 2 spec., 151–154 mm, females (Ivan M. Goodbody coll.; L 663-662). [Fig. 4, 26–27, 30, 37, 40; Pl. II-1, IV]

Puerto Rico

LA PARGUERA, Cayo Májimo (Sta. *1418*), 12. IX. 1963; sand flat with *Cymodocea* [= *Syringodium*] and scattered *Thal.*, 1½–2½ m. [Pl. III-2]
frondosa: 20 spec., 55–208 mm (8 A, 10 L, 2 U).
LA PARGUERA, Cayo Caracoles (very near *1418*), 9. II. 1963.
frondosa: 1 spec., 160 mm (Inst. Biol. Mar. Mayagüez; L).
LA PARGUERA, Isla la Gata (near *1418*), 18. II. 1963; sand flat, abt. 2 m.
frondosa: 1 spec., 135 mm (J. H. Stock coll.; A).

St. Croix

KRAUSSE LAGOON, outer part (Sta. *1404*), 15. VI. 1955; *Thal.* flat with small islands of *Rhiz.*, on muddy sand among *Cym.* and *Thal.*, with *Batophora*, 1–2 m.
xamachana: 37 spec., 19–138 mm.
KRAUSSE LAGOON, inner bay (Sta. *1406*), 15. VI. 1955; very shallow mud flat with *Rhiz.*, on sandy mud among *Bat.*, with some *Cym.* and *Thal.*, ½–1 m.
xamachana: 13 spec., 17–145 mm (*1404* + *1406*: 25 A, 23 L, 2 U). [Fig. 7, 29, 42]

St. Martin

SIMSON LAGOON, near Halley's jetty at Simson Bay, 2. VIII. 1949; shallow bight of large land-locked lagoon, near *Rhiz.*, on brownish mud, 1 m.
frondosa: 16 spec., 43–174 mm, considered a hybrid population, 4 specimens or more showing several *xamachana* characteristics (5 A, 7 L, 4 U). [Fig. 12–13, 32–33; Pl. II-2]

OYSTER POND, near southern shore (Sta. *1429*), 13. X. 1963; a few scattered specimens amidst patches of *Thal.*, *Cym.* and *Halimeda*, on sandy mud of large mangrove lagoon, ½–1½ m.
frondosa: 6 spec., 90–118 mm (3 A, 3 U).

Los Roques

GRAN ROQUE, eastside, channel leading into the mangroves, 15. IV. 1955.
xamachana: 2 spec., about 80–120 mm (F. Martín S. and Ganis Rose coll., S.C.N. La Salle).

Bonaire

LAC, northeastern part, Poejito (Sta. 1064 A), 12. X. 1930; bight of large landlocked lagoon, on sandy mud among *Thal.*, near *Rhiz.*, 1–1½ m.
xamachana: 11 spec., 28–210 mm.
frondosa: 1 spec., 81 mm (L). [Fig. 10]
LAC, Poejito 19. X. 1930; same locality.
xamachana: 37 spec., 72–240 mm. [*1064a*, 18. XI. 1930; scyphistoma's on *Rhiz.*]

LAC, Poejito (Sta. *1064Aa*), 18. XI. 1930; same locality.
xamachana: 49 spec., 22–250 mm (all together: 5 A, 3 Zool. Mus. Berlin, 2 Ind. Mus. Calcutta, 1 Zool. Mus. Hamburg, 86 L). [Fig. 8, 22–24, 39, 43]
frondosa: 5 spec., 44–120 mm (L).
LAC, Poejito (Sta. *1064Ab*), 17. IX. 1948; same locality, numerous on soft mud among *Thal.*, near *Rhiz.*, 1–1½ m.
xamachana: 2 spec., 68–118 mm (L).
LAC, Poejito (Sta. *1064Ac*), 17. IV. 1955; same locality, few specimens.
xamachana: 6 spec., 29–132 mm (L).
LAC, Cay (Sta. *1066b*), 19. III. 1937; mud flat, among Thal., ½ m.
xamachana: 3 spec., 40–170 mm + 2 spec., 29. III. (L).
frondosa: 1 spec., 66 mm (A).

LAC, Soerebon, most southeastern part of Lac (Sta. *1450*), 6. XII. 1963; sheltered inlet, partly bordered by *Rhiz.* with conspicuous growth of *Acetabularia*, small number on sandy rock debris overgrown by algae, ¾–1 m.
xamachana: 9 spec., 105–175 mm (4 A, 5 U).
frondosa: 2 spec., 100–105 mm (L).

ORANJEPAN, small canal leading into salt pan, 8. VI. 1960; abt. 50 × 1 × ½ m, dug in wall of coral debris, sometimes in connection with the sea, in only slightly concentrated seawater.
frondosa: 5 spec., 52–84 mm (Jan Rooth coll.; A). [Pl. I-2, III-2]

Curaçao

AWA BLANCO pool, between Awa Blanco and Lagoen Blanco, Fuik, 22. XI. 1963; exposed pond after removal of coral shingle, 150 × 30 × 1–1½ m, no mangroves nor seagrass, few specimens near shore on coral debris covered with some whitish mud, with very scanty *Halimeda* and *Batophora*, ¼–½ m.
xamachana: 3 spec., 145–205 mm (L). [Pl. III-1]

FUIK BAAI, Duitse Bad (Sta. *1038a*), 17. IV. 1949; rocky shore of large landlocked bay, single spec. on muddy sand with scanty *Thal.* near *Rhiz.*, 1 m.
frondosa: 1 spec., 105 mm (U). [Fig. 35]
FUIK BAAI, Krijgsgevangenen piertje, 10. XII. 1958; same locality.
frondosa: 2 spec., 84–132 mm (J. H. Stock coll.; A).

SPAANSE WATER, northeastern part of inner bay, 6. III. 1949; near mangroves.
frondosa: 1 spec., 30 mm (M. Diemont-Koiter coll.; U).
SPAANSE WATER, Spaanse Baai, Newport Beach (Sta. *1037A*), 21. IV. 1949; entrance of large inland bay; single spec. on sandy bottom with very scanty *Thal.*, near isolated *Rhiz.*, ½ m.
frondosa: 1 spec., 74 mm (L). [Pl. V-2]

SPAANS LAGOEN near Kabrietenberg, Spaanse Baai (Sta. *1337a*), 6. VIII. 1955; muddy lagoon bordered by *Rhiz.*; many *Cassiopea* on sandy mud among *Thal.*, 1–1½ m. [Pl. I-1]
xamachana: 10 spec., 26–240 mm (1 L, 9 U).

SPAANS LAGOEN (*Sta. 1337b*), 3. I. 1964; same locality; several spec.
xamachana: 5 spec., 160–202 mm (3 A, 2 L). [Fig. 44]

CARACAS BAAI, pool bordering Spaanse Water, IV–V. 1920; mangrove-lined pool.
xamachana: 20 spec., 50–180 mm (C. J. van der Horst coll.; 12 *A*, 8 L). [Fig. 25]
frondosa: 1 spec., 44 mm (C. J. van der Horst coll.; A).

RIFWATER pool, along Rifweg near Willemstad (Sta. *1033*), II. 1949; pools in porous wall of coral shingle.
xamachana: 6 spec., 34–131 mm (J. G. de Jong coll.; A).
frondosa: 1 spec., 94 mm (J. G. de Jong coll.; A).
RIFWATER pools, along Rifweg, 15. X. 1962; in wall of coral shingle.
xamachana: 2 spec., 65–105 mm (Louise J. van der Steen coll.; L). [Fig. 9]
RIFWATER, near abandoned foundation of Stuyvesant Hotel, 14. X. 1962.
xamachana: 2 spec., 91–92 mm (L. J. van der Steen coll.; L).
RIFWATER, near St. Elisabeths Gasthuis, 2. XI. 1963; northeast corner of rather large lagoon behind wall of coral debris, narrowly communicating with the sea, in part lined with *Rhiz.*; very many specimens drifted near shore, ¼–1 m.
xamachana: 88 spec., 40–105 mm (29 A, 40 L, 19 U). [Fig. 14, 44]

SLANGENBAAI pool S of St. Michielsbaai, 13. I. 1951; small lagoon between limestone terrace and wall of coral shingle.
xamachana: 19 spec., 65–106 mm (M. Diemont-Koiter coll.; L).
frondosa: 1 spec., 72 mm (M. Diemont-Koiter coll.; L).
SLANGENBAAI, 11. V. 1960; probably same locality.
xamachana: 6 spec., 11–70 mm (Ingvar Kristensen coll.; L).

SANTA MARTA BAAI, Kreek, E of Boca (cf Sta. *1320*), 13. II. 1955; creek by which a series of small, in part mangrove-lined lagoons, which are situated between a porous wall of coral debris and a limestone terrace, are communicating with the entrance of a large inland bay; creek 2–5 m wide and ½–1 m deep; many *Cassiopea* with abundant *Batillaria* on muddy bottom with *Batophora*.
xamachana: 72 spec., 5–142 mm (8 A, 64 L). [Fig. 6, 44]
SANTA MARTA BAAI, Kreek, near Zoutkeet (= abandoned salt barn), 16. VIII. 1955; about same locality.
xamachana: 27 spec., 11–80 mm (6 A, 12 L, 9 USNM).
SANTA MARTA BAAI, Kreek, 31. X. 1954; same locality.
xamachana: 5 spec., 24–60 mm (J. S. Zaneveld coll.; A).
SANTA MARTA BAAI, Kreek, 17. IV. 1960; same locality.
xamachana: 29 spec., 28–94 mm (J. G. de Jong coll.; A).
SANTA MARTA BAAI, Kreek, near Zoutkeet, 5. VII. 1962; about same locality.
xamachana: 2 spec., 72–86 mm (Louise J. van der Steen coll.; U).

SANTA MARTHA BAAI, first lagoon, E of Boca (Sta. *1321*), 3. III. 1955; small lagoon with *Rhiz.*, narrowly connected with *1320*, crowded with *Batophora*, some *Batillaria*-paved muddy spaces between which are covered by small *Cassiopea*, ¼–1 m.
xamachana: many spec., 5–148 mm (A, L, U). [Fig. 44–45]
SANTA MARTA BAAI, first lagoon, 5. XII. 1962; probably same locality.
xamachana: 3 spec., 95–115 mm (L. J. van der Steen coll.; U).

SANTA MARTA BAAI, second lagoon, E of Boca (Sta. *1322*), 3. III. 1955; small lagoon with *Rhiz.*, narrowly connected with *1321*, with very scanty *Batophora* and flourishing *Zoanthus*; muddy areas between algae paved with *Cassiopea*, ½–1 m.
xamachana: 19 spec., 14–22 mm, and more individuals (ZMA). [Fig. 44]
SANTA MARTA BAAI, second lagoon, 5. VII. 1962; probably same locality.
xamachana: 4 spec., 32–70 mm (L. J. van der Steen coll.; ZMA).

SANTA MARTA BAAI, third lagoon (Sta. *1323*), 25. II. 1955 (4 L).
SANTA MARTHA BAAI, third lagoon, 3. III. 1955; abt. 200 × 50 × 1½ m, narrowly connected with *1322*, with mangrove growth; many *Cassiopea* among *Thal.*
xamachana: 55 spec., 15–165 mm (A, L). [Fig. 45]
SANTA MARTA BAAI, third lagoon, 29. VII. 1953; probably same locality.
xamachana: 1 spec., 85 mm (J. G. de Jong coll.; L).
SANTA MARTHA BAAI, third lagoon, 9. XI. 1958; probably same locality.
xamachana: 1 spec., 106 mm (J. H. Stock coll.; A).
SANTA MARTA BAAI, third lagoon, 5. VII. 1962; probably same locality.
xamachana: 3 spec., 56–75 mm (L. J. van der Steen coll.; A).
SANTA MARTA BAAI, three small pools in coral debris E of *1323*, 5. VII. 1962.
xamachana: 8 spec., 55–203 mm (L. J. van der Steen coll.; A).

Aruba

LAGOEN BOEKOETI (Lagoon Bucuti), E of Oranjestad near Fofoti (Sta. *1004*), 29. XII. 1948; open lagoon near low limestone cliff, single growth of *Rhiz.* [Stud. Cur. *4*, pl. VII-b]; isolated specimens among *Thal.*, with some *Halimeda*, on greyish blue mud, about 1 m.
xamachana: 2 spec., abt. 110–180 mm (L). [Fig. 42]
frondosa: 1 spec., 128 mm (A). [Fig. 36]

RIF BOEKOETI (Bucuti Reef), S point, S of Oranjestad (Sta. *1007*), 17. I. 1949; mangrove-lined creek in sandy reef; several *Cassiopea* on muddy sand with *Halimeda* and *Zoanthus*, near *Thal.*, abt. 1 m.
xamachana: 5 spec., 41–177 mm (2 A, 3 L). [Fig. 42]
frondosa: 1 spec., 124 mm (U).

RIF BOEKOETI pool at N point, S of Oranjestad (Sta. *1304*), 6. V. 1955; isolated pool in sandy reef, 20 × 15 × ¾ m, in connection with lagoon at very high tide; many rather small *Cassiopea* on almost pure sand, no *Rhiz.* nor *Thal.*
xamachana: 31 spec., 42–194 mm, considered a hybrid population in which several specimens show *frondosa* characteristics (10 A, 21 L). [Fig. 31]

OCCURRENCE

[Tables 1–2; Figures 1–2; Plate I]

Although Cassiopeas are by no means rare in shallow Caribbean coastal waters, and much research has already been done – especially by R. P. BIGELOW and A. G. MAYER on *C. xamachana* (see HUMME-

LINCK 1933, p. 494–495) and by H. G. SMITH (1936) on *C. frondosa* many questions on structure, development and biology still remained unanswered.

The occurrence of both species of *Cassiopea* – according to the specimens dealt with in this paper – may be summarised as follows (material collected by author in italics):

FLORIDA	Dry Tortugas	xamachana	
	Garden Key	xamachana	
	Miami		frondosa
	Key Biscayne	*xamachana*	
BAHAMAS	North Bimini	xamachana	
	South Bimini	*xamachana*	
JAMAICA	Port Royal	xamachana	
PUERTO RICO	La Parguera		*frondosa*
ST. CROIX	Krausse Lagoon	*xamachana*	
ST. MARTIN	Simson Lagoon	*xamachana*	× *frondosa*
	Oyster Pond		*frondosa*
LOS ROQUES	Gran Roque	xamachana	
BONAIRE	Lac	*xamachana*	*frondosa*
	Oranjepan ditch		frondosa
CURAÇAO	Awa Blanco pool	*xamachana*	
	Fuik Baai		*frondosa*
	Spaanse Water		*frondosa*
	Spaans Lagoen	*xamachana*	
	Caracas Baai pool	xamachana	frondosa
	Rifweg pools	xamachana	frondosa
	Rifwater	*xamachana*	
	Slangenbaai pool	xamachana	frondosa
	Santa Marta lagoons	*xamachana*	
ARUBA	Lagoen Boekoeti	*xamachana*	*frondosa*
	Rif Boekoeti	*xamachana*	*frondosa*
	Rif Boekoeti pool	*xamachana*	× *frondosa*

The fact that *C. xamachana* in cases of mutual occurrence far outnumbers *C. frondosa* may be the reason why both species have not been found together in so many localities. This does not apply, however, to localities of adequate sampling, such as La Parguera, Krausse Lagoon and Santa Marta.

Cassiopeas are also known in several other areas, such as Cuba, Honduras, St. Thomas, and possibly Bermuda (see HUMMELINCK 1933, p. 492). Low transparency of the water might be one of the reasons for our lack of data of *Cassiopea* from the mangrove swamps along the mainland coast. This too may be the cause of the author's failure to collect *Cassiopea* on Margarita, but he is rather sure that insufficient research is the reason for the fact that these animals were not reported by him from Grenada, Guadeloupe, and from Barbuda's Great Lagoon.

Transparent lagoons are very liable to change by other than natural agents. Curaçao's handshaped Schottegat, once an inland bay of great beauty, has felt the consequences of harbouring a world-famous oil refinery. The disappearance of *Cassiopea* from Piscadera Baai may be due to an increasing supply of waste-water since 1960, which has turned the inner bay into a fertile but quite unattractive Cassiopea-habitat. The Spaanse Water, which may be compared with the Schottegat in former times, has developed into an increasingly important recreation centre. Bonaire's unique Lac is threatened by disturbance through development projects. Barbuda's enormous Great Lagoon still is almost untouched, for the time being. The narrow entrance of St. Martin's Simson Lagoon was closed shortly after our Cassiopeas were collected in 1949; it proved to be a salt-lake habitat in 1955 and is now awaiting the result of its reopening at the French side near Marigot on February 7th, 1967. And St. Croix's Krausse Lagoon, with its marvellous bird life, has been transformed into Port Harvey.

The shallow lagoons and small ponds near the entrance of the Schottegat and at many other places along the shore of Curaçao fully illustrate, however, the fact that both species of *Cassiopea* are quite capable of surviving in isolated marine pools and in other suitable spots quite near all places of human activity.

Cassiopea frondosa is generally considered as being the less hardy one, which prefers purer water than does *C. xamachana* and which appears to be a little more vulnerable to disturbances of environment. Yet, *C. frondosa* has been found in a small canal in a wall of coral debris at Oranjepan (Bonaire), a habitat which still looks less attractive than the unprotected pond near Awa Blanco (Curaçao), in which a few medusae of *xamachana* were also living at the edge of their ecological possibilities.

When tabulating size of specimens and time of collecting (Table 1) nothing can be deduced as to span of life and fate of populations. GOHAR & EISAWEY (1961, p. 24–25), who studied *C. andromeda* occurring in the waters near Al Ghardaqa (Red Sea) "concluded that *Cassiopea* is practically an annual animal with a life span of less than one and a half years (roughly 16–17 months)," having a breeding season from April to late August. If we might assume the same for *C. xamachana*, large medusae may be expected the whole year round, but very small specimens from May to October only. This does not agree however, with the occurrence on Curaçao and Bonaire of scyphistoma's in November and of very small medusae (in which the central mouth is still wide open) in February.

LIESJE YPMA (now Mrs M. E. DER VARTANIAN-YPMA) – who studied the ecology of *Cassiopea xamachana* in lagoons and bays along the leeward coast of Curaçao (20. V.–20. XI. 1962) found *Cassiopea* at the following localities:
1) creek, lagoons and pools of Santa Marta Baai [cf. Sta. *1320–1323*];
2) small lagoon east of Playa Hoendoe;
3) narrow lagoon West of St. Jan [a locality without medusae in 1955];
4) Rifwater lagoons, and small pools along the Rifweg [cf. Sta. *1033*];
5) small lagoon near Kabrietenberg [Sta. *1337*];
6) small pools in wall of coral debris separating Fuikbaai from the sea.
She did not find medusae at Slangenbaai, nor at Jan Thiel and Piscadera Baai where Cassiopeas were said to have occurred in previous years. Miss YPMA accepts a yearly cycle, in which most medusae mature in the early Fall and afterwards disappear. Scyphostoma-polyps were observed by her in the aquarium of the Caribbean Marine-Biological Institute, reared from medusae which were collected a few days before along the Rifweg (10. X. 1962). The polyps which were brought to Holland in a small glass tube were in a poor state, but alive.

CANAL SYSTEM

[Tables 4–6; Figures 3–19; Plates II–III]

As a rule the external appearance of the medusae in the field is quite sufficient for a reliable identification. The first impression of a *frondosa*'s relatively short oral arms which are covered with many small, cream-coloured vesicles, is quite different from that of a *xamachana*, whose arms usually distinctly exceed the bell's margin and support large elongate or even ribbon-like vesicles. When alive, *frondosa*'s umbrella shows a number of creamish dots, which are more striking than the light spots of a young *xamachana* which tend more to fuse and which – in large specimens – are usually united into a whitish peripheral band, which may become rather inconspicuous afterwards.

In doubtful cases the rhopalia or the radial vessels may be counted: a clear view of the canal system may be obtained after injection of a contrasting dye, preferably some diluted Indian ink.

If the number of the radial vessels does not put an end to all doubt – e.g. because of its variability or because the specimens have been damaged or badly preserved – the following details may be of importance (cf Fig. 4–13):

1) The radial canals of *frondosa* which communicate by anastomosis are more rectangularly branched, compared with those of *xamachana*, which latter usually diverge from the radial vessels towards the periphery and form a more or less sharp angle.

2) In *frondosa* the interradial vessels usually reach the marginal lappets, whereas those of *xamachana* often form more or less distinct arcs uniting the radial vessels towards the periphery.

3) The rhopalial vessels of *xamachana* are, as a rule, spindle-shaped somewhat below the rhopalia, whereas those of *frondosa* are usually of equal width or, at most, somewhat widened towards the margin.

More or less irregular widenings in the peripheral parts of the radial vessels in *frondosa* are not rare – especially in small individuals – but these are seldom so shaped that they may arouse serious confusion.

In two populations, however, there was a great deal of uncertainty. The first consisted of a number of specimens which were observed in a shallow mangrove-lined bight of the Simson Lagoon (St. Martin), which at that time (1949) had a salinity only slightly higher than that of sea water. In the field the collector was tempted to distinguish between a) a few small *frondosa*-like specimens, b) several larger ones which looked like *xamachana*, and c) a number about which no decision could be made. After close inspection uncertainty remained: According to arms and vesicles and some details of the canal system all specimens ought to belong to *frondosa*; however, an identification as to number and form of rhopalial vessels resulted in 9 *frondosa* and 4 *xamachana*. This population which, as a whole, reminds the author of *frondosa*, but at the same time possesses a few *xamachana*-characteristics, was considered a population of a hybrid character.

The second doubtful population was found in a small sandy pool of the reef of Bucuti, Aruba. In the field these rather small specimens looked like *C. xamachana*, with the exception of a few individuals whose colour design had some similarity with that of *C. frondosa*. After closer examination most specimens were identified as *xamachana* because of their number of rhopalial vessels with fusiform widening and because their vesicles were as large as 22 × 8 and 18 × 1½ mm. Other medusae, however, showed 12 rhopalial vessels with a few irregular widenings only, and had small-vesicles which looked like those of *frondosa*. This population too - which, as a whole, looks like *xamachana* but may be taxonomically split into two groups (cf. Tables 3 and 5) – has been considered as being of hybrid character.

The great variability of the basic numbers 16 and 12 in *xamachana* and *frondosa* – which may be characteristics of a supra-specific nature (contra GOHAR & EISAWEY 1961, p. 39) – is rather astonishing. We cannot agree with the statement of several authors (e.g. MAYER 1910, p. 647, BOONE 1953, p. 45, GOHAR & EISAWEY 1961, p. 17 and 39) that *C. frondosa* has a fixed number of 12 rhopalia (or 24 radial canals). In *frondosa* the number 12 (and 24) is no more constant than the number 16 (or 32) is in *xamachana*.

It may, however, be of interest, that in *C. xamachana* a distinct preference for acquiring higher values may be observed (average 16.75, cf. Tables 3 and 4), in contrast to *C. frondosa* (average 11.85, cf. Tables 5 and 6), of which, it is true, much less regular specimens were counted (571 against 49).

When comparing the counts of the five largest samples of *xamachana* (which comprise 45 or more specimens) the following average numbers of rhopalial vessels are obtained; *17.0*, *17.55*, *16.45*, *16.8* and *16.6*. The average number *17.55* taken from the Poejito population of the Lac (Bonaire, 1930) would be more impressive if the other specimens which were collected in the same Lac at a later date had shown about the same values.

Striking differences in comparable samples (e.g. those of Bimini and the Santa Marta samples, see Table 3) show that not much value may be attached to average numbers of radial vessels, especially if small samples are examined. The lowest values were observed in samples consisting of only very few specimens which possibly survived under unfavorable conditions.

Generally the average number of radial vessels is only slightly lower than two times that of the rhopalial vessels. The higher number of rhopalia compared with that of the rhopalial vessels, is derived from the frequent occurrence of twin-rhopalia, or even triplets and quadruplets, often in combination with periferal bifurcations of the rhopalial vessels concerned, especially in regenerated specimens.

Individual variation in vessel characters is much larger than average counts would suggest. As a matter of fact some tendency may be observed to maintain an even distribution of rhopalia and radial vessels, so that a shortage in a certain part of the umbrella often tends to be neutralized by an excess in a neighbouring part. Therefore, there is no reason to assume that specimens counting 16–16–32, 18–18–36 or 12–12–24 should be regular ones.

The fact that average numbers of rhopalial vessels in selected regular specimens do not differ from those in unselected specimens is surprising; it was to be expected that the estimates would more approach 16 and 12.

The manifold ways by which a more or less even supply of the sub-umbrella may be achieved by means of abnormal branching of the radial vessels, may be illustrated by a number of sketches (Fig. 14) which have been drawn (by Miss GODERIE) from a single sample of *C. xamachana* from the Rifwater.

ORAL ARMS

[Tables 7–10; Figures 20–36; Plates IV–VI]

From the development of radial vessels in *Cassiopea* it is evident that the numbers 16 and 12 characterizing the groups *Andromedae* and *Frondosae* are independent of the size of the specimens. [If an increase in numbers of rhopalia in large specimens is observed, this may be due to a higher frequency of regenerated parts in which

rhopalia tend to multiplicate]. This in contrast with size and shape of oral arms and large-vesicles (appendages or filaments), whereby at the same time the question arises to what extent existing differences may be brought about by environmental factors.

When trying to get a better insight into the diversity of the material of *Cassiopea xamachana*, the author (1933, p. 494–498) devoted several pages to the description of three varieties viz. *tortugensis*, *vanderhorsti* (from Curaçao) and *bonairensis*, which should differ in a somewhat confusing way from each other and from the typical forma (Jamaica) in quite a number of minor characteristics.

However, after having seen so much more material of the same species, he still feels justified in distinguishing a var. *bonairensis* (which might even deserve the status of subspecies), in which the average length of oral arms does not notably exceed the umbrella radius, and in which the large-vesicles are relatively broader, less narrowly lanceolate or ribbon-like, more oblong, and less pointed than in most other populations (cf. Fig. 43). Looking for other specimens having the same arm length and similar large-vesicles, it appeared that such isolated *bonairensis*-characters are relatively rare in other populations and may be due to unfavorable environmental conditions (e.g. Awa Blanco).

A creek in Key Biscayne produced some specimens (Fig. 38, 41) which appeared so different as regards form and size of its large-vesicles that the author could not resist the temptation to consider this population as belonging to a new variety, *biscayensis*. According to photographs published by ARGO (1965) the same variety also occurs at Key West.

In delimitating the other varieties, *tortugensis* and *vanderhorsti*, from each other and from the forma *typica*, an arbitrary judgement is often necessary. Though the author does not think GOHAR & EISAWEY (1961, p. 16) are quite right in considering the length of the arm, its branching and the vesicles of no use for classification, he has to admit that arm characteristics – as obviously being mainly of an ecological nature – ought to be used with great care, and that the differences observed become more confusing with the increase of material, as long as proper evaluation by field work and experiments is lacking.

It is highly probable that the type material of *Cassiopea xamachana* from "a lagoon near Kingston Harbor, Jamaica" (BIGELOW 1892, p. 214) " at Port Henderson, in a little bay that forms a deep indentation in the barrier separating Great Salt Pond ... from the sea..." (1900, p. 191) has been lost. When a neotype should be necessary, attention may be drawn to the smaller of the two specimens, collected by IVAN M. GOODBODY in a little channel which enters Kingston Harbour, deposited at the Rijksmuseum van Natuurlijke Historie at Leiden (663, cf. "Localities and Material"; Fig. 4, 26–27, 30, 37, 40; Pl. IV): Bell-diam. 151 mm, disc 61 mm; arm-length from center 155 [Fig. 27], 135, 121, 123, 134, 134, 140, 147 mm; rhop. 27, rhop. can. 16, rad. can. 32; longest vesicle 50 × 8 mm [Fig. 37] – Para-neotype: Diam. 154 mm, disc 58 mm; arm-length 135, 117, 116, 113, 119, 132, 131 mm; rhop. 18, rhop. can. 16, rad. can. ?32; longest vesicle 40 × 4 mm. – Large-vesicles on disc 10–15 > 10 mm, 5–12 > 20 mm; total number on arms 40–80 > 10 mm, 15–25 > 20 mm; central five protruding, central-one not exceeding the primary four.

Considering the whole scale of variation in *Cassiopea xamachana*, as shown by the material on which this paper is based, the author ventures to present the following unsatisfying Key for infraspecifical identification.

KEY to the Varieties of *Cassiopea xamachana*
(based on the material dealt with in this paper)

1a Oral arms as a rule about as long as bell-radius (= 1.0 R) . var. *bonairensis*

Central large-vesicles lanceolate to ovate, pouch-like or spatulate, few, clearly protruding. – Brachial large-vesicles spatulate or ovate, few.
Bonaire, Orchila.

1b Oral arms as a rule distinctly longer than bell-radius . . 2

2a Central large-vesicles generally broadly ovate to oblong, few, clearly protruding . . . . . var. *biscayensis*

Brachial large-vesicles lanceolate or narrowly ovate to linear, rather few. – Oral arms 1.4–1.8 R.
Key Biscayne, Key West.

2b Central large-vesicles generally not ovate to oblong . 3

3a Central large-vesicles generally linear to very narrowly lanceolate, numerous, not protruding . . . . var. *tortugensis*

Brachial large-vesicles usually tape-like or linear, numerous. – Oral arms 1.3–1.4 R.
Dry Tortugas.

3b Central large-vesicles generally lanceolate to narrowly ovate or even linear, mostly protruding 4

4a Brachial large-vesicles usually lanceolate or slightly spatulate to narrowly ovate, not numerous. . . forma *typica*
Central large-vesicles lanceolate to ovate or narrowly ovate, not numerous, protruding. – Oral arms *1.4–1.9* R.
Jamaica, St. Croix, Bimini.

4b Brachial large-vesicles usually lineate, numerous . . . var. *vanderhorsti*
Central large-vesicles lanceolate to narrowly ovate or even tape-like, numerous, often somewhat protruding. – Oral arms *1.2–1.45* R.
Curaçao, Aruba.

No varieties in *Cassiopea frondosa* have been distinguished, due to lack of a sufficient number of specimens from different localities. From this species also the type material may be considered as lost.

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Beautiful photographs of *Cassiopea xamachana* forma *biscayensis*; experiments and description of the animals alive. "Actually, apparently only two species are present in the shallows at Key West – *Cassiopeia frondosa* and *Cassiopeta xamachana*. (The photographs here are of the latter.)"

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"The type is deposited in the Museum of Comparative Zoölogy." This statement of Miss BOONE is in error. The type material of *C. xamachana* R. P. Bigelow was never at the M.C.Z.; Prof. H. B. BIGELOW's many types of coelenterates are deposited in this collection, but R. P. BIGELOW is a different person.
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"MEJ. L. YPMA, (Universiteit van Amsterdam) vertoefde van 20 mei tot 24 november 1962 op het Carmabi met een beurs van Wosuna. Zij bestudeerde de oecologie van de kwal *Cassiopea xamachana*, die men in vele ondiepe plaatsen en lagoens aantreft. In Florida was gebleken, dat deze soort eigenlijk een brakwatersoort zou zijn, omdat zijn regeneratie-vermogen maximaal was indien zeewater enigszins verdund werd. Op Curaçao komt de soort juist in min of meer hypersalien water voor en het leek interessant om na te gaan wáár het zout-optimum voor de Curaçaose exemplaren zou liggen. Nu bleek de regeneratie hier niet in het brakke gebied te liggen, maar bij het zoutgehalte van de zee of enkele ‰ hoger – dat is juist het gebied waar de kwal wordt aangetroffen.
De vraag, waarom de kwal alleen in *rustig* water voorkomt, was spoedig beantwoord. Indien men het water, waarin zich de kwal bevindt, langdurig schudt, stopt de pulsatie van het scherm. Wanneer men dan geen goed geaereerd water over en onder de kwal laat lopen, sterft deze in de daaropvolgende nacht door gebrek aan zuurstof. Overdag zal een Cassiopea niet gauw uit zuurstofgebrek sterven, want het bleek dat de eencellige groenalgen, die in symbiose met de kwal leven, in het licht kolossale zuurstofproducenten zijn, die een oververzadiging van 100% en méér in het omringende water kunnen veroorzaken. De eencellige algen bleken echter niet onmisbaar te zijn, want ook in volkomen duisternis floreerden de kwallen, bij afwezigheid van de algjes. Deze kwallen maakten overigens wel een iets miezerige indruk, maar regenereerden na beschadiging toch goed." – See YPMA, 1963.

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Fig. 9: *Cassiopeia xamachana*, after MAYER 1910.

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Laboratory experiments showed that the optimum chlorinity of *Cassiopea* is ca. 22‰ while the measured chlorinity in the lagoons varied between 19‰ after rainfall and 23.65‰ in dry periods.

The mortality is caused partly by high temperature in the lagoons (temperatures above 37°C. kill *Cassiopea*) and probably partly by turbulence of the water. It seemed not to be restricted to the two months of September and October.

High temperatures and turbulence of the water probably account for the absence of *Cassiopea* in some bodies of water and not others.

The effects of other factors such as oxygen, light, pH, and amount of organic material were not studied." – Complete quotation of author's abstract.

TABLE 1.

Cassiopea xamachana

Specimens measured arranged according to SIZE, and to MONTH of collecting.

Size = diameter of umbrella in mm: 1–20, 21–40, 41–60, 61–80 mm, etc.
Categories discerned: *1* = up to 40, *2* = 41–100, *3* = 101–180, *4* = 181 mm or more.
S = young scyphistoma's.

Localities	*Nrs.*	1–20	21–40	41–60	61–80	81–100	101–120	121–140	141–160	161–180	181–200	201–220	221–240	241–260	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
FLORIDA																										
Garden Key '13	6	.	.	.	.	.	3	3	.	.	.	.	.	.	—	—	—	*3*	—	—	—	—	—	—	—	—
Key Biscayne '63	9	.	1	1	1	.	1	1	1	.	1	1	1	.	—	—	—	—	—	—	—	*1234*	—	—	—	—
BAHAMAS																										
S. Bimini '49	20	.	3	3	6	4	.	.	1	2	1	.	.	.	—	—	—	—	—	—	—	*1234*	—	—	—	—
N. Bimini '63	22	.	.	.	.	.	1	14	5	2	.	.	.	.	—	—	—	—	—	—	—	—	—	—	*3*	—
JAMAICA																										
Port Royal '58	2	.	.	.	.	.	.	.	2	.	.	.	.	.	—	—	—	—	—	—	—	—	—	*3*	—	—
ST. CROIX																										
Krausse Lagoon '55	47	2	11	8	9	3	8	5	1	.	.	.	.	.	—	—	—	—	—	*123*	—	—	—	—	—
LOS ROQUES																										
Gran Roque '55	2	.	.	.	1	.	1	.	.	.	.	.	.	.	—	—	—	*23*	—	—	—	—	—	—	—	—
BONAIRE																										
Poejito '30	97	.	11	6	5	3	12	7	12	5	9	13	11	3	—	—	—	—	—	—	—	—	*23*	*1234*	S *1234*	—
Poejito '48	2	.	.	.	1	.	1	.	.	.	.	.	.	.	—	—	—	*13*	—	—	—	—	—	—	—	—
Poejito '55	6	.	1	.	.	.	3	2	.	.	.	.	.	.	—	—	*13*	—	—	—	—	—	—	—	—	*3*
Cay '37	3	.	1	.	.	.	.	.	1	1	.	.	.	.	—	—	—	—	—	—	—	—	—	—	—	—
Soerebon '63	9	.	.	.	.	.	2	1	1	5	.	.	.	.	—	—	—	—	—	—	—	—	—	—	—	—
CURAÇAO																										
Awa Blanco '63	3	.	.	.	.	.	.	.	1	1	1	.	.	.	—	—	—	—	—	—	—	—	—	—	*34*	—
Spaans Lagoen '55	9	.	.	.	.	.	.	.	.	.	.	.	1	.	—	—	—	—	—	—	—	*1234*	—	—	—	—
Spaans Lagoen '64	5	.	.	2	3	2	1	.	.	.	.	.	.	.	*34*	—	—	—	*23*	—	—	—	—	—	—	—
Caracas Baai '20	20	.	.	.	.	.	.	.	2	1	1	1	.	.	—	—	—	—	—	—	—	—	—	—	—	—
Rifwater '49	6	.	.	2	1	2	4	4	2	5	.	.	.	.	—	*123*	—	—	—	—	—	—	—	—	—	—
Rifwater '62	4	.	2	.	1	1	1	1	.	.	.	.	.	.	—	—	—	—	—	—	*23*	—	—	—	S *123*	—
Rifwater '63	76	.	26	33	13	2	2	.	.	.	.	.	.	.	*23*	—	—	—	*12*	—	—	—	—	—	—	—
Slangenbaai '51	19	.	.	.	8	9	2	.	.	.	.	.	.	.	—	—	—	—	—	—	*2*	—	—	—	—	—
Slangenbaai '60	6	1	2	2	1	.	.	.	.	.	.	.	.	.	—	—	—	—	—	—	—	—	—	*12*	—	—
Santa Marta '53	1	.	.	.	.	1	.	.	.	.	.	.	.	.	—	—	—	—	—	—	—	*12*	—	—	—	—
Santa Marta '54	4	.	1	2	1	.	.	.	.	.	.	.	.	.	—	*123*	*123*	—	—	—	—	—	—	—	*123*	—
Santa Marta '55	211	53	68	38	27	14	6	2	3	.	.	.	.	.	—	—	—	*12*	—	—	—	—	—	—	—	—
Santa Marta '58	11	.	1	.	.	2	3	3	2	.	.	.	.	.	—	—	—	—	—	—	*1234*	—	—	—	—	—
Santa Marta '60	29	.	6	9	9	5	.	.	.	.	.	1	.	.	—	—	—	—	—	—	—	—	—	—	—	—
Santa Marta '62	19	.	1	4	4	4	3	.	1	1	.	.	.	.												
ARUBA																										
Boekoeti Lag. '48	2	.	.	.	.	.	.	.	.	.	.	.	.	.	—	—	—	—	—	—	—	—	—	—	—	*3*
Boekoeti Rif '49	5	.	.	.	.	.	1	.	.	1	.	.	.	.	*23*	—	—	—	—	—	—	—	—	—	—	—
Boekoeti Rif '55	24	.	.	1	.	.	1	1	.	2	.	.	.	.	—	—	—	—	*24*	—	—	—	—	—	—	—
Totals:	679	56	135	113	103	64	57	41	35	26	14	16	13	3	*234*	*123*	*123*	*123*	*123*	*123*	*1234*	*1234*	*23*	*1234*	*1234*	*3*

TABL 2.

Cassiop. frondosa

Specimens measured arranged accordi to SIZE, and to MONTH of collecting.

Size = diameter of umbrella in mm: 1–20, 21–40, 41–60, 61–80 mm, etc.
Categories discerned: *1* = up to 40, *2* = 41–100, *3* = 101–180, *4* = 181 mm or more.

Localities	*nrs.*	1– 20	21– 40	41– 60	61– 80	81– 100	101– 120	121– 140	141– 160	161– 180	181– 200	201– 22	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
BAHAMAS																								
S. Bimini '49	8	.	2	3	1	.	.	.	1		1	.	—	—	—	—	—	—	—	*1234*	—	—	—	—
PUERTO RICO																								
Parguera '63	17	.	.	1	1	.	.	3	3	6	2	1	—	*3*	—	—	—	—	—	—	*234*	—	—	—
ST. MARTIN																								
Simson Lagoon '49	15 [1]	.	.	.	4	1	.	1	.	7	1	1	—	—	—	—	—	—	—	*234*	—	—	—	—
Oyster Pond '63	6	.	.	.	.	3	3	.	.	.	.	.	—	—	—	—	—	—	—	—	—	*23*	—	—
BONAIRE																								
Poejito '30	6	.	.	1	1	2	2	.	.	.	.	.	—	—	—	—	—	—	—	—	—	*23*	—	—
Cay '37	1	.	.	.	1	.	.	.	.	.	.	.	—	—	*2*	—	—	—	—	—	—	—	—	*23*
Soerebon '63	2	.	.	.	.	1	1	.	.	.	.	.	—	—	—	—	—	*2*	—	—	—	—	—	—
Oranjepan '60	5	.	.	2	2	1	.	.	.	.	.	.	—	—	—	—	—	—	—	—	—	—	—	—
CURAÇAO																								
Fuik Baai '49	1	.	.	.	.	.	1	.	.	.	.	.	—	—	—	*3*	—	—	—	—	—	—	—	*23*
Fuik Baai '58	2	.	.	.	.	1	.	1	.	.	.	.	—	—	—	—	—	—	—	—	—	—	—	—
Spaanse Baai '49	1	.	.	.	1	.	.	.	.	.	.	.	—	—	—	*2*	—	—	—	—	—	—	—	—
Spaanse Water '49	1	.	1	.	.	.	.	.	.	.	.	.	—	—	*1*	—	—	—	—	—	—	—	—	—
Caracas Baai '20	1	.	.	1	.	.	.	.	.	.	.	.	—	—	—	*1*	—	—	—	—	—	—	—	—
Rifwater '49	1	.	.	.	.	1	.	.	.	.	.	.	—	*2*	—	—	—	—	—	—	—	—	—	—
Slangenbaai '51	1	.	.	.	1	.	.	.	.	.	.	.	*2*	—	—	—	—	—	—	—	—	—	—	—
ARUBA																								
Lagoen Boekoeti '48	1	.	.	.	.	.	.	1	.	.	.	.	—	—	—	—	—	—	—	—	—	—	—	*3*
Rif Boekoeti '49	1	.	.	.	.	.	.	1	.	.	.	.	*3*	—	—	—	—	—	—	—	—	—	—	—
Rif Boekoeti '55	7 [2]	.	.	4	3	.	.	.	.	.	.	.	—	—	—	—	*2*	—	—	—	—	—	—	—
Totals:	77	—	3	12	15	10	7	7	4	13	4	2	*23*	*23*	*12*	*123*	*2*	*2*	—	*1234*	*234*	*23*	—	*23*

[1] considered a hybrid population, × *xamachana*.
[2] part of a possibly hybrid population, × *xamachana*.

TABLE 3.

MARGINAL SENSE ORGANS and RADIAL VESSELS in samples of *Cassiopea xamachana*

Localities	*Nrs. of specimens*	*Rhopalia*	*Rhopalial canals*	*Radial canals*
FLORIDA				
Garden Key 1913	6	13–*16.7*–19	13–*16.5*–19	28–*32.2*–36
Dry Tortugas 1931	13	14–*16.7*–18	14–*16.6*–18	28–*33.5*–36
FLORIDA				
Key Biscayne 1963	9	16–*18.0*–30	16–*16.5*–18	32–*33.1*–36
BAHAMAS				
South Bimini 1949	20	13–*16.6*–20	12–*16.3*–20	22–*32.6*–40
North Bimini 1963	22	12–*16.8*–20	12–*16.8*–20	20–*32.3*–39
JAMAICA				
Port Royal 1958	2	18 – 27	16 – 17?	32 – 33?
ST. CROIX				
Krausse Lagoon 1955	48	14–*17.1*–21	13–*17.0*–21	26–*33.75*–42
LOS ROQUES				
Gran Roque 1955	2	15 – 17	16 – 16	32 – 32
BONAIRE				
Lac, Poejito 1930	94	16–*18.37*–31	15–*17.55*–23	28–*34.9*–41
Lac, Poejito 1948	1	20	16	32
Lac, Poejito 1955	6	14–*17.2*–20	14–*16.3*–19	28–*33.0*–37
Lac, Cay 1937	3	16–*17.1*–19	16–*17.1*–19	32–*34.7*–39
Lac, Soerebon 1963	6	15–*17.5*–21	15–*16.6*–19	29–*32.6*–36
CURAÇAO				
Awa Blanco 1963	3	16–*16.0*–16	14–*15.5*–16	21–*27.5*–31
Spaans Lagoen 1955	9	16–*17.2*–19	16–*17.2*–19	32–*34.3*–38
Spaans Lagoen 1964	5	15–*16.6*–21	15–*16.2*–17	30–*31.6*–34
Caracas Baai pool 1920	20	15–*17.3*–22	15–*16.9*–20	26–*33.65*–40
Rifwater pool 1949	6	16–*16.3*–17	16–*16.5*–18	32–*33.3*–36
Rifwater pools 1962	3	15–*15.3*–16	14–*15.0*–16	30–*31.7*–32
Rifwater 1963	75	14–*16.35*–21	14–*16.45*–21	27–*32.2*–40
Slangenbaai 1951	18	15–*16.8*–20	14–*16.7*–20	28–*34.5*–38
Slangenbaai 1960	6	15–*16.2*–19	15–*16.0*–18	30–*31.5*–35
Santa Marta kreek 1954	4	16–*16.0*–16	16–*16.0*–16	30–*31.6*–32
Santa Marta kreek 1955	70	17–*17.11*–22	15–*16.81*–22	30–*33.77*–44
Santa Marta kreek 1958	10	16–*16.6*–18	16–*16.3*–18	30–*32.4*–36
Santa Marta kreek 1960	20	15–*16.5*–18	16–*16.1*–18	30–*32.2*–34
Santa Marta lagoon 1 1955	46	14–*16.9*–22	13–*16.6*–20	27–*33.0*–40
Santa Marta lagoon 2 1955	10	13–*16.5*–20	13–*17.0*–20	26–*34.0*–40
Santa Marta lagoon 3 1955	23	13–*16.3*–21	15–*16.1*–18	28–*31.7*–35
Santa Marta lagoons 1962	15	16–*17.2*–20	16–*16.9*–20	28–*31.4*–36
ARUBA				
Lagoen Boekoeti 1948	2	15 – 16	15 – 16	30 – 32
Rif Boekoeti 1949	6	15–*15.6*–16	15–*15.8*–16	30–*31.6*–32
Rif Boekoeti pool 1955 [1]	23	14–*15.8*–17	13–*15.7*–17	25–*31.3*–32

[1] part of a possibly hybrid population, × *frondosa*.

TABLE 4.

RHOPALIAL VESSELS in regular specimens of *Cassiopea xamachana*

Localities	sample		regular specimens									
	Nrs.	*Rhop. can.*	*Nrs.*	*Rhop. can.*	*Distribution*							
					13	*14*	*15*	*16*	*17*	*18*	*19*	*20*	*21*	*22*
FLORIDA														
Garden Key 1913	6	*16.5*	3	*16.7*	.	.	.	1	2	.	.	.	.	.
Dry Tortugas 1931	13	*16.6*	8	*16.5*	.	.	.	5	2	1	.	.	.	.
Key Biscayne 1963	9	*16.5*	7	*16.3*	.	.	.	5	2	.	.	.	.	.
BAHAMAS														
South Bimini 1949	20	*16.3*	13	*16.9*	.	.	.	7	2	3	.	1	.	.
North Bimini 1963	22	*16.8*	11	*17.6*	.	.	.	1	2	8	.	.	.	.
ST. CROIX														
Krausse Lagoon 1955	48	*17.0*	35	*17.14*	.	1	2	10	7	11	2	1	1	.
BONAIRE														
Lac, Poejito 1930	94	*17.55*	50	*17.48*	.	.	.	11	15	14	9	1	.	.
Lac, Poejito 1955	6	*16.3*	3	*16.7*	.	1	.	.	1	.	1	.	.	.
Lac, Soerebon 1963	6	*16.6*	3	*16.7*	.	.	.	1	2	.	.	.	.	.
Lac, Cay 1937	3	*17.1*	2	*16.5*	.	.	.	1	1	.	.	.	.	.
CURAÇAO														
Spaans Lagoen 1955	9	*17.2*	6	*16.8*	.	.	.	3	1	2	.	.	.	.
Spaans Lagoen 1964	5	*16.2*	1	*15*	.	.	1	.	.	.	.	.	.	.
Caracas Baai pool 1920	20	*16.9*	9	*16.65*	.	.	1	5	1	1	.	1	.	.
Rifwater pool 1949	6	*16.5*	5	*16.4*	.	.	.	4	.	1	.	.	.	.
Rifwater pools 1962	3	*15.0*	2	*15.5*	.	.	1	1	.	.	.	.	.	.
Rifwater 1963	75	*16.45*	41	*16.31*	.	.	4	28	4	3	1	1	.	.
Slangenbaai 1951	17	*16.7*	7	*17.3*	.	.	.	2	2	2	1	.	.	.
Slangenbaai 1960	6	*16.0*	3	*15.7*	.	.	2	.	1	.	.	.	.	.
Santa Marta kreek 1954	4	*16.0*	3	*16.0*	.	.	.	3	.	.	.	.	.	.
Santa Marta kreek 1955	70	*16.81*	57	*16.91*	.	.	1	29	11	10	4	1	.	1
Santa Marta kreek 1958	10	*16.3*	8	*16.4*	.	.	.	6	1	1	.	.	.	.
Santa Marta kreek 1960	20	*16.1*	17	*16.0*	.	.	1	15	1	.	.	.	.	.
Santa Marta lagoon 1 1955	46	*16.6*	33	*16.6*	.	.	.	24	2	5	1	1	.	.
Santa Marta lagoon 2 1955	10	*17.0*	5	*16.4*	1	.	.	2	1	.	.	1	.	.
Santa Marta lagoon 3 1955	23	*16.1*	12	*16.0*	.	.	.	12	.	.	.	.	.	.
Santa Marta lagoons 1962	15	*16.9*	7	*16.4*	.	.	.	5	1	1	.	.	.	.
ARUBA														
Lagoen Boekoeti 1948	2	*15.5*	2	*15.5*	.	.	1	1	.	.	.	.	.	.
Rif Boekoeti 1949	6	*15.8*	4	*15.8*	.	.	1	3	.	.	.	.	.	.
Rif Boekoeti pool 1955	23[1]	*15.7*	13	*15.85*	.	.	2	11	.	.	.	.	.	.
Totals	597	*16.75*	370	*16.75*	1	2	17	196	62	63	19	8	1	1

[1] part of possibly hybrid population, × *frondosa*.

TABLE 5.

MARGINAL SENSE ORGANS and RADIAL VESSELS in samples of *Cassiopea frondosa*

Localities	*Nrs. of specimens*	*Rhopalia*	*Rhopalial canals*	*Radial canals*
FLORIDA				
Miami	2	12 – 14	12 – 12	23 – 24
BAHAMAS				
South Bimini 1949	8	12–*12.4*–14	12–*12.1*–13	12–*24.0* 25
PUERTO RICO				
Cayo Májimo 1963	16	9–*12.44*–15	7–*11.3*–14	16–*22.6* 26
Cayo Caracoles 1963	1	12	11	19
Cayo la Gata 1963	1	12	11	19
ST. MARTIN				
Simson Lagoon 1949	16[1]	12–*14.7*–16	12–*14.6*–16	24–*26.2* 32
Oysterpond 1963	6	10–*11.9*–13	10–*11.9*–13	20–*23.1* 26
BONAIRE				
Lac, Poejito 1930	6	10–*12.3*–15	10–*12.2*–15	20–*23.2* 24
Lac, Cay 1937	1	20	20	38
Lac, Soerebon 1963	2	19 – 22	18 – 20	36 – 36
Oranjepan 1960	5	11–*11.8*–13	11–*11.6*–12	22–*23.2* 24
CURAÇAO				
Fuik Baai 1949	1	12	12	24
Fuik Baai 1958	2	12 – 12	12 – 12	24 – 24
Spaanse Baai 1949	1	12	12	24
Spaanse Water 1949	1	11	11	23
Caracas Baai pool 1920	1	14	14	28
Rifwater pool 1949	1	14	13	24
Slangenbaai 1951	1	12	12	24
ARUBA				
Lagoen Boekoeti 1948	1	11	11	21
Rif Boekoeti 1949	1	14	16	32
Rif Boekoeti pool 1955	6[2]	12–*12.5*–20	12–*13.4*–19	24–*27.0* 35

[1] considered a hybrid population, × *xamachana*.
[2] part of a possibly hybrid population, × *xamachana*.

TABLE 6.

RHOPALIAL VESSELS in regular specimens of *Cassiopea frondosa*

Localities	sample		regular specimens							
	Nrs. of spec.	*Rhop. can.*	*Nrs. of spec.*	*Rhop. can.*	*Distribution*						
					10	*11*	*12*	*13*	*14*	*15*	*16*
FLORIDA											
Miami	2	*13.0*	1	*12.0*	.	.	1	.	.	.	.
BAHAMAS											
South Bimini	8	*12.1*	7	*12.1*	.	.	6	1	.	.	.
PUERTO RICO											
Cayo Májimo 1963	16	*11.3*	3	*11.7*	.	1	2	.	.	.	.
ST. MARTIN											
Simson Lagoon 1949	16[1]	*14.6*	13	*13.4*	.	.	6	1	2	2	2
Oyster Pond 1963	6	*11.9*	5	*11.6*	1	1	2	1	.	.	.
BONAIRE											
Lac, Poejito 1930	6	*12.2*	4	*11.5*	1	.	3	.	.	.	.
Oranjepan 1960	5	*11.8*	3	*11.3*	.	2	1	.	.	.	.
CURAÇAO											
Fuik Baai 1949	1	12	1	12	.	.	1	.	.	.	.
Fuik Baai 1958	2	*12.0*	2	*12.0*	.	.	2	.	.	.	.
Spaanse Baai 1949	1	12	1	12	.	.	1	.	.	.	.
Caracas Baai pool 1920	1	14	1	14	.	.	.	.	1	.	.
Slangenbaai 1951	1	12	1	12	.	.	1	.	.	.	.
ARUBA											
Rif Boekoeti pool 1955	6[2]	*12.5*	4	*13.2*	.	.	2	.	.	1	1
Totals	49[3]	*11.85*	29	*11.85*	2	4	20	2	1	.	.

[1] considered a hybrid population, × *xamachana*
[2] part of possibly hybrid population, × *xamachana*
[3] excluding Simson Lagoon and Rif Boekoeti samples

TABLE 7.

ANORMAL NUMBER OF ARMS IN *Cassiopea xamachana* in not obviously regenerated specimens.

*Diam*eter of umbrella in mm. – Maximal *arml*ength expressed in Radius of umbrella. – Number of *rhop*alia, *rhop*alial canals, and *rad*ial canals. – Normal *formula* of arms and subgenital pits: 2.2.2.2.

Localities	*diam.*	*arml.*	*rhop.*	*rh. c.*	*rad. c.*	*formula*
BAHAMAS						
South Bimini 1949	54	1.35	17	17	32?	2.2.2.
	156	1.4	17	16?	30?	2.2.1.2.
North Bimini 1963	145	1.6	18	18	36	2.2.3.2.
ST. CROIX						
Krausse Lag. 1955	56	1.45	19	19	38	2.2.2.2.2.
BONAIRE						
Lac, Poejito 1930	111	1.1	18	18	36	2.2.3.2.
	132	1.1	16	16	32	2.1.1.2.
	135	1.35	23	19?	37	2.2.1.2.
	201	0.8	18	18	36	2.3.3.4.
	215	0.9	19	18	36	2.2.3.2.
	241	1.0	21	18?	36?	2.2.2.
Lac, Poejito 1955	119	1.2	17	15	30	2.2.1.½.2.
Lac, Cay 1937	170	1.1	16	16	32	2.½.1.1.½.1.2.
CURAÇAO						
Awa Blanco 1963	145	1.15	16	16	31	2.2.2.
Spaans Lagoen 1955	26	0.8	18	18	36	2.3.4.2.
Spaans Lagoen 1964	185	1.55	16	17	30	2.2.3.2.
Rifwater 1963	45	1.0	17	17	32	2.2.1.2.
	56	1.1	15	15	32	2.2.1.2.
	66	1.3	18	18	36	2.2.2.2.2.2.
	75	0.9	16	16	30	2.2.2.2.2.
Slangenbaai 1951	98	1.4	16	14?	28?	2.2.1.2.
Santa Marta 1955	10	1.1	16	16	32	5 arms
	11	1.1	17	17	34	2.1.2.1.
	16	0.9	16	16	32	2.2.1.2.
	30	1.4	16	16	32	2.1.2.
	32	1.1	18	16?	28?	1.1.1.1.
	41	1.55	18	18?	36?	2.1.1.2.
	44	1.2	14?	16?	?	2.2.1.2.
	47	1.35	15	14?	21?	2.1.2.
	51	1.55	19	19	38	2.2.1.2.
	58	1.55	19	18?	36?	2.2.1.2.
	60	1.35	11	?	30?	2.1.3.1.2.
	66	1.1	16	16	32	2.2.1.2.
	70	1.5	17	?	30?	2.1.1.1.1.
	76	1.65	15	?	25?	2.1.1.1.1.
	78	1.65	18	18	36	2.2.3.2.
	87	1.8	16?	10?	24?	2.1.1.1.
Santa Marta 1962	98	1.55	15	17	34?	2.2.1.3.2.
	45	1.55	16	16	32?	2.2.1.2.
	55	1.2	16	17	32	2.2.1.2.
	72	1.15	16	17	32?	2.2.3.2.
	100	1.25	13	12	26?	2.2.1.2.
	170	1.4	11	12	30	2.2.1.1.1.2.

TABLE 8.

ANORMAL NUMBER OF ARMS IN *Cassiopea frondosa*

*Diam*eter of umbrella, in mm. – Maximal *arml*ength, expressed in Radius of umbrella. – Number of *rhop*alia, *rhop*alial canals and *rad*ial canals. – Normal *formula* of arms and subgenital pits: 2.2.2.2.

Localities	*diam.*	*arml.*	*rhop.*	*rhop. c.*	*rad. c.*	*formula*
BIMINI						
South Bimini 1949	153	1.00	14	12	22	2.2.3.2.
PUERTO RICO						
Cayo Májimo 1963	55	1.28	15	13	25	2.2.1.2.2.
	128	1.17	9	8	22	2.1.1.1.1.
	158	1.08	12	11	22	2.2.2.2.2.
	165	1.23	13	13	24	2.2.2.1.2.
	170	1.14	12	11	19	2.1.1.1.1.
	190	1.16	15	14	25	2.2.1.2.
Cayo Caracoles 1963	160	1.25	12	11	19	2.1.2.
ST. MARTIN						
Simson Lagoon 1949	78	1.00	12	12	24	2.2.1.2.
	140	1.30	14	13	26	2.1.2.1?.
BONAIRE						
Lac, Poejito 1930	81	1.15	15	15	23	2.4.3.2.
Lac, Cay 1937	66	1.10	20	20	38	2.1.3.3.2.
Oranjepan 1960	52	1.17	13	12	24	2.4.4.4.
	53	1.10	12	12	24	3.4.4.4.
	67	0.84	11	11	22	3.3.4.3.
	68	1.00	12	?	?	2.3.3.2.

TABLE 9.

Cassiopea xamachana

Specimens arranged according to SIZE and maximal ARM LENGTH.

Size = diameter of umbrella in mm: 1–20, 21–40, 41–60, 61–80 mm, etc.
Arm length measured from centre of subumbrella, expressed in R (= radius of umbrella).

Measurements in single specimens in parenthesis.
Average values of 2–4 specimens in ordinary type, of 5–9 specimens in italics, of 10 or more specimens in thick type.

Localities	1–20	21–40	41–60	61–80	81–100	101–120	121–140	141–160	161–180	181–200	201–220	221–240	241–260
FLORIDA													
Garden Key '13	—	—	—	—	—	1.3	1.35	—	—	—	—	—	—
Dry Tortugas' 31	1.2	1.35	1.65	—	1.4	—	—	—	—	—	—	—	—
Key Biscayne '63	—	(1.6)	(1.4)	(1.6)	—	(1.4)	(1.45)	(1.6)	—	(1.3)	(1.85)	(1.35)	—
BAHAMAS													
South Bimini '49	—	1.3	1.35	*1.4*	1.4	—	—	(1.4)	1.35	(1.45)	—	—	—
North Bimini '63	—	—	—	—	—	(1.25)	**1.45**	*1.36*	1.4	—	—	—	—
JAMAICA													
Port Royal '58	—	—	—	—	—	—	—	1.9	—	—	—	—	—
ST. CROIX													
Krausse Lagoon '55	1.05	**1.25**	*1.3*	*1.45*	1.45	*1.55*	*1.6*	(1.85)	—	—	—	—	—
LOS ROQUES													
Gran Roque '55	—	—	—	(1.1)	—	(0.85)	—	—	—	—	—	—	—
BONAIRE													
Lac, Poejito '30	—	**0.9**	0.9	0.9	1.1	**1.0**	*1.1*	**1.0**	*1.0*	*1.1*	**1.0**	**1.0**	0.95
Lac, Poejito '48	—	(1.0)	—	(1.25)	—	(1.1)	—	(1.00)	(0.95)	—	—	—	—
Lac, Soerebon '63	—	—	—	—	—	1.05	—	(1.05)	1.15	—	—	—	—
CURAÇAO													
Awa Blanco '63	—	—	—	—	—	—	—	(1.15)	(0.8)	(1.0)	—	—	—
Spaans Lagoen '55	—	(0.8)	1.3	1.4	1.4	(1.45)	—	—	—	—	—	(1.45)	—
Spaans Lagoen '64	—	—	—	—	—	—	—	1.45	(1.35)	(1.55)	(1.5)	—	—
Caracas Baai '20	—	—	1.35	—	1.3	1.5	1.5	(1.35)	(1.3)	—	—	—	—
Rifwater '49	—	1.05	—	(1.05)	(1.3)	(1.15)	(1.2)	—	—	—	—	—	—
Rifwater '62	—	—	—	(0.95)	(1.0)	1.25	—	—	—	—	—	—	—
Rifwater '63	—	**1.2**	**1.1**	**1.05**	**0.95**	1.3	—	—	—	—	—	—	—
Slangenbaai '51	—	—	—	*1.2*	**1.2**	1.4	—	—	—	—	—	—	—
Slangenbaai '60	(0.85)	1.2	1.1	(0.9)	—	—	—	—	—	—	—	—	—
Santa Marta '54	—	(1.0)	1.25	—	—	—	—	—	—	—	—	—	—
Santa Marta '55	**1.0**	**1.2**	**1.4**	**1.4**	**1.5**	1.45	(1.4)	1.55	—	—	—	—	—
Santa Marta '58	—	—	—	—	1.4	1.6	1.5	1.5	—	—	—	—	—
Santa Marta '60	—	*1.05*	*1.3*	*1.2*	*1.25*	—	—	—	—	—	—	—	—
Santa Marta '62	—	(1.0)	1.2	1.15	1.15	1.1	—	(1.0)	(1.4)	—	(1.2)	—	—
ARUBA													
Boekoeti Lag. '48	—	—	—	—	—	(1.4)	—	—	(1.3)	—	—	—	—
Boekoeti Rif '49	—	—	(1.2)	—	—	(1.35)	(1.4)	—	(1.35)	—	—	—	—
Boekoeti Rif '55 [1]	—	—	1.15	**1.15**	**1.2**	—	—	—	—	—	—	—	—
Averages as accepted [2]	**1.0**	**1.15**	**1.25**	**1.25**	**1.20**	**1.25**	**1.35**	**1.35**	**1.25**	**1.3**	**1.3**	**1.1**	0.95

[1] part of a possibly hybrid population, × *frondosa*
[2] excluding Rif Boekoeti '55 sample

TABLE 10.

Cassiopea frondosa

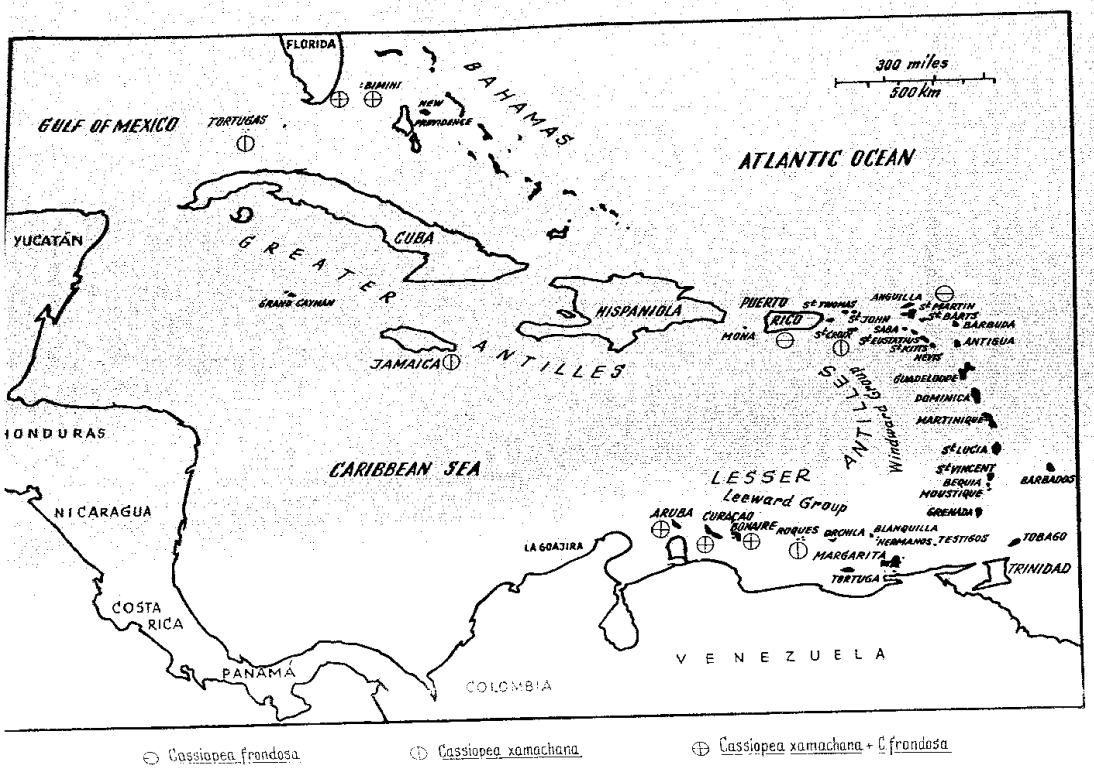
Specimens arranged according to SIZE and maximal ARM LENGTH.

Size = diameter of umbrella in mm: 1–20, 21–40, 41–60, 61–80 mm, etc.
Arm length measured from centre of subumbrella, expressed in R (= radius of umbrella).

Measurements of single specimens in parenthesis.
Average values of 2–4 specimens in ordinary type, of 5–9 specimens in italics.

Localities	1–20	21–40	41–60	61–80	81–100	101–120	121–140	141–160	161–180	181–200	201–220	221–240	241–260
FLORIDA													
Miami	—	—	—	—	—	(1.15)	(1.05)	—	—	—	—	—	—
BIMINI													
South Bimini '49	—	1.0	1.1	(1.05)	—	—	—	(1.05)	—	(1.15)	—	—	—
PUERTO RICO													
Parguera '63	—	—	(1.3)	(1.15)	—	—	1.2	1.15	*1.125*	1.2	(1.45)	—	—
ST. MARTIN													
Simson Lagoon '49 [1]	—	—	—	1.2	(1.2)	—	(1.3)	—	*1.25*	(1.0)	(1.05)	—	—
Oyster Pond '63	—	—	—	—	0.85	0.8	—	—	—	—	—	—	—
BONAIRE													
Lac, Poejito '30	—	—	(0.86)	—	0.95	0.95	—	—	—	—	—	—	—
Lac, Cay '37	—	—	—	(1.1)	—	—	—	—	—	—	—	—	—
Lac, Soerebon '63	—	—	—	—	(1.05)	(1.1)	—	—	—	—	—	—	—
Oranjepan '60	—	—	1.15	0.95	(0.95)	—	—	—	—	—	—	—	—
CURAÇAO													
Spaanse Water '49	—	(1.0)	—	—	—	—	—	—	—	—	—	—	—
Caracas Baai '20	—	—	0.95	—	—	—	—	—	—	—	—	—	—
Rifwater '49	—	—	—	—	(0.95)	—	—	—	—	—	—	—	—
Slangenbaai '51	—	—	—	(1.15)	—	—	—	—	—	—	—	—	—
ARUBA													
Lagoen Boekoeti '49	—	—	—	—	—	—	(1.1)	—	—	—	—	—	—
Rif Boekoeti '49	—	—	—	—	—	—	(1.0)	—	—	—	—	—	—
Rif Boekoeti '55 [2]	—	—	1.15	1.2	—	—	—	—	—	—	—	—	—
Averages [3]	—	1.0	*1.08*	*1.03*	*0.93*	*0.9*	*1.05*	1.1	*1.12*	1.15	1.25	—	—

[1] considered a hybrid population, × *xamachana*.
[2] part of possibly hybrid population, × *xamachana*.
[3] excluding Simson Lagoon and Rif Boekoeti '55 samples.



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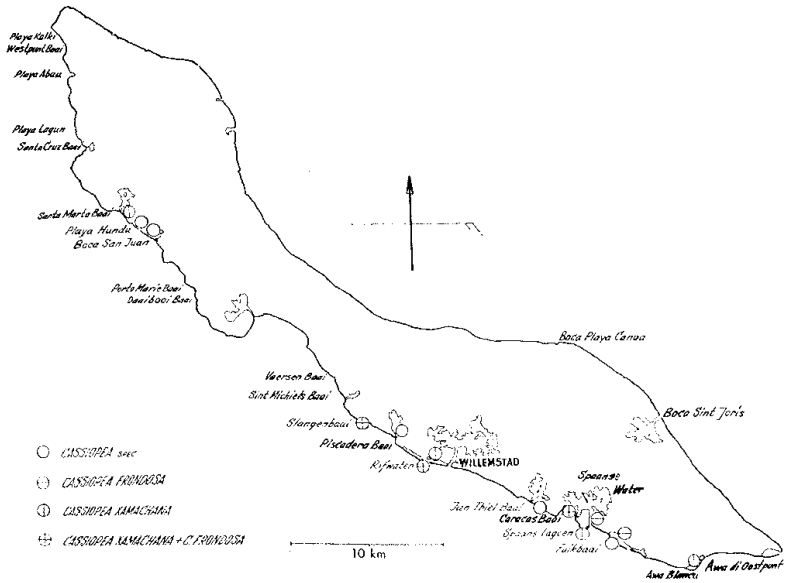

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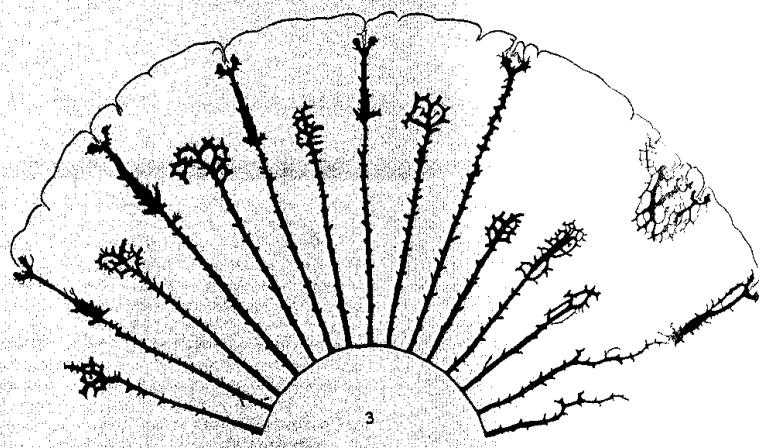
Fig. 2. Sketch map of CURAÇAO, showing localities of *Cassiopea*.



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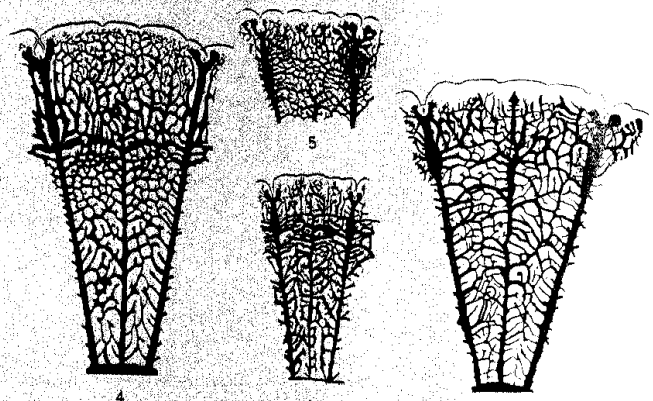
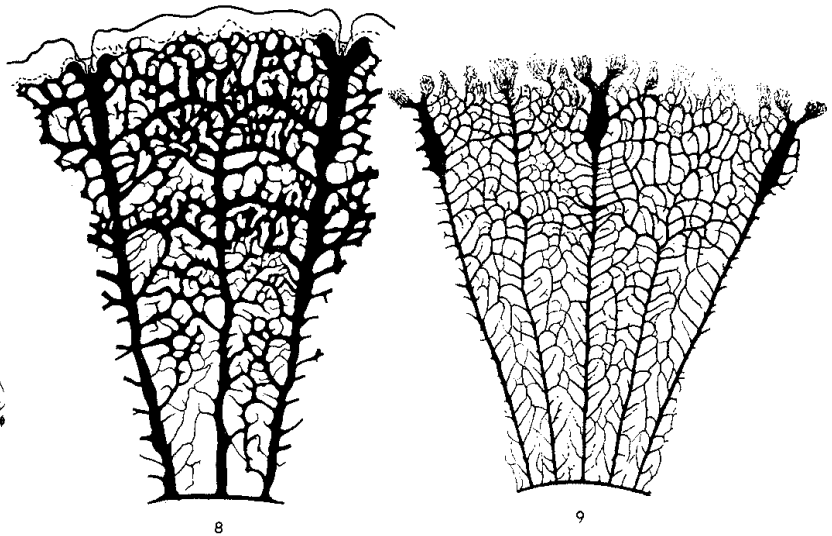


4 5 6 7

Fig. 3. RADIAL VESSELS in *Cassiopea xamachana* from Jamaica, Port Royal, 1958 (natural size; RML 663).

Fig. 4–7. RADIAL CANALS and anastomosing vessels in *Cassiopea xamachana* from: 4, Jamaica, Port Royal, 1958 (RML 662); 5, Dry Tortugas, 1931; 6, Curaçao, Santa Marta, 1955; 7, St. Croix, Krausse Lagoon, 1955 (all natural size).



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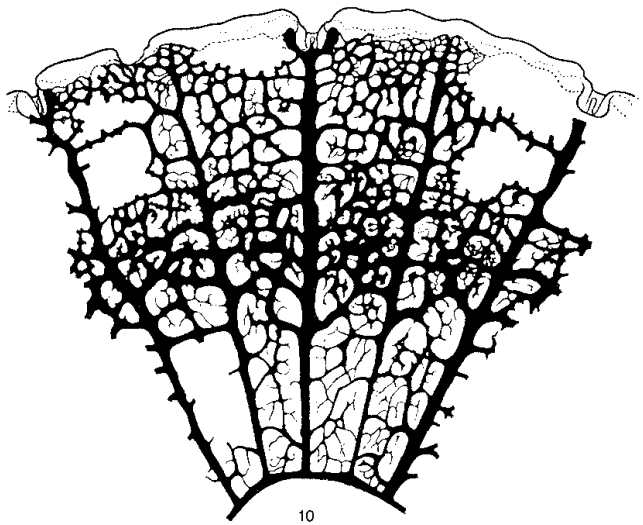

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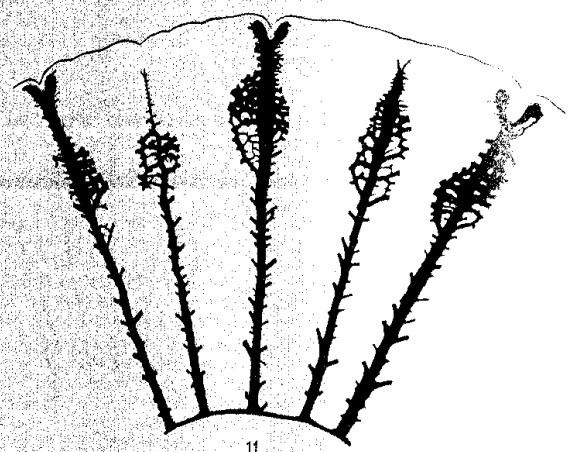
Fig. 8–9. RADIAL CANALS and anastomosing vessels in *Cassiopea xamachana* from: 8, Bonaire, Lac, 1930 (Zool. Jahrb. Syst. *64*, p. 494), and Curaçao, Rifwater pool, 1962 (8, nat. size; 9, x 2).

Fig. 10. RADIAL CANALS and anastomosing vessels in *Cassiopea frondosa* from [illegible] (Zool. Jahrb. Syst. *64*, p. 491) (nat. size).



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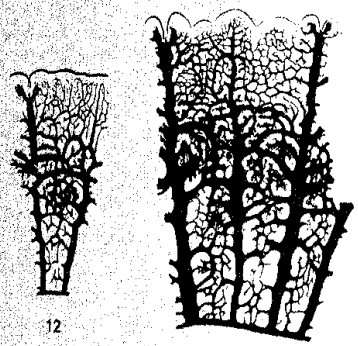

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Fig. 11. RADIAL VESSELS in *Cassiopea frondosa* from South Bimini, 1949 (nat. size).

Fig. 12-13. RADIAL CANALS and anastomosing vessels in *Cassiopea frondosa* from St. Martin, Simson Lagoon, 1949; 12, showing a few *xamachana* characteristics (nat. size).

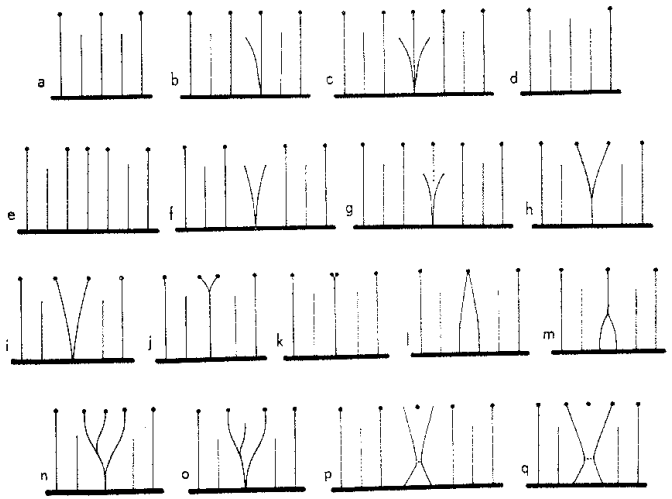


Fig. 14. Schematic drawings showing types of ANOMALIES IN RADIAL VESSELS which were observed in a single sample of *Cassiopea xamachana* from Curaçao, Rifwater, 1963: a, three rhopalial and two interrhopalial canals in normal case; b-q, anomalies arranged according to decreasing abundance.

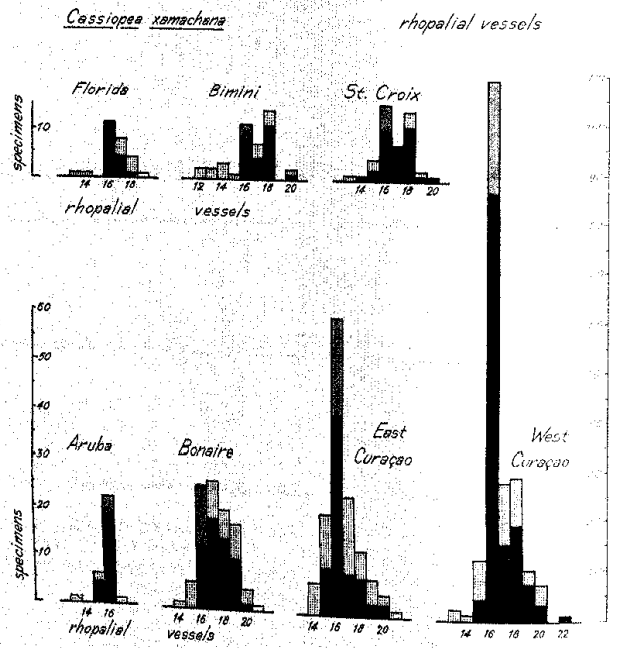


Fig. 15.

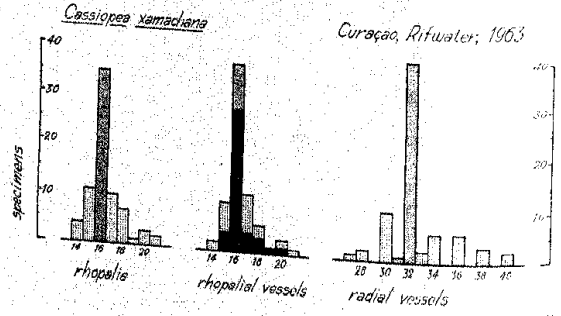


Fig. 16.

Fig. 15. Variation in numbers of RHOPALIAL VESSELS in unselected samples of *Cassiopea xamachana*, and in regular specimens (in black) from same samples: Florida (Garden Key, Tortugas, and Key Biscayne; 26 unselected specimens, 16 regular ones); Bimini (North Bimini and South Bimini; 42 spec., 24 regular); St. Croix (48 spec., 35 regular); Aruba (incl. Reef Bucuti pool, 30 spec., 22 regular); Bonaire (102 spec., 56 regular); East Curaçao (135 spec., 68 regular), and West Curaçao (199 spec., 125 regular).

Fig. 16. Variation in numbers of RHOPALIA, RHOPALIAL VESSELS and RADIAL VESSELS in *Cassiopea xamachana* from Curaçao, Rifwater, 1963 (73 specimens, 41 regular ones from same sample in black).

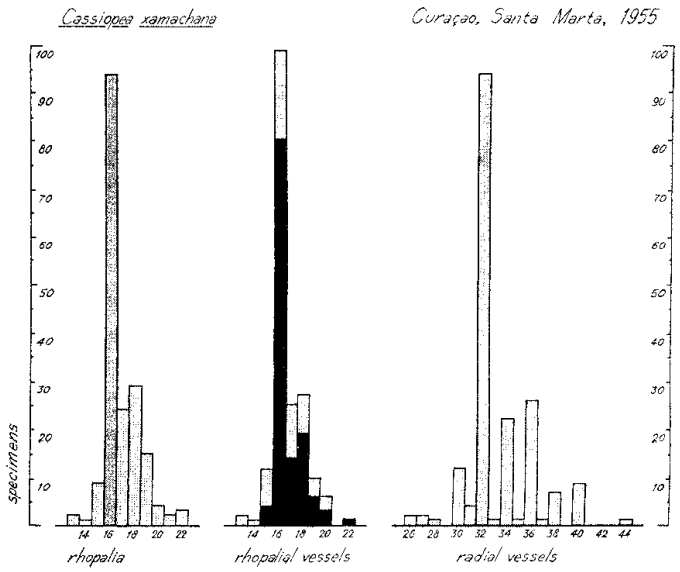


Fig. 17. Variation in numbers of RHOPALIA, RHOPALIAL VESSELS and RADIAL VESSELS in *Cassiopea xamachana* from Curaçao, Santa Marta, 1955 (183 specimens, 118 regular ones from same sample in black).

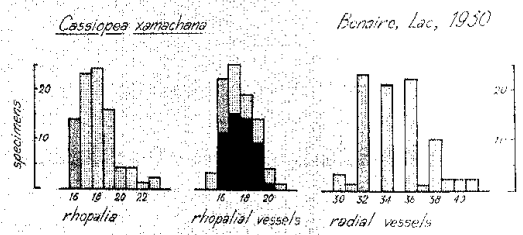


Fig. 18. Variation in numbers of RHOPALIA, RHOPALIAL VESSELS and RADIAL VESSELS in *Cassiopea xamachana* from Bonaire, Lac, 1930 (88 specimens, 50 regular ones from same sample in black).

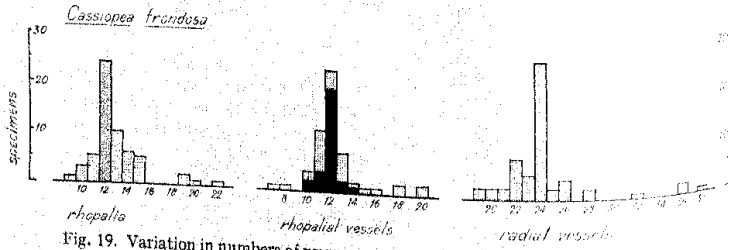


Fig. 19. Variation in numbers of RHOPALIA, RHOPALIAL VESSELS and RADIAL VESSELS in *Cassiopea frondosa* from various Caribbean localities, cf. Table 6 (58 specimens, 29 regular ones from same samples in black).

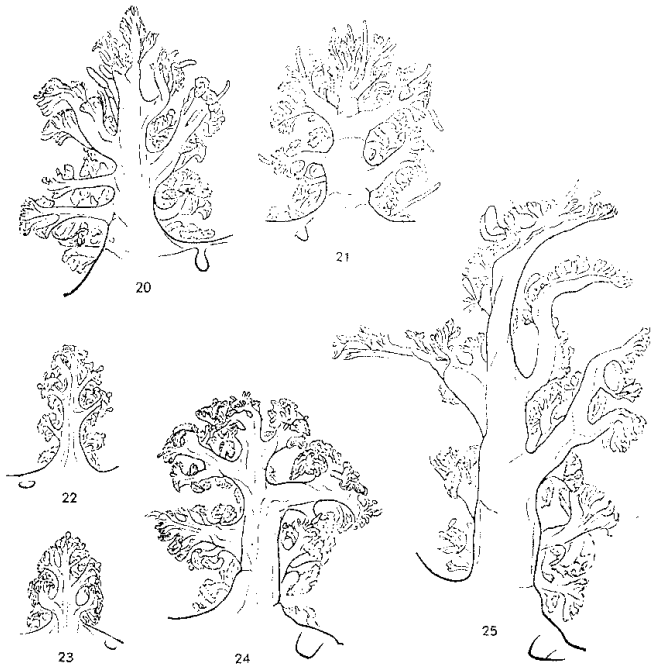


Fig. 20–25. Oral ARMS of *Cassiopea xamachana* as seen from the aboral side (Zool. Jahrb. Syst. *64*, p. 496), from: 20, Dry Tortugas (diameter of umbrella 120 mm, length of arm 1.14 R); 21, Dry Tortugas (diam. 90 mm, arm 1.3 R); 22, Bonaire, 1930 (diam. 75 mm, arm 1.1 R); 23, Bonaire, 1930 (diam. 116 mm, arm 0.75 R); 24, Bonaire, 1930 (diam. 160 mm, arm 1.0 R); 25, Curaçao, Caracas Bay, 1920 (diam. 170 mm, arm 1.35 R).

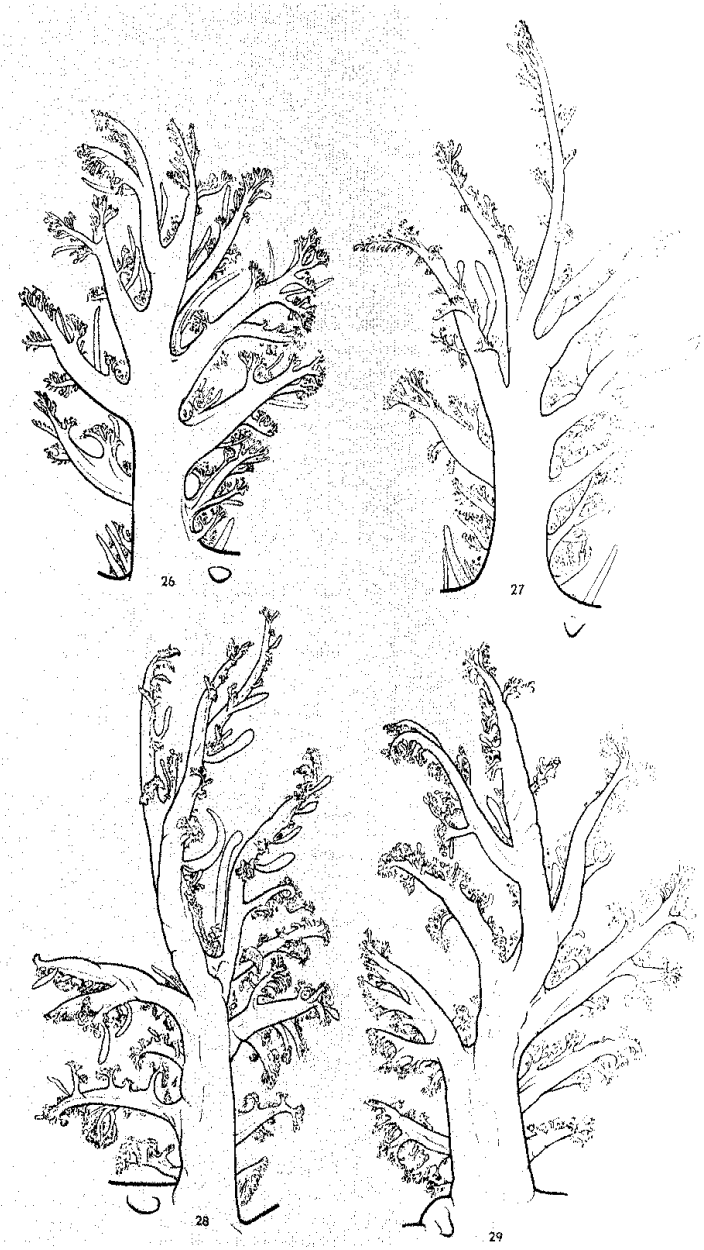


Fig. 26–29. Oral ARMS of *Cassiopea xamachana* from: 26, Jamaica, Port Royal, 1958 (diam. umbrella 154 mm, arm 1.75 R; RML 662); 27, Jamaica, Port Royal, 1958 (diam. 151 mm, arm 2.0 R; RML 663); 28, South Bimini, 1949 (diam. 185 mm, arm 1.4 R); 29, St. Croix, Krausse Lagoon, 1955 (diam. 145 mm, arm 1.7 R).

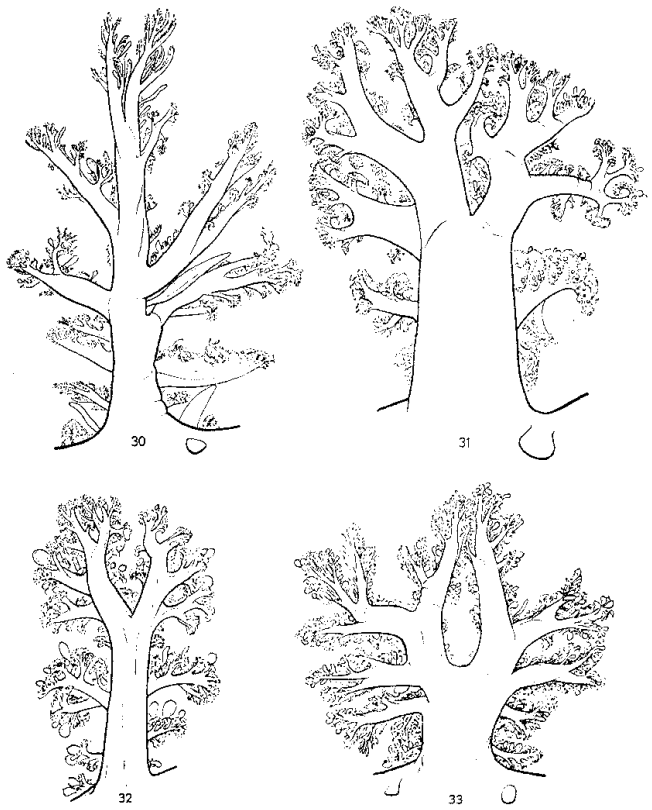


Fig. 30–33. Oral ARMS of *Cassiopea xamachana* from: 30, Jamaica, Port Royal, 1958 (same specimen as Fig. 27, diam. 151 mm, arm 1.65; RML 663); 31, Aruba, Reef Bucuti pool, 1955 (× *frondosa*?, 16 rhop., diam. 190 mm, arm 1.1 R). – Arms of *C. frondosa* (× *xamachana*?) from St. Martin, Simson Lagoon, 1949: 32 (12 rhop., diam. 150, arm 1.25 R); 33 (13 rhop., diam. 140 mm, arm 1.3 R).

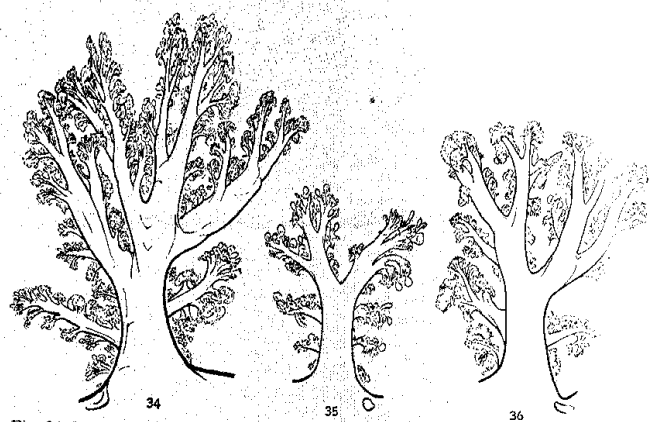


Fig. 34–36. Oral ARMS of *Cassiopea frondosa* as seen from the aboral side, from: 34, South Bimini, 1949 (diameter of umbrella 186 mm, length of arm 1.15 R); 35, Curaçao, Fuik Baai, 1949 (diam. 105 mm, arm 0.95 R); 36, Aruba, Lagoon Bucuti, 1948 (diam. 128 mm, arm 1.1 R).

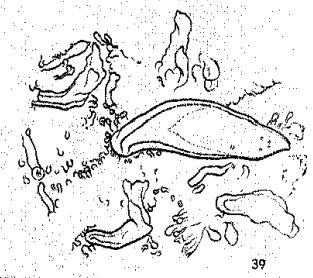
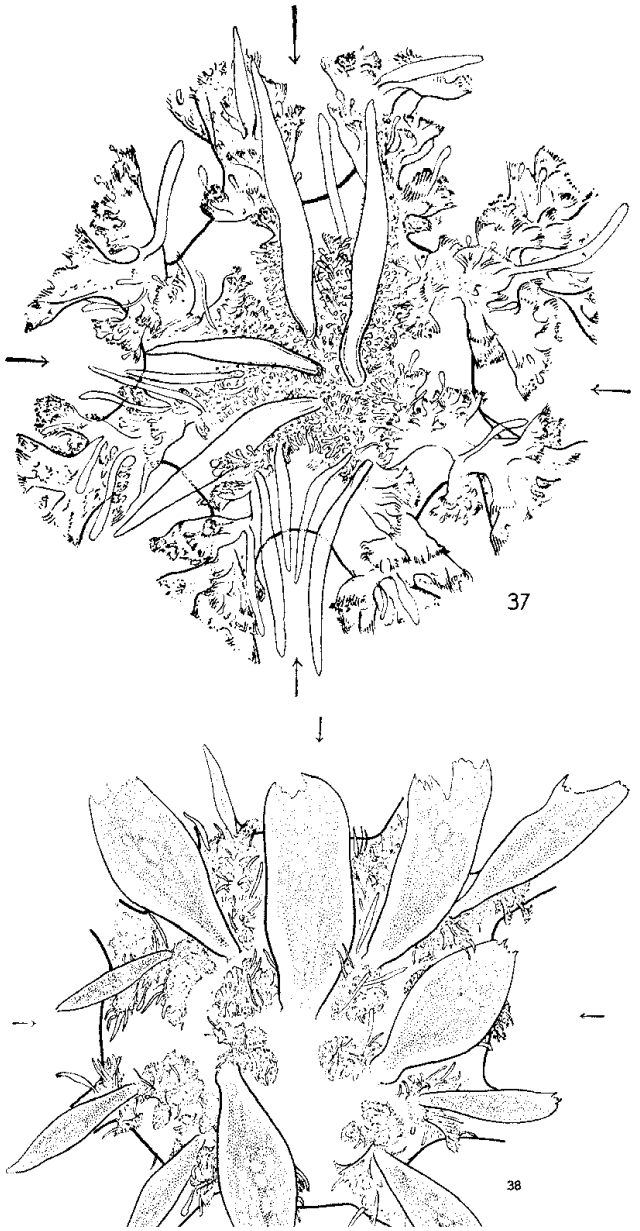


Fig. 39. LARGE-VESICLES on central disc of *Cassiopea xamachana* from Bonaire, Lac, 1930 (Zool. Jahrb. Syst. *64*, p. 470; diam. 160 mm; × 1/1). Central vesicle more wide than usual.

Fig. 37. LARGE-VESICLES on central disc of *Cassiopea xamachana* from Jamaica, Port Royal, 1958 (diam. 151 mm, arrows indicating subgenital pits; RML 663; × 1/1). Central vesicle small, one oral vesicle of 1st order lacking; ♀).

Fig. 38. LARGE-VESICLES on central disc of *Cassiopea xamachana* from Key Biscayne, 1963, ♂ (diam. umbrella 225 mm, arrows indicating subgenital pits; × 1/1). Largest central vesicles reddish brown, with decaying tip.



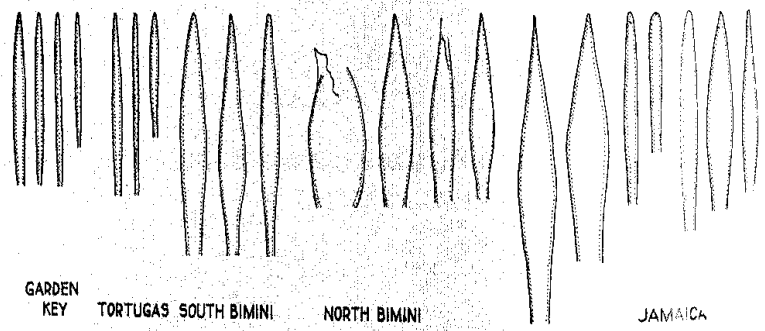


Fig. 40. Variation in shape and size of LARGE-VESICLES (or filaments) in *Cassiopea xamachana* from: Dry Tortugas, Garden Key, 1913 (3 central, 1 peripheral); Dry Tortugas, 1931 (2 c., 1 p.); South Bimini, 1949 (2 c., 1 p.); North Bimini, 1963 (4 c.), and Jamaica, Port Royal, 1958 (5 c., 4 p., from 2 specimens). (× 1/1).

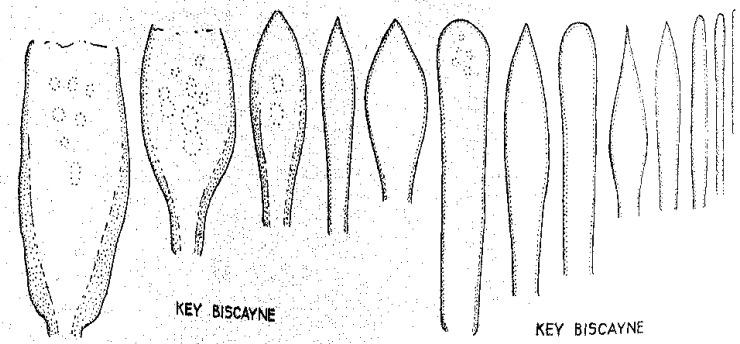


Fig. 41. Variation in shape and size of LARGE-VESICLES in *Cassiopea xamachana* from Key Biscayne, Florida, 1963 (5 central, 9 peripheral; × 1/1).

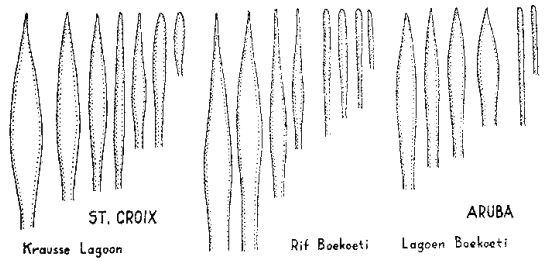


Fig. 42. Variation in shape and size of LARGE-VESICLES in *Cassiopea xamachana* from: St. Croix, Krausse Lagoon, 1955 (4 central, 3 peripheral); Aruba, Reef Bucuti, 1949 (4 c., 4 p.) and Lagoon Bucuti, 1948 (4 c., 2 p.). (× 1/1).

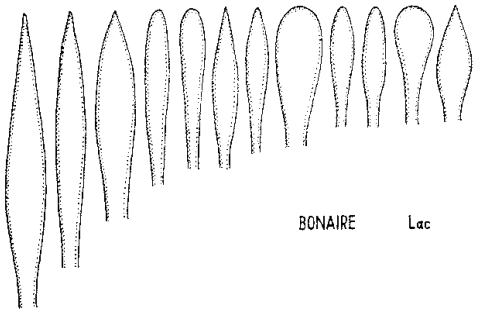


Fig. 43. Variation in shape and size of LARGE-VESICLES in *Cassiopea xamachana* from Bonaire, Lac, 1930 (8 central, 4 peripheral; × 1/1).

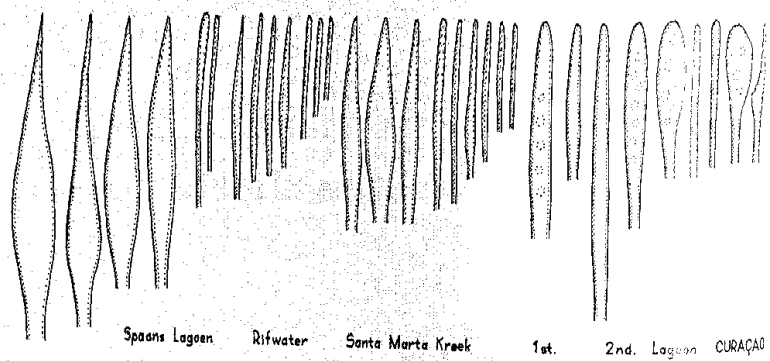


Fig. 44. Variation in shape and size of LARGE-VESICLES in *Cassiopea xamachana* from Curaçao: Spaans Lagoen, 1964 (4 central, 2 peripheral); Rifwater, 1963 (4 c., 3 p.); Santa Marta, 1955, creek (3 c., 6 p.), 1st. lagoon (1 c., 1 p.), and 2nd. lagoon (3 c., 5 p.). (× 1/1).

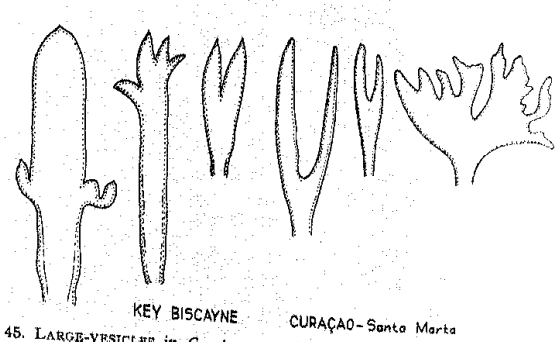


Fig. 45. LARGE-VESICLES in *Cassiopea xamachana* of unusual shape, from: Key Biscayne, 1963 (3 central vesicles), and Curaçao, Santa Marta, 1st. lagoon, 1955 (1 c., 1 per.) and 2nd. l-

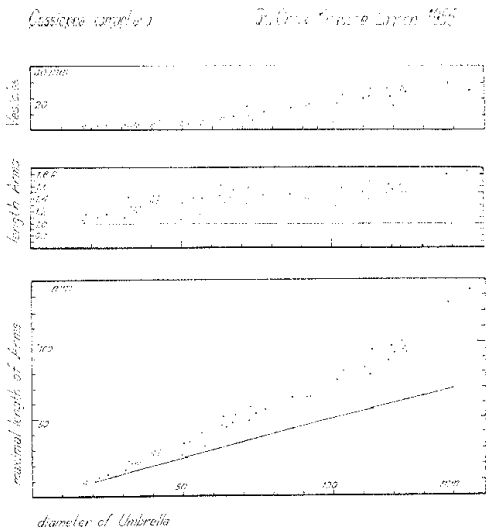
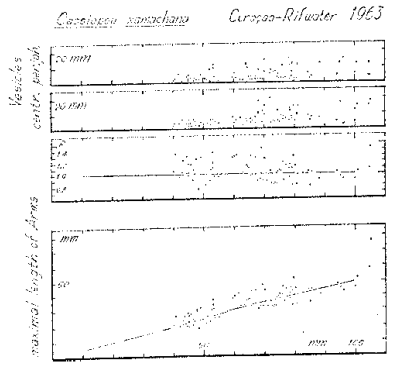


Fig. 46. Maximal length of oral ARMS (expressed in mm, and in terms of bell radius = R), and of LARGE-VESICLES in a sample of *Cassiopea xamachana* from St. Croix, Krausse Lagoon, 1955 (49 specimens).



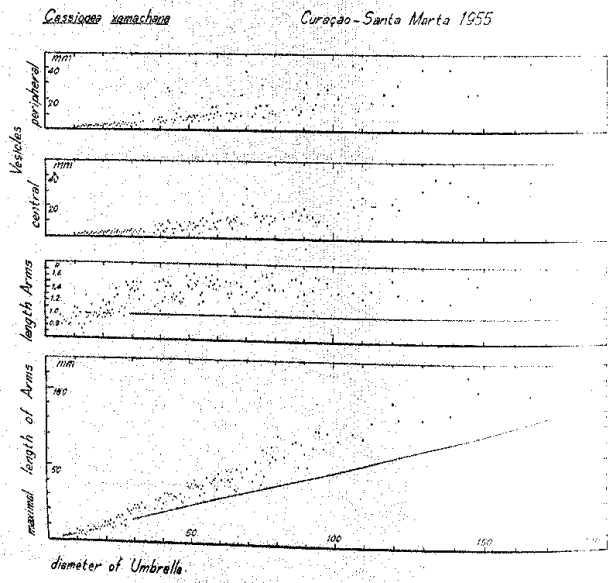


Fig. 48. Maximal length of oral ARMS, and of central and peripheral LARGE-VESICLES in samples of *Cassiopea xamachana* from Curaçao, Santa Marta, 1955 (142 specimens).

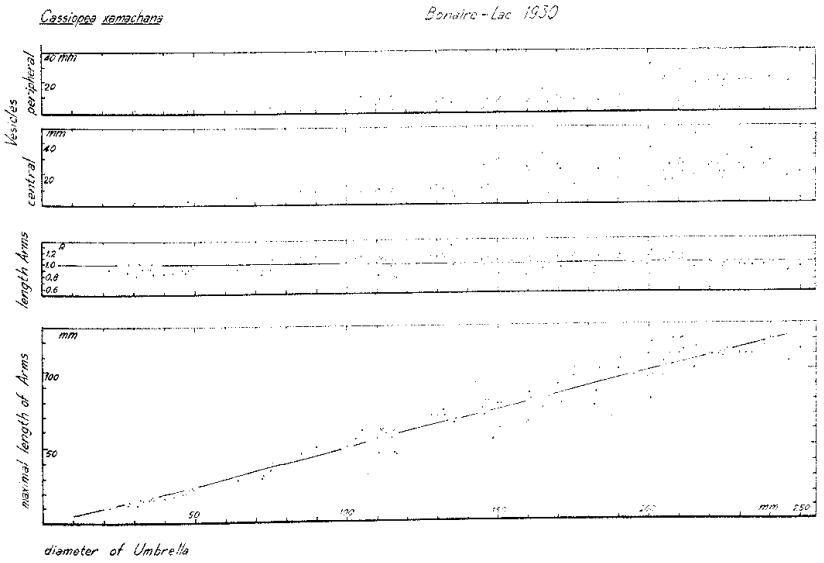


Fig. 49. Maximal length of oral ARMS, and of central and peripheral LARGE-VESICLES in samples of *Cassiopea xamachana* from Bonaire, Lac, Poejito, 1930 (97 specimens).

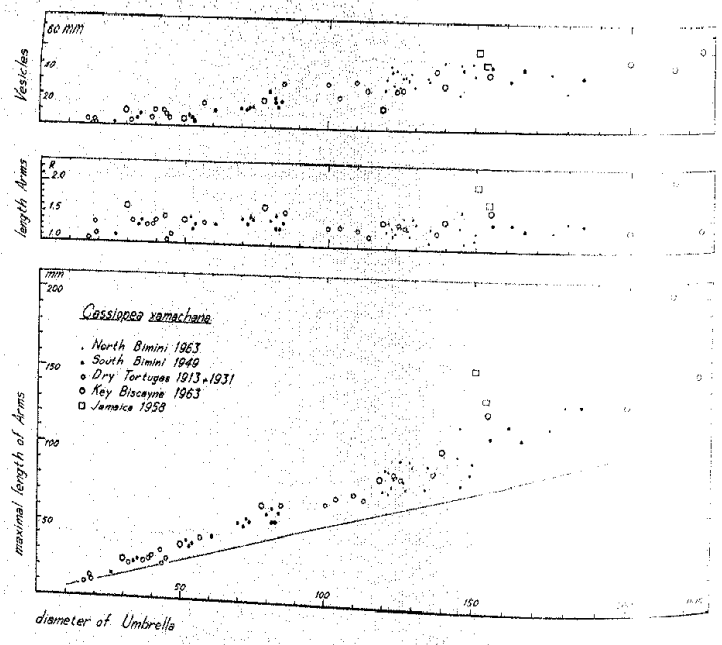


Fig. 50. Maximal length of oral ARMS, and of LARGE-VESICLES in samples of *Cassiopea xamachana* from: Key Biscayne, 1963 (9 specimens, larger circles); Garden Key, 1913 (6 spec. > 105 mm, small circles); Dry Tortugas, 1931 (13 spec. < 105 mm, small circles); North Bimini, 1963 (22 spec., light dots); South Bimini, 1949 (20 spec., heavy dots); Jamaica, Port Royal, 1958 (2 spec., small squares).

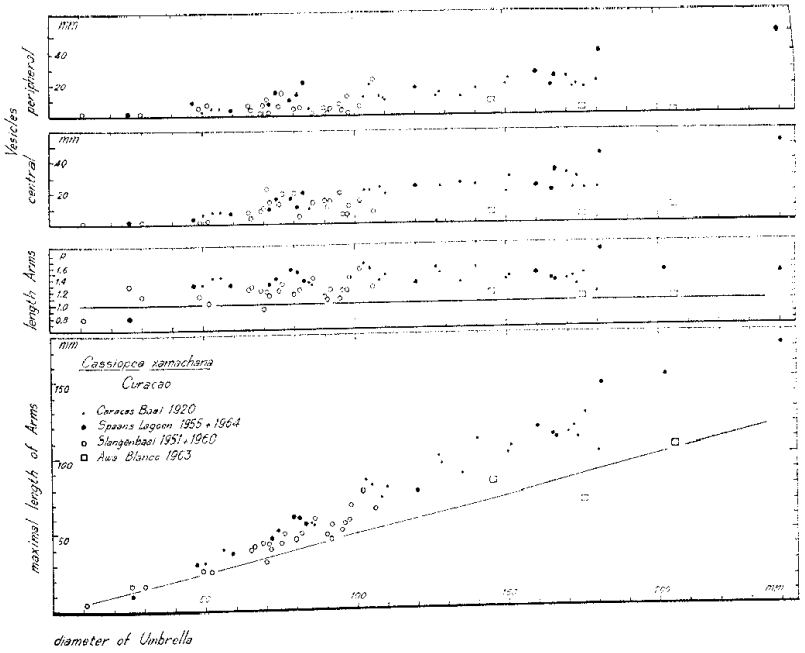


Fig. 51. Maximal length of oral ARMS, and of central and peripheral LARGE-VESICLES in samples of *Cassiopea xamachana* from Curaçao: Caracas Baai, 1920 (19 specimens, light dots); Spaans Lagoen, 1955 and 1964 (15 spec., heavy dots); Slangenbaai, 1951 and 1960 (25 spec., small circles); Awa Blanco, 1963 (3 spec., small squares).

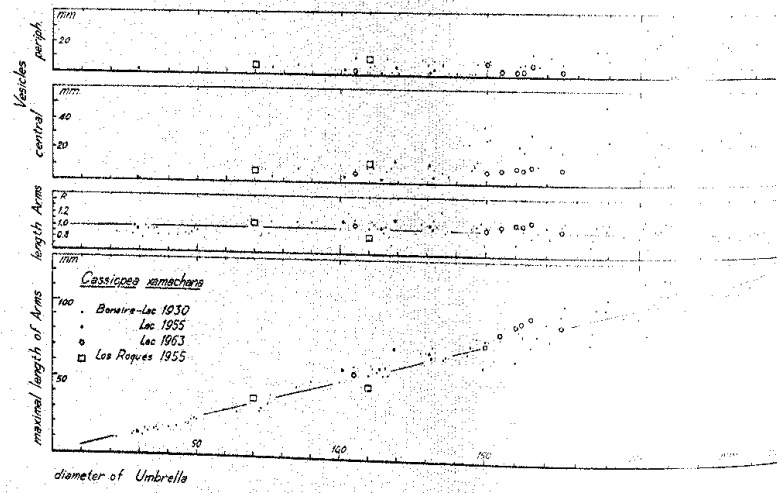


Fig. 52. Maximal length of oral ARMS, and of central and peripheral LARGE-VESICLES in samples of *Cassiopea xamachana* from Bonaire: Lac, Poejito, 1930 (95 specimens, light dots); Poejito, 1955 (6 spec., heavy dots); Lac, Soerebon, 1963 (7 spec., circles); Los Roques, Gran Roque, 1955 (2 spec., small squares).

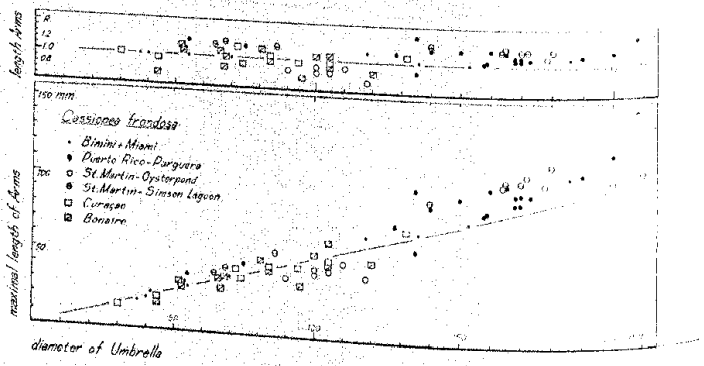


Fig. 53. Maximal length of oral ARMS (expressed in mm, and in terms of bell radius = R) in samples of *Cassiopea frondosa* from: South Bimini, 1949 (8 specimens, small dots); Miami (2 spec., small dots); Puerto Rico, La Parguera, 1963 (18 spec., heavy dots); St. Martin, Oysterpond, 1963 (6 spec., small circles), and Simson Lagoon, 1949 (12 spec., crossed circles); Curaçao, 1930 [illegible]

Fig. 54. Detail of an abnormal specimen of *Cassiopea frondosa* from Oranjepan, BONAIRE, in which two poorly-developed oral arms are fused (R = 26.5 mm).