STUDIES ON THE FAUNA OF CURAÇO, ARUBA, BONAIRE AND THE VENEZUELAN ISLANDS: No. 5.

MOLLUSKS OF THE GENERA CERION AND TUDORA

by

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Although the islands of Curaçao, Aruba and Bonaire have received the attention of many naturalists, from the beginning of the West-Indian trade until to-day, it was not before 1924 that a suitable publication on the "Land and Freshwater Molluscs of the Dutch Leeward Islands" was written by Horace Burrington Baker. I should like to express my appreciation of this work, which not only facilitated my studies, but, at the same time, forced me to collect the landshells of these islands in a most intensive and systematical way, — because I should not have been competent to critisize his results, if I had not had a material of at least the same value at my disposal.

As Baker very precisely localized his stations, I could collect a large series of topotypes of nearly all his new species and subspecies. This, in addition to his reproductions of the holotypes and paratypes, and the comparison of some of his paratypes in the Zoological Museum of Amsterdam, made a study of Baker's collection rather unnecessary.

The greater part of the material has been deposited in the "Zoölogisch Museum, Amsterdam"; smaller series have been distributed to the "Rijksmuseum van Natuurlijke Historie, Leiden" and the "Zoölogisch Museum, Utrecht".

The present paper may be considered as a kind of supplement to the above mentioned publication of H. B. Baker in the "Occasional Papers of the Museum of Zoology, University of

Michigan", Number 152, and to the survey of the mollusks of the Leeward Group, in this series, Number 2. — I have confined myself to the study of the shell and the operculum, because my main object was to check the value of the lower systematical categories, created by Baker, which were based chiefly on such external characters. Furthermore, from the anatomical work already done, I got the impression that further studies on this subject would not prove very promising.

It was impossible to proceed with the division in species and subspecies in such a detailed manner, as given by H. B. Baker. *Tudora* and *Cerion* lead us directly to the problems, connected with the origin of species. A taxonomist will do well to leave these for the greater part to the student of genetics and heredity, who will undoubtedly find on these small islands an endless number of questions inviting solution.

CERION Röding, 1798

Genotype: *Turbo uva* Linné, 1758

South Florida, Bahamas, Cuba, Cayman Islands, Hispaniola, Puerto-Rico, Virgin Islands †, St. Croix †, Bonaire, Curaçao, Aruba.

Key to the Subgenera — cf. Hummelinck, 1940, p. 100.

Cerion uva (Linné, 1758) Röding, 1798

Cochlea alba, ventricosa, bidens, strijs eminentibus exasperata. Lister, 1688, tab. 588 fig. 47.

Olivaris striata & fasciata Americana. Petiver, 1709, tab. 27 fig. 2 (Cat. p. 4).

Turbo integer, fimbriatus, cylindroidaeus, per longitudinem striatus, striis interruptis, ore dentato, subalbidus. Gualtieri, 1742, tab. 58 fig. D. [excl. Bonanno, 1681, Ricreatione..., 1684, Recreatio..., 1709, Tractatus..., fig. 140]

Oxy-strombus. Asper. Clathratus. Albus, ventricosus, striis eminentibus asper. Klein, 1753, p. 33.

Apiarum [p.p.]. Seba, 1758, p. 153, tab. 55 no. 21 fig. interm. "...gedaante van byekorfjes en gebakerde kindertjes... andere noemen zy *Cunae* of Kinderwiegjes."

Turbo uva Linné, 1758, p. 765 "T. testa cancellata ovata obtusa: anfractibus contiguis: striis longitudinalibus imbricatis. *Pet. gaz. t.* 27. *f.* 2. Olivaris striata fasciata. *Gualt. test. t.* 58. *f. D. Habitat*..."; Linné, 1764, p. 659 "Testa facie Uvae pictorum, ovato-oblonga, obtusa, vertice obtusissimo, alba.

Anfractus undecim: rugis longitudinalibus, aequalibus, confertis, viginti peripheriam constituentibus, arcte imbricatis. Apertura subrotunda margine reflexo. Faux latere interiore notata tuberculo s. dente obsoleto."; Linné, 1767, p. 1238; Huddesford, 1770, p. 60; Houttuyn, 1771, p. 396 "Men krijgtze uit Westindie."; Müller, 1775, p. 554 "... Bienenkörbchen ... oder ... Wickelkind ... Sie kommen aus Curacao und den antillischen Inseln." [First Curaçao record.] [cf. Knorr, 1771, Delices des Yeux, 5, p. 49, tab. 25 fig. 4 "... enfant au maillot ... ruches d'abeilles ... berceau."]; Born, 1778, p. 364; Chemnitz, 1780, p. 281, fig. 1439; Born, 1780, p. 354, p. 340 fig. e; Schröter, 1783, p. 54, tab. 2 fig. 7; Schröter, 1784, p. 41—42; Kämmerer, 1786, p. 149; Gmelin, 1791, p. 3604 [p.p. 68α]; Dillwyn, 1817, p. 861 [excl. — *Fusus*]; Hanley, 1855 (Ipsa), p. 343 (Linnaean specimens like figures in Schubert et Wagner, 1829).

non Turbo uva Linné. Chemnitz, 1786, N. Syst. Conch. Cab., 9, 1, p. 24, 123, fig. 965; Brookes, 1815, Introd. Study Conch., p. 126, fig. 101.

Turbo testa cancellata ovata obtusa ... Gronow, 1781, p. 328.

Bulimus mumia Bruguière, 1792, p. 348 [cf. Bruguière, 1789, Encycl. Méthod. Vers 1, p. 291]; Bosc, 1824, p. 107 [*B. numia*, in errore].

non Bulimus uva (Linné) Bruguière, 1792, p. 349 [cf. Bruguière, 1789, Encycl. Méthod., Vers 1, p. 292]; Bosc, 1824, p. 107 [cf. Bosc, 1803, Nouv. Dict. Hist. Nat., 13, p. 527; Bosc, 1836, Hist. Nat. Coq., 4, p. 95].

Cerion vulgare Röding, 1798, p. 90 [p.p. Knorr, non Lister] "*C. Vulgare.* Der gemeine Bienenkorb. Gmel. Turbo uva. sp. 68. Lister 588. fig. 48. Knorr 6. t. 25. f. 4."

Cerion uva (Linné) Röding, 1798, p. 90 "*C. Uva.* Das Wickelkind. Gmel. Turbo uva. sp. 68. Lister 588. fig. 47. Martini 4. 1. 153. f. 1439."; Mörch, 1852, p. 33; Dall, 1894, p. 121, 123, fig. 3; Pilsbry et Vanatta, 1896, p. 315, 318, 328; Smith, 1898, p. 114 [First Aruba record.]; Pilsbry, 1901, p. 180..., tab. 33 figg. 41—45, tab. 47 fig. 38 [Radula]; Hartert, 1902, p. 294, 295 [First Bonaire record.]; Plate, 1907, p. 439; Vernhout, 1914, p. 179, 186; Schepman, 1915, p. 480; Maynard, 1919, fig. 2, tab. 5 fig. 1—3; Baker, 1923, p. 7; Horst, 1924, p. 2; Baker, 1924, p. 98..., 110..., tab. 18... [Classification, Variation, Distribution]; Bartsch, 1924, p. 188; Jutting, 1925, p. 25; Baker, 1925, p. 42; Bartsch, 1925 (Smiths.), p. 44; Bartsch, 1925 (Yearb.), p. 222; Bartsch, 1926, p. 46; Bartsch, 1927, p. 86; Bartsch, 1928, p. 54, 56; Bartsch, 1930, p. 111, fig. 92; Intern. Comm. 1931, p. 23; Thiele, 1931, p. 668, fig. 724; Jaenicke, 1933, p. 278..., figg. [Anatomy]; Jutting, 1934, p. 34, fig. p. 35; Davies, 1935, p. 339, fig. 533; Schmitt, 1936, p. 375, 377; Hummelinck, 1940, p. 101—102, tab. 16a; Hummelinck, 1940 (Zoogeogr.), p. 116...

Cerion uva desculptum Pilsbry et Vanatta, 1896, p. 328, 318, 337, tab. 11 fig. 1 [Curaçao]; Pilsbry, 1901, p. 181, tab. 33 fig. 46; Jaenicke, 1933, p. 280.

Cerion uva var. *desculptum*, Baker, 1923, p. 7; Baker, 1924, p. 100..., tab. 18 C6 D5.

Cerion uva uva, Baker, 1924, p. 98..., tab. 18 [Variation].

Cerion uva uva f. *diablensis* Baker, 1924, p. 100, tab. 18 A2; Jutting, 1925, p. 2.

Cerion uva uva f. *hatoensis* Baker, 1924, p. 100, tab. 18 F6; Jutting, 1925, p. 2.

Cerion uva knipensis Baker, 1924, p. 102..., tab. 19 [Curaçao; Variation].

Cerion uva knipensis f. *djerimensis* Baker, 1924, p. 103, tab. 19 A1.

Cerion uva arubanum Baker, 1924, p. 104..., tab. 20 [Aruba; Variation].

Cerion uva bonairensis Baker, 1924, p. 105..., tab. 21 [Bonaire; Variation]; Werner, 1925, p. 552.

Cerion uva bonairensis f. *kralendijki* Baker, 1924, p. 106, tab. 21 A2.

Cerion uva diablensis Baker, 1925, p. 42.

Cerion uva hatoensis Baker, 1925, p. 42.

non Cerion uva α Röding, 1798, p. 90 "C. *Uva.* Lister 588. f. 49."

? *non Cerion apiarum* Röding, 1798, p. 90 "C. *Apiarum.* Der Bienenkorb. Gmel. Turbo uva. sp. 68."

Pupa uva (Linné) Lamarck, 1801, p. 88; Cuvier, 1817, p. 407; Lamarck, 1822, p. 105; Blainville, 1823, p. 94; Schubert et Wagner, 1829, p. 173—174, fig. 4122—4123; Deshayes, 1830, p. 401; Menke, 1830, p. 34; Oken, 1835, p. 426; Beck, 1837, p. 82 [p.p. P. uva normalis coarctata]; Deshayes, 1838, p. 169 [p.p.]; Deshayes et Férussac, 1838—1851, p. 206 [p.p.], cf. Férussac, Atlas, tab. 153 fig. 11—14; Potiez et Michaud, 1838, p. 163; Küster, 1841, p. 5, tab. 1 fig. 3—4; Pfeiffer, 1842, p. 107; Sowerby II, 1842, p. 303, fig. 291; Catlow, 1845, p. 145; Dujardin, 1846, p. 594; Pfeiffer, 1848, p. 317; Jay, 1850, p. 233; Pfeiffer, 1853, p. 537; Adams et Adams, 1855, p. 168, tab. 76 fig. 3a; Chenu, 1859, p. 443, fig. 3256 [p.p.]; Pfeiffer, 1859, p. 659; Martens, 1860, p. 209; Reeve, 1860, p. 208; Bland, 1861, p. 28; Bland, 1866, p. 143, 366, 369; Pfeiffer, 1868, p. 292; Pätel et Schaufuss, 1869, p. 85; Semper, 1873, p. 128 [Radula]; Martens, 1873, p. 219; Sowerby II, 1875, Pupa spec. 7, tab. 1 fig. 7; Pfeiffer, 1877, p. 355; Lorié, 1887, p. 140, 142; Martin, 1888(1), p. 120; Martin, 1888(2), p. 17, 21, 97, 100, 125, 127; Hartert, 1902, p. 285; Boeke, 1907, p. 143; Rutten, 1931, p. 666; Pijpers, 1933, p. 45.

non Pupa uva, Bosc, 1803, Nouv. Dict. Hist. Nat., 13, p. 527; Roissy, 1805, Hist. Nat. Mollusques, 5, p. 360; Pfeiffer, 1841, Symb. ad Hist. Helic., p. 86.

Helix uva (Linné) Férussac, 1821, p. 62; Rang, 1829, p. 169.

Cochlodon uva (Linné) Sowerby I, 1825, p. 40.

Clausilia uva (Linné) Anton, 1839, p. 47.

[?] *Helix pentodon* Menke, 1846, Z. Malakozool. 3, p. 128 [*Cerion* spec. juv., probably C. *uva,* possibly C. *milleri* or a similar form]; Pfeiffer, 1848, Monogr. Helic. 1, p. 185; Pfeiffer, 1848, Syst. Conch. Cab., (1) 12, p. 198, tab. 100 fig. 32—34 (ed. 1850); Pfeiffer, 1859, p. 154; Martens, 1860, 209; Bland, 1861, p. 28; Bland, 1866, p. 143, 366; Pfeiffer, 1867, Malak. Bl. 14, p. 129; Pfeiffer, 1867, Novit. Conch. (1) 3, p. 366; Pfeiffer, 1868, Monogr. Helic., 5, p. 219; Pfeiffer, 1868, p. 289; Bland, 1869, p. 192; Martens, 1873, p. 219; Kobelt, 1880, p. 286; Clessin, 1881, p. 362; Dall, 1894, p. 123; Smith, 1898, p. 114; Vernhout, 1914, p. 179; Schepman 1915, p. 480; Jutting, 1925, p. 25.

Strophia uva (Linné) Albers, 1850, p. 203; Albers, 1860, p. 300; Bland, 1869, p. 192; Pätel, 1873, p. 107; Gibbons, 1879, p. 136; Kobelt, 1880, p. 257, 286; Clessin, 1881, p. 363; Fischer, 1883, p. 481, tab. 12 fig. 16; Pätel, 1889, p. 309; Maynard, 1890, p. 188, fig. 51.
[?] *Pitys pentodon* (Menke) Adams et Adams, 1855, p. 114.
Scalaria curassavica Simons, 1868, p. 150 [Curaçao; nomen nudum].

Shell ellipsoid or obovoid, sometimes oblong or cylindrical, altitude *3—2,3—2* times major-diameter of spire, *(31½—)26,4—22,0—19,4(—16)* by *(12—)11,2—9,8—8,9(—7)* mm, very narrowly perforated, solid, ribbed. Whorls *(15—)12,7—11,4—10,2(—9)*, strongly compressed in the direction of the axis, very narrow, in cross-section quadrangular; outer wall somewhat convex; the first 7—9 regularly increasing, nearly equal in the later ones. The first 7—9 whorls forming a short, obtuse cone with convex sides; later on the shell is more or less parallel sided, often slowly tapering towards the aperture. Suture distinct, very slightly channelled. Umbilical-channel beginning abruptly after the second whorl, ½—1½ mm wide, gradually narrowing after the 5—7th and rarely closing in the penultimate whorl, visible only as a narrow slit from the outside. Aperture vertical, subovate or subcircular, somewhat angular at the apex. Peristome not continuous but in older individuals a uniting parietal enamel is developed, narrow, reflected, in older specimens somewhat thickened. Rather often the last whorl near the aperture tends to jut out tangentially, so that the palatal wall of the peristome projects from the maximum width of the spire. Parietal-tooth low, usually situated in the angle between the columella and the parietal wall, entire, as a rule penetrating over *(¼—)1/3(—½)* of the whorl. Often 1—2 parietal-teeth occur in the higher whorls, usually with 1 (—2) palatal-teeth opposite. Axial-lamella low but distinct, ascending the columella as far as the 7—9th whorl, hardly ever visible from the outside. Sculpture consists of numerous vertical or somewhat reclined, often sligthly parasigmoidal ribs, it begins on the 3—4th whorl and gradually increases; besides this a fine pattern of growth-lines is visible. Ribs usually (15—)20—25(—30) per whorl on widest part of spire, as a rule regularly placed but not corresponding in the successive whorls, solid, rounded or obtuse, they are as wide or somewhat narrower than their interspaces; they are rarely not or practically not developed. Surface of ribs generally polished, those of the interspaces usually dull; aperture internally more or less porcellaneous. Colour very variable, mostly white or greyish, generally with a haze of blue, very often entirely or partly with brownish-grey, greyish-brown, yellowish-brown, brown, violet-brown or brownish-salmon in different but generally weak intensities; sometimes these colours are limited to a little blotch at the underside of the interspaces. Ribs very lightly coloured or whitish. Aperture very light yellowish-brown, greyish-brown, yellowish-grey, brownish-grey or nearly colourless.

Curaçao: Almost everywhere on limestone, abundant in favourable localities; often occurring in more or less wooded places in the region of the diabase and the cherts. Subfossil or fossil specimens of quaternary age have been found in loose soil, limestone beds, pockets of phosphate and ?basal-conglomerates of the limestone. Bonaire: Almost everywhere on limestone.

abundant in favourable localities; often occurring in more or less wooded places in the region of the porphyrite and diabase. Subfossil or fossil specimens of quaternary age have been found separate and in pockets of phosphate. Klein Bonaire: Almost everywhere, abundant in favourable localities. Also fossil. Aruba: Limited to the limestone region between Savaneta and Baca Morto, irregularly distributed, abundant in favourable localities; found only on limestone or diorite- and diabase-detritus near limestone. Dead specimens occur at the Boca Grandi. Subfossil or fossil specimens of quaternary age have often been found throughout the southern and eastern limestone portion of the island, in loose soil, cave-deposits or pockets of phosphate.

A terrestrial or sligthly subarboreal species, which aestivates under rocks and in crevices, or glued to the trunks of shrubs and trees, a short distance above the ground.

The peculiar restriction of living *Cerion* on Aruba to the limestone region between Savaneta and Baca Morto is very puzzling, especially as this species was formerly more universally distributed. Subfossil or fossil shells commonly occur throughout the southern and eastern limestone portion of the island, from Oranjestad as far as Cerro Colorado and Fontein. — The distribution of the living animals is very irregular; they clearly show a colonial habit which, on Curaçao and Bonaire is less obvious, in connection with their almost universal distribution. From field evidence the colonies probably will migrate from one part of an area to another (cf. Hummelinck, 1940, p. 102).

In order to obtain some statistical idea of the amount and the character of variation in *Cerion uva*, data were taken from a representative series of shell from nearly all localities. In table 2 the number of the whorls, the altitude, the diameter of the spire and the width of three whorls on the broadest part of the spire are listed. The stations which are printed in ordinary type, are situated on limestone or on other soil with scattered debris of limestone; stations printed in italics, are deprived of any limestone within a hundred meters or more; where only the station-number has been printed in italics, this indicates a locality not situated on calcareous soil, but limestone may be found within a distance of twenty to eighty meters.

The specimens of *Cerion* from two localities were more extensively studied (cf. Table 3). The data gathered from these two populations show, as already pointed out by H. B. Baker (1924, p. 99), that the variation of this species may be divided into two phases: the number of whorls (or the altitude of the shell) and the width of the whorls (or the diameter of the shell). The former seems to be simply a function of the period of growth, while the latter expresses actual variation in size. The altitude of the shell is closely correlated with the number of whorls, but seems to be rather independent from the diameter of the shell and the width of the whorls. The diameter of the shell is in some way correlated with the width of the whorls on the spire. The size of the peristome is of course largely dependent on the width of the last whorl. Generally higher specimens have also a somewhat wider body-whorl; often however, their aperture is slightly narrowed in submature state. The direct proportional relation between the width of the body-whorl and the diameter of the shell, and between the

body-whorl and the whorls on the spire is obvious. Furthermore, the number of ribs appeared to be rather independent from the diameter of the shell.

In *Cerion* we may say, generally speaking, that the size of the shell increases, up to a certain point, with the richer vegetation of the habitat, therefore in most cases it appears to be inversely proportional to the amount of trade-wind exposure. The polished appearance of the ribs may also be favoured by a certain abundancy of plant-life. In wooded localities the interspaces are usually greyish coloured and less mottled than in other parts of the island. The reduction in size and number of ribs, which occasionally occurs, and the tendency of the last whorl to jut out tangentially, which is most obvious on Aruba and Bonaire, are very probably of a non-ecological nature. The direct influence of the soil could not be ascertained.

Material of Cerion uva — arranged according to the classification of H. B. Baker — with notes on the distribution and occurrence of the different forms (abundant, a; common, c; often, o; rare, r).

1a Ribs well, rather well or weakly developed 2

1b Ribs very weak or undeveloped ... *Cerion uva desculptum* Pilsbry et Vanatta [type-locality: Curaçao]

Cave of Quadirikiri, Aruba, a, fossil in cave-deposits, smooth, slender specimens; see also St. 202, 213, 221, 233, 235, 253A.

2a From Curaçao. Last whorl rather often tending to jut out tangentially; mean width of 3 whorls on broadest part of spire 6,8 mm 3

2b From Bonaire or Aruba. Last whorl very often tending to jut out tangentially; mean width of 3 whorls on broadest part of spire 6,5 mm 4

3a From East and Middle Curaçao ... *Cerion uva uva* [type-locality: unknown, assigned to Curaçao]

3a′ Largest specimens with heaviest sculpture, *C. uva uva* f. *hatoensis* Baker [type-locality: Hato = St. 217]

3a″ Most dwarfed specimens, *C. uva uva* f. *diablensis* Baker [type-locality: Ronde Klip = St. 201]

St. 201, a; St. 201A, c; St. 202, a, variable, some specimens show light approach towards *desculptum*; St. 203, a; St. 204A, c; St. 205, o; St. 206, a; St. 207, a; St. 210, a; St. 211, a; St. 212, a; Fort Nassau, a; St. 213A, c; St. 213, a, one spec. approaching *desc.*; St. 214, a; St. 215, a; St. 217, a; St. 220, a; St. 221, a, some spec. sligthly approaching *desc.*; St. 222, c; St. 223, a; St. 224, a; St. 226, a, variable.

3b From West Curaçao ... *Cerion uva knipensis* Baker [type-locality: between Seroe Palomba and S. Hoendoe = near St. 235]

3b′ Smallest specimens, *C. uva knipensis* f. *djerimensis* Baker [type-locality: Seroe Djerimi = St. 242A]

St. 225, a; St. 225a, a; St. 227, a; St. 228, a; St. 229, a; S. Bartool, a; St. 230, o; St. 231, a; St. 232, a; St. 233, o, some spec. approaching *desc.*; St. 234, r; St. 235, o, some spec. slight approach to *desc.*; St. 237, a; St. 238, c; St. 239, a; St. 240, a; St. 240A, a; St. 241, a; St. 242, a; St. 242A, a; St. 243, c; St. 243A, c; St. 244, c; St. 245A, o.

TABLE 2.

Measurements in *Cerion uva*.

STATION:		Nrs. coll.:	Nrs. meas.:	Whorls:	Altitude, in mm:	Diameter of spire, in mm:	Width of 3 whorls, in mm:
181	Zuidpunt	30	30	10,6 (11½— 9½)	19,4 (21 —17½)	8,8 (9½— 8)	6,0 (6½—5)
184	Lima	80	30	10,8 (12 —10)	20,5 (23 —18)	9,0 (10 — 8)	6,2 (7 —5½)
184A	Lima	40	30	11,2 (15 —10)	22,6 (31½—19½)	9,6 (10½— 8½)	6,3 (7 —5½)
186	Deenterra	30	30	11,5 (12½—10½)	24,0 (26½—19½)	10,1 (11 — 9)	6,8 (7½—6)
187	Spelonk	50	30	10,6 (11½— 9)	21,3 (23½—18½)	9,8 (10½— 9)	6,6 (7 —6)
s.n.	Porta Spanjó	20	10	10,8 (11½—10)	21,4 (23 —19½)	10,0 (11 — 9)	6,5 (7 —6½)
195	Boca Onima	30	30	10,7 (11½—10)	20,5 (24½—18)	9,3 (10 — 8½)	6,2 (7 —6)
196	Boca Onima	30	30	11,0 (12 —10)	21,5 (26 —19½)	9,8 (10½— 9)	6,4 (7 —6)
197	*Brandaris*	30	30	10,9 (12 — 9½)	22,5 (25 —21)	9,7 (10½— 9)	6,5 (7 —6)
199	Klein Bonaire	20	10	10,9 (11½—10)	20,9 (22½—19)	9,4 (10 — 9)	6,3 (6½—6)
199A	Klein Bonaire	40	30	10,9 (14 — 9)	21,6 (30 —17)	9,5 (10½— 8½)	6,3 (7 —5½)
201	Ronde Klip	220	30	11,1 (13 —10)	20,0 (24½—16½)	9,2 (10½— 8½)	6,3 (7½—5½)
202	S. di Boca	220	30	11,2 (13½—10)	20,7 (26½—16½)	8,8 (11 — 7)	6,3 (7 —6)
203	S. Mainsjie	100	30	11,2 (12½—10)	20,0 (23½—16½)	9,2 (10 — 8)	6,4 (7½—5½)
204A	*Seinpost*	40	30	11,8 (13 —10½)	22,1 (25½—19)	9,6 (10 — 8½)	6,6 (7 —6½)
205	R. Manzalienja	10	10	12,0 (12½—11)	22,1 (24½—20)	9,3 (9½— 8½)	6,7 (7 —6)
206	Tafelberg S. B.	160	30	11,8 (13½—10½)	22,2 (26½—17½)	9,4 (10 — 8½)	6,7 (7½—6)
207	Newport	250	30	11,3 (13½—10)	20,5 (25½—17)	9,6 (10½— 9)	6,7 (7½—5½)
210	Quarantaine	350	300	11,5 (13½—10)	21,8 (27 —18)	9,6 (11 — 8½)	7,1 (8½—6)
211	Beekenburg	100	30	11,5 (13½—10½)	21,6 (25½—19)	9,2 (10½— 8½)	6,6 (7½—6)
212	Schaarloo	110	30	11,4 (13 —10)	21,2 (24 —18)	9,5 (10½— 8½)	6,9 (7½—6)
213	S. Pretoe	150	30	11,9 (13½— 9½)	23,0 (26 —20)	10,0 (11 — 9)	6,9 (7½—6)
214	Evertszberg	400	30	11,3 (13 — 9½)	21,6 (25½—16½)	9,6 (11 — 8½)	6,8 (7½—6)
215	S. Spreit	180	30	11,8 (13 —10)	22,1 (26 —18½)	9,9 (11½— 9)	6,8 (7½—6)
217	Hato	100	30	11,4 (14 —10)	21,4 (27½—17)	9,8 (11 — 8½)	6,6 (7½—5½)
220	Wandongo	350	300	12,0 (14 —10)	23,2 (28½—19)	10,6 (12 — 9½)	7,2 (8½—6)
221	Groote Berg	400	30	12,0 (13½—10½)	22,7 (26 —19)	10,0 (11 — 9)	6,7 (7½—6)
222	*Koenoekoe Abau*	60	30	12,7 (14½—11)	24,5 (29½—21)	11,0 (11 — 9)	6,7 (8 —6)
223	Hermanus	70	30	11,9 (13 —10½)	21,8 (24½—17½)	9,8 (10½— 9)	6,6 (7½—5½)
224	S. Kabritoe	90	30	11,8 (13½—10½)	22,7 (28 —19)	10,1 (11½— 9½)	6,7 (7½—6)
225	S. Cabajé	120	30	11,1 (12½— 9½)	21,4 (24 —17½)	9,8 (10½— 9)	6,8 (7½—6)
226	San Pedro	340	30	11,5 (13 —10)	20,6 (25 —16½)	9,1 (10½— 7½)	6,1 (7 —5)

227	*S. di Cueba*	100	30	10,8 (12 — 9½)	20,2 (23½—16)	9,5 (10½— 8)	6,5 (7½—6)
228	Calbas Boshi	250	30	10,6 (12½— 9)	19,8 (23 —17)	9,4 (11 — 8½)	6,6 (7½—6)
229	S. Bartool	190	30	11,0 (12½— 9½)	23,5 (27 —20)	10,1 (11 — 9)	7,4 (8 —6½)
230	*St. Silvester*	40	30	11,5 (13 —10)	23,4 (28 —19)	10,5 (12 — 9½)	7,3 (8½—6½)
231	S. Teintje	70	30	11,3 (13 —10)	22,5 (28 —19½)	9,7 (11½— 9)	7,0 (8 —6)
232	Tafelberg S. H.	90	30	11,3 (12½— 9½)	22,5 (26½—19½)	9,9 (11 — 8½)	6,9 (7½—6)
233	*Rooi Sorsaka*	110	30	12,1 (13½—10)	25,7 (29½—22)	10,0 (11 — 9)	7,0 (8 —6)
234	*S. Christoffel*	10	10	12,1 (13 —11½)	26,4 (29½—24)	11,2 (12 —10)	7,2 (7½—6½)
235	*S. Christoffel*	30	30	11,8 (13½—10½)	24,8 (28 —22)	11,0 (12 —10)	7,0 (7½—6½)
237	Boca Tabla	110	30	10,8 (12 — 9½)	20,6 (25½—17)	9,5 (10½— 8)	6,7 (8 —5½)
238	Boshi Westpunt	50	30	10,5 (12 — 9½)	21,1 (24½—18)	9,6 (11 — 8½)	7,0 (7½—6)
239	Westpunt	80	30	10,6 (12½— 9½)	21,9 (28 —18½)	9,6 (10½— 9)	6,9 (7½—6)
240	Plaja Abau	140	30	11,0 (12½— 9½)	22,0 (24½—19)	9,9 (10½— 9)	6,9 (7½—6½)
240A	Plaja Abau	50	30	11,0 (12 — 9½)	21,7 (24 —18½)	9,7 (11 — 9)	6,7 (7½—6)
241	Plaja Abau	30	30	11,0 (12½—10)	21,9 (25½—19)	9,5 (10 — 8½)	6,6 (7½—6)
242	S. Djerimi	160	30	10,9 (12 — 9½)	21,2 (25 —17)	9,3 (10½— 8)	6,5 (7 —5½)
242A	S. Djerimi	110	30	10,2 (12 — 9½)	20,5 (23½—17)	9,4 (10½— 8½)	6,8 (7½—5½)
243	St. Kruis Baai	30	30	11,1 (12½— 9½)	22,6 (25½—18)	9,6 (10½— 8½)	6,8 (7½—6)
244	Plaja Chikitoe	50	30	10,7 (11½— 9½)	21,8 (25½—19)	10,1 (11 — 9)	7,0 (8 —6)
245A	*Hofje St. Kruis*	10	10	12,0 (13 — 9½)	24,4 (27 —19½)	10,2 (11 — 9½)	7,0 (7½—6½)
s.n.	Quadirikiri †	20	10	11,4 (12½—10)	22,2 (24½—20)	9,5 (10½— 9)	6,6 (7 —6)
253A	Boca Grandi †	10	5	10,3 (10½—10)	22,2 (23 —22)	10,8 (12 —10)	7,4 (8 —7)
256	Savaneta	5	5	11,6 (12 —11½)	21,4 (22½—20½)	9,7 (10 — 9½)	6,4 (7 —6)
258	R. Lamoenchi	90	30	11,4 (12½—10½)	22,0 (24 —19)	9,9 (10½— 9)	6,7 (7½—6)
258A	R. Lamoenchi	60	30	11,6 (12½—11)	21,9 (24½—19)	9,8 (11 — 9)	6,5 (7 —6)
259	Isla	10	5	12,0 (12½—11)	21,9 (23½—19½)	10,0 (11 — 9½)	6,5 (7 —6)
260B	Rooi Taki	30	30	11,7 (12½—10½)	22,0 (24½—19½)	9,4 (10 — 8½)	6,4 (7 —6)
261	Spaansch Lagoen	70	30	11,9 (13 —10½)	22,7 (25 —19)	9,4 (10½— 8½)	6,2 (6½—5½)
262	Spaansch Lagoen	160	30	11,9 (12½—10½)	22,1 (26 —18½)	9,1 (10½— 8)	6,3 (7 —5½)
262A	Balashi	50	30	11,6 (13 —10½)	21,6 (25 —19½)	9,8 (10½— 9)	6,4 (7 —6)
264	Barcadera	60	30	11,4 (13 —10½)	22,4 (25 —19½)	9,4 (10 — 8½)	6,5 (7 —5½)
265	Perkietenbosch	10	10	11,9 (13 —11)	22,8 (25½—21)	9,9 (10½— 9)	6,5 (7 —6)
s.n.	Baca Morto †	5	5	11,8 (12½—11)	22,8 (25 —21½)	9,9 (10½— 9½)	6,4 (6½—6)
s.n.	S. Canashito †	30	30	11,5 (13 —10)	23,4 (27 —20½)	10,5 (12 — 9)	6,9 (7½—6½)
66	Populations	6540	2280	*11,4* (15 — 9)	*22,0* (31½—16)	*9,8* (12 — 7)	*6,7* (8½—5)
	Average of longest specimens			*12,5*	*25,5*	*9,9*	*6,8*
	Average of broadest specimens			*11,3*	*22,5*	*10,7*	*7,0*

TABLE 3.

Shell - measurements in *Cerion uva*.

Station	210	220
Number of specimens	300	300
Number of whorls	*11,5* (13½—10)	*12,0* (14 —10)
Altitude, in mm	*21,8* (27 —18)	*23,2* (28½—19)
Diameter of spire, in mm	*9,6* (11 — 8½)	*10,6* (12 — 9½)
Width of three whorls on broadest part of spire, in mm	*7,1* (8½— 6)	*7,2* (8½— 6)
Width of ultimate whorl, in mm	*6,5* (8 — 5½)	*7,2* (8 — 6½)
Length of peristome, in mm	*7,4* (9 — 6)	*7,7* (9 — 6½)
Width of peristome, in mm	*6,4* (7½— 5)	*6,7* (8 — 5½)
Number of ribs on broadest part of spire	*23,8* (30 —20)	*20,0* (24 —15)

4a From Bonaire and Klein Bonaire ... *Cerion uva bonairensis* Baker [type-locality: Porta Spañó = St. s.n. Porta Spanjó]

4a' Smaller specimens, *C. uva bonairensis* f. *kralendijki* Baker [type-locality: South of Kralendijk = St. s.n. Baca]

St. 181, c, with one large, old spec. (whorls 12½, alt. 27½ mm, diam. 11½ mm, width 3 wh. 7½ mm); St. 184, a; St. 184A, a, two very long spec. with unfinished peristome; Baca, a; St. 186, c; St. 187, a; Porta Spanjó, c; St. 195, a; St. 196, a; St. 197, c; St. 199, a; St. 199A, a, one very long spec. with unfinished peristome; Klein Bonaire, fossil in limestone-beds.

4b From Aruba ... *Cerion uva arubanum* Baker [type-locality: Baranca Alto = near St. 259]

Cave of Quadirikiri, a, fossil in phosphate-pockets and cave-deposits; St. 253A, o, old, very broad, with two *desc.*; St. 256, o, dead; St. 258, a; St. 258A, c; St. 259, c; Shidaharaka, r, dead; St. 260B, c; St. 261, a; St. 262, a; St. 262A, c; Rooi Francés, o, old; St. 264, c; St. 265, c; Baca Morto, o, fossil in loose soil; Top Seroe Canashito, o, fossil in loose soil; Base of S. Canashito, o, fossil in loose soil.

TUDORA Gray, 1850

Genotype: *Cyclostoma simile* Sowerby I, 1843

Bonaire, Curaçao, Aruba, mainland of North Venezuela.

Key to the Subgenera and Species — cf. Hummelinck, 1940, p. 88.

Tudora megacheilos megacheilos (Potiez et Michaud, 1838) Pfeiffer, 1852

Cyclostoma megacheilos Potiez et Michaud, 1838, p. 237, tab. 24 fig. 9—10 ed. 1836.

Cyclostoma simile Sowerby I, 1843, p. 103, tab. 24 fig. 48—49; Hanley, 1854—58, fig. 53—56.

Cyclostoma megacheilum, Pfeiffer, 1846 (Rev.), p. 33 "ich besitze die Schnecke von Curaçao." [First Curaçao record].

Cyclostoma megachilum, Pfeiffer, 1848 (Conch. Cab.), p. 66; Lorié, 1887, p. 131, 142; Martin, 1888 (1), p. 120; Hartert, 1902, p. 285.

Tudora similis (Sow.) Gray, 1850, p. 48.

Tudora megachila (Pot. et Mich.) Pfeiffer, 1852 (Consp.), p. 38 "Var.: *C. cancellatum* Menke. Curaçao."; Pfeiffer, 1852 (Monogr.), p. 243; Mörch, 1852, p. 40; Pfeiffer, 1858, p. 126; Pätel, 1889, p. 473; Pfeiffer, 1876, p. 183.

Cyclostoma roridum, C. proteus, C. cancellatum, Pfeiffer, 1852 (Monogr.), p. 244 [nomina nuda; in syn.].

Cistula megacheila (Pot. et Mich.) Adams et Adams, 1856, p. 294.

Cyclostoma megachila, Reeve, 1860, p. 198.

Tudora megacheila, Bland, 1861, p. 28; Bland, 1866, p. 143; Bland, 1869, p. 191; Pätel et Schaufuss, 1869, p. 96; Poulsen, 1878, p. 6 [p. p.]; Gibbons, 1879 (Pulm.), p. 134; Gibbons, 1879 (Cur.), p. 137; Smith, 1898, p. 113, 116; Hartert, 1902, p. 294; Vernhout, 1914, p. 180, 185.

Tudora megachilos, Martens, 1873, p. 219.

Tudora megacheilos, Kobelt, 1880, p. 286; Schepman, 1915, p. 480; Baker, 1923, p. 2, 27, tab. 2 fig. 10 [Variation]; Baker, 1924, (p. 55...) p. 114... [Classification, Variation, Distribution]; Baker, 1925, p. 41, 43.

Tudora megacheilos megacheilos, Baker, 1924, p. 55..., fig. 27, tab. 13 fig A [Radula, Variation]; Baker, 1925, p. 43; Hummelinck, 1940, p. 89, 93; Hummelinck, 1940 (Zoogeogr.), p. 120,124.

Tudora megacheilos spreitensis Baker, 1924, p. 58..., fig. 35, tab. 13 fig. C, [Curaçao; Variation].

Tudora megacheilos rondeklipensis Baker, 1924, p. 60..., fig. 36, tab. 13 fig. D [Curaçao; Variation]; Baker, 1925, p. 43.

Tudora megacheilos kabrietensis Baker, 1924, p. 61..., tab. 13 fig. E, [Curaçao; Variation]; Baker, 1925, p. 43.

Tudora megacheilos f. *desculpta* Baker, 1924, p. 56..., fig. 34, tab. 13 fig. B [Curaçao].

Cistula megachila, Fischer, 1885, p. 748.

Cyclostoma megachile, Martin, 1888 (2), p. 97, 100, 127; Rutten, 1931, p. 663.

Chondropoma megacheila (Pot. et Mich.) Dall, 1905, p. 209.

Tudora megacheilus, Gratacap, 1907, p. 117.

Tudora megachile, Horst, 1924, p. 2.

Tudora fossor Baker, 1924 (Naut.), p. 94 [Curaçao, Aruba]; Baker, 1924, (p. 63...) p. 110... [Classification, Variation, Distribution]; Jutting, 1925, p. 31; Baker, 1925, p. 43.

Tudora fossor fossor, Baker, 1924, p. 63..., fig. 37, tab. 13 fig. G [Variation].
Tudora fossor djerimensis Baker, 1924, p. 65..., tab. 12 fig. I [Curaçao; Variation].
Tudora fossor westpuntensis Baker, 1924, p. 66..., tab. 13 fig. H [Curaçao Variation].
Tudora fossor arubana Baker, 1924, p. 68..., fig. 38, tab. 13 fig K [Aruba; Variation].
Tudora fossor canashitensis Baker, 1924, p. 69..., tab. 13 fig. I [Aruba; Variation].
Tudora megacheile, Jutting, 1925, p. 30.
Tudora megacheile f. *desculpta*, Jutting, 1925, p. 30.

Shell conical, somewhat acuminate, altitude (1,7—) *2,0* (—2,2) times minor-diameter, (23½—) *17,4—14,3—11,5* (—9) by (11½—) *9,7—7,3—6,1* (—5) mm (excluding the apical-whorls, which in adult specimens are usually lacking), narrowly or rather narrowly perforated, usually solid, sometimes rather fragile, generally cancellated or reticulated, more rarely decussated. Average males somewhat smaller than females, measurements of sexes quite intergrading. Whorls 7—6—5½, of which 6—*4,0*—3 are usually retained, slightly compressed in transversal direction, in cross-section ovate or obovate, sometimes subcircular; apical-whorls more slowly increasing than the later ones. The first 2—3 whorls, forming an acuminate cone, usually lacking in adult specimens; the later ones, forming a more or less acute cone with an apical-angle of (50—) *44—34—30* (—25)°, gradually increasing as far as the last part of the body-whorl, which widens more rapidly and is somewhat ascending at the peristome. Suture distinct, deeply impressed, not channelled. Umbilical-channel gradually increasing, ½—1 mm wide, often sligthly narrowing in the ultimate whorl. Aperture vertical, subovate or subcircular, generally somewhat angular at the apex, flattened at the parietal side, with long-axis at about 20—30° to that of the shell. Peristome continuous in old specimens; margin thin, more or less undulated, usually with a shallow palatal sinus, gradually expanded in palatal and basal portions, shorter and more reflected in columellar region; parietal and basal angle generally produced. Sculpture of last whorl a combination of numerous vertical or somewhat reclined growth-riblets and several spiral-ridges. Growth-riblets closely or more widely spaced, (3—) 4—10 (—14) per 1 mm, broad and flattened or more laterally compressed and somewhat rounded, they may be broader or, more often than not, narrower than their interspaces. Spiral-ridges (0—) 14—24 (—30) per whorl, broad and flattened or more laterally compressed and angular, they are much narrower than their interspaces; they are often very weakly developed and, more rarely, absent or practically absent; they are most prominent in the umbilical region. The spiral-ridges, which are more prominent than the growth-riblets, are in most cases more or less surmounted by the growth-sculpture; the intersections are often developed as rounded elevations or small tooth-like projections, which give the shell a granulate appearance. Operculum about 4—4½ whorls, subovate, usually somewhat angular at the apex; nucleus rather markedly eccentric. Calcareous-plate rather thin, not or very fragmentary present on the initial whorls, as large or somewhat smaller than the chondroic-plate. Outer-surface generally slightly concave, with the rim of each whorl slightly raised;

inner-surface almost flat. Colour usually quite a complicated mixture of pink, yellow and brown, sometimes reddish or bluish tints predominate, often with a varying number of spiral-bands which may be broken, rather often with more or less irregular vertical flammulations. The brightest colours and the most marked designs occur, as a rule, in thin or young shells. Ground-colour usually greyish or pinkish to dull or rather vivid yellow, orange, salmon, yellowish-brown, reddish-brown, or brown; occasionally very dark specimens occur, more often almost colourless specimens are to be found, which sometimes have a somewhat bleached appearance. Apex often much darker or differently coloured. Sculpture whitish or white-tipped. Spiral-bands clearly visible, obscure or lacking, 1—6 or more, varying in width, either continuous or broken into square, elongated or rounded blotches, sharply defined or diffuse, sometimes partly joined, usually yellowish-brown, reddish-brown, greyish-brown or brown. Blotches of broken spiral-bands often arranged in vertical rows, tending to unite into more or less distinct vertical bands. Aperture internally light-orange to yellowish-brown, greyish-brown or brown; as a rule showing the spiral-bands. Peristome white. Operculum whitish or white.

Curaçao: Almost everywhere on limestone, abundant in favourable localities; often occurring in more or less wooded places in the region of the diabase and the cherts. Subfossil or fossil specimens of quaternary age have been found in pockets of phosphate, limestone beds, cave-deposits and loose soil. Aruba: Almost everywhere on limestone, abundant in favourable localities; often occurring in more or less wooded places in the region of the diabase, diorite and hooibergite. Subfossil or fossil specimens of quaternary age have been found in cave-deposits and loose soil.

A terrestrial or subarboreal subspecies, which usually aestivates buried under rocks and in crevices of the talus, coming to the surface during rains or dew and climbing often the moistened trunks or larger branches of trees and shrubs.

Tudora megacheilos pilsbryi Baker, 1924

[?] *Cyclostoma megacheilus* Sowerby I, 1843, tab. 31 fig. 276.

[?] *Cyclostoma sowerbyi* Pfeiffer, 1847, p. 56 [Other name for *C. megach.* Sow.]

Tudora pilsbryi Baker, 1924, (Naut.), p. 94 [Curaçao]; Baker, 1924, p. 62..., 113..., fig. 39, 44, tab. 13 fig. F [Variation, Distribution]; Baker, 1925, p. 41, 43.

Tudora megacheilos pilsbryi Baker, Hummelinck, 1940, p. 90; Hummelinck, 1940 (Zoogeogr.), p. 117, 120, 124.

[Characters in common with *T. megacheilos megacheilos* are omitted.]

Shell rather widely perforated, altitude (1,2—) *1,6* (—1,8) times minor-diameter, (16½—) *14,1* (—11½) by (10½—) *8,9* (—7½) mm. Whorls about 6, of which 4½—*3,6*—3 are usually retained, in cross-section broadly ovate or subcircular. The later whorls forming a cone with an apical-angle of (70—) *56* (—45)°. Suture very deeply impressed. Umbilical-channel about 1—1½ mm wide, sometimes slightly narrowing in the ultimate whorl. Peristome strongly undulate, usually with a marked palatal sinus. Sculpture with widely spaced growth-riblets, which are laterally com-

TABLE 4.

Measurements in *Tudora megacheilos megacheilos.*

STATION:		Nrs. coll.:	Nrs. meas.:	Whorls retained:	Altitude, in mm:	Minimum diameter, in mm:	Apical-angle, in degrees:
201	Ronde Klip	90	60	4,5 (6 —3½)	17,4 (21 —12)	9,7 (11½—8)	44 (50—35)
201A	Ronde Klip	30	30	4,2 (4½—3½)	15,3 (17½—11½)	8,0 (9½—6½)	37 (40—30)
202	S. di Boca	230	90	4,5 (5 —4)	16,7 (20½—12½)	9,0 (11 —6½)	40 (50—30)
203	S. Mainsjie	100	60	4,5 (5 —3½)	16,4 (23½—12½)	8,6 (10 —7)	39 (45—30)
204A	*Seinpost*	170	60	4,2 (5 —3½)	15,9 (20 —12½)	8,4 (9½—6½)	40 (45—30)
206	Tafelberg S. B.	5	5	4,3 (4½—4)	15,8 (18 —14)	8,0 (9½—7)	40 (40—40)
207	Newport	70	60	4,3 (4½—3½)	15,7 (18 —13)	8,2 (8½—6½)	42 (50—35)
210	Quarantaine	60	60	4,4 (5 —3½)	15,3 (18½—11½)	8,2 (9½—6½)	42 (50—30)
212	Schaarloo	130	120	4,3 (5 —3½)	16,3 (20 —12½)	8,3 (10½—6)	41 (50—35)
s.n.	Fort Nassau	10	10	4,1 (4½—4)	15,3 (16½—12½)	8,0 (9 —6½)	40 (45—35)
213A	S. Domi	20	20	4,6 (5 —4)	16,8 (19 —13½)	8,3 (9 —6½)	40 (40—35)
213	S. Pretoe	190	60	4,4 (5 —4)	16,0 (18 —13)	8,7 (10 —7)	42 (50—40)
214	Evertszberg	50	30	4,5 (5 —4)	16,3 (19 —13)	8,5 (9½—7½)	40 (45—35)
215	S. Spreit	170	60	4,3 (5 —4)	15,7 (19 —13)	8,1 (9½—6½)	39 (45—30)
217	Hato	90	60	4,3 (5 —3½)	16,0 (19½—13)	8,6 (11½—7)	41 (50—35)
220	Wandongo	20	20	4,2 (5 —4)	14,0 (18 —12)	7,6 (8½—6½)	40 (40—35)
221	Groote Berg	80	60	4,3 (5 —3)	15,8 (19 —13)	8,4 (10 —7)	41 (50—40)
222	*Koenoekoe Abau*	60	60	4,1 (4½—3½)	14,7 (17½—12)	7,4 (8½—6)	34 (40—30)
223	Hermanus	30	30	4,2 (5 —3½)	15,6 (18 —12)	8,0 (9½—6½)	40 (45—35)
224	S. Kabritoe	30	30	4,0 (4½—3½)	14,2 (16 —11½)	7,3 (8 —6)	36 (40—30)
225	S. Cabajé	30	30	4,0 (4½—3)	13,2 (16 —10½)	6,7 (8 —5½)	35 (40—30)
225a	S. Cabajé	30	20	4,0 (6 —3½)	13,5 (17 —11)	6,6 (8 —5½)	33 (40—30)
226	San Pedro	80	60	4,1 (5 —3)	14,8 (17 —12)	7,7 (9 —6)	39 (45—30)
227	S. di Cueba	20	20	4,0 (4½—3½)	14,9 (18½—12)	7,4 (9 —6)	37 (40—30)
228	Calbas Boshi	20	20	4,0 (4½—3½)	14,2 (16 —12)	7,3 (8½—6½)	39 (40—35)
229	S. Bartool	20	20	3,8 (4½—3½)	13,4 (14½—11)	6,7 (7 —6)	33 (40—30)
s.n.	S. Bartool	10	10	3,8 (4 —3½)	13,5 (15½—10½)	6,7 (7½—5½)	36 (40—30)
229A	*S. Bartool*	20	20	3,8 (4 —3½)	13,7 (15½—11)	6,9 (7½—6)	36 (40—30)
230	*St. Silvester*	10	10	3,8 (4 —3½)	12,8 (14½—10½)	6,6 (7 —5½)	32 (35—30)
231	S. Teintje	10	5	3,7 (4 —3½)	12,6 (14 —11)	6,3 (7 —5½)	34 (40—30)
232	Tafelberg S. H.	30	20	3,8 (4 —3½)	12,8 (14½—10½)	6,6 (7½—5½)	33 (40—30)
233	*Rooi Sorsaka*	20	20	3,7 (4 —3½)	13,1 (14½—12)	6,4 (7 —6)	33 (40—30)
237	Boca Tabla	5	5	3,7 (4 —3½)	12,6 (14 —11½)	6,4 (6½—6)	32 (35—30)
238	Boshi Westpunt	20	20	3,8 (4 —3½)	14,5 (14½—10½)	6,5 (7 —5½)	33 (40—30)
239	Westpunt	50	40	3,9 (4½—3½)	13,1 (15 —10)	6,6 (7½—5½)	32 (40—30)

240	Plaja Abau	80	60	3,9 (4 —3½)	12,0 (15½— 9)	6,1 (7 —5)	31 (40—30)
240A	Plaja Abau	10	10	3,8 (4 —3½)	12,4 (14 —10½)	6,5 (7 —6)	33 (40—30)
242	S. Djerimi	60	60	3,9 (5 —3½)	14,8 (18 —12)	7,4 (8½—6)	35 (40—30)
242A	S. Djerimi	80	60	4,0 (5 —3½)	13,3 (16 — 9½)	6,7 (7½—5)	32 (40—30)
243A	S. Commandant	20	20	3,9 (4 —3½)	13,2 (15½—11½)	6,6 (7½—5½)	31 (35—30)
243	St. Kruis Baai	120	60	4,0 (4½—3½)	13,8 (16½—11)	6,9 (7½—5½)	34 (40—30)
244	Plaja Chikitoe	40	30	3,8 (4½—3½)	12,8 (14½—10½)	6,6 (7½—5½)	33 (40—30)
245A	*Hofje St. Kruis*	30	30	3,8 (4½—3)	12,8 (14½—11)	6,3 (7 —5½)	31 (40—25)
246	Rooi Prins	20	10	4,0 (4 —3½)	15,5 (17 —13)	8,0 (7 —9)	36 (40—35)
247A	Boca Prins	40	30	3,8 (4 —3½)	13,3 (15½—10½)	7,0 (8 —5½)	32 (40—30)
248	Boca Prins	30	30	4,2 (5 —3½)	14,4 (16 —13)	7,6 (8½—6½)	36 (40—30)
249	Quadirikiri	40	30	4,0 (5 —3½)	14,3 (16½—11½)	7,4 (8 —6½)	36 (40—30)
s.n.	Quadirikiri †	30	30	4,0 (4½—3)	16,7 (19½—14½)	8,5 (10 —7½)	35 (40—30)
253	Boca Grandi	50	30	4,0 (5 —3½)	14,4 (17 —12)	7,2 (8½—6)	34 (40—30)
253A	Boca Grandi	20	10	4,1 (5 —3½)	14,8 (17 —11½)	7,5 (9 —6)	36 (40—30)
254A	Culebra	30	20	3,9 (4 —3½)	14,7 (17½—11)	7,4 (8½—6)	33 (40—30)
255	Rooi Spoki	100	60	3,8 (5½—3)	13,7 (16½—10)	6,9 (8 —6)	34 (40—30)
s.n.	Rooi Spoki †	5	5	4,4 (5 —4)	18,0 (18½—16½)	9,0 (10 —8½)	39 (40—35)
256	Savaneta	40	20	3,6 (4 —3)	13,0 (15 —11)	6,8 (7½—6)	34 (40—30)
258	R. Lamoenchi	300	60	3,8 (5 —3)	13,2 (15½—10½)	6,7 (8 —5)	31 (40—30)
258A	R. Lamoenchi	40	30	3,8 (4½—3½)	14,4 (17 —11½)	7,4 (8½—6)	32 (40—30)
259	Isla	10	10	4,0 (6½—3½)	14,0 (15½—12)	7,2 (8 —6)	35 (40—30)
260	Baranca Alto	40	30	3,7 (4 —3½)	13,1 (15½—10)	6,9 (7½—6)	35 (40—30)
260B	Rooi Taki	20	20	3,6 (4½—3)	13,8 (17½—11)	6,7 (8½—6)	32 (40—30)
261	Spaansch Lagoen	20	20	3,8 (4½—3½)	14,1 (17½—11)	7,2 (8½—6)	33 (40—30)
262	Spaansch Lagoen	20	20	3,8 (4½—3½)	14,2 (18 —12)	7,3 (9 —6)	33 (40—30)
262A	Balashi	20	20	3,7 (4 —3½)	13,0 (15 —10½)	6,8 (8 —6)	31 (35—30)
264	Barcadera	20	20	3,8 (4 —3½)	14,2 (17 —11½)	7,0 (8 —6)	30 (35—30)
265	Perkietenbosch	10	5	3,5 (4 —3½)	13,1 (15½—11½)	6,4 (7 —6)	31 (35—30)
265A	Perkietenbosch	30	20	3,9 (4 —3½)	14,8 (16½—12½)	7,2 (8½—6)	32 (35—30)
266	S. Canashito	20	20	3,6 (4 —3½)	12,5 (14 —10½)	6,5 (7 —5½)	31 (40—30)
s.n.	S. Canashito †	5	5	3,5 (4 —3½)	14,0 (15 —13½)	7,0 (7½—6)	30 (30—25)
268	*Hooiberg*	10	10	3,6 (4 —3)	14,2 (15 —13)	7,2 (8 —7)	31 (35—30)
270	*Jamanota*	10	10	3,8 (4 —3½)	14,6 (17½—12)	7,2 (8½—6)	33 (40—30)
s.n.	*Rooi Tamboe*	10	10	3,8 (4 —3½)	14,6 (17 —12)	7,3 (8½—6½)	30 (35—30)
271	S. Cristal	20	20	3,8 (4½—3½)	12,2 (14½—11)	6,2 (7½—5½)	31 (35—30)
272	Hudishibana	40	40	3,4 (4 —3)	11,5 (13 — 9)	6,1 (7 —5)	31 (40—30)
272A	Annaboei	30	30	3,7 (4 —3½)	12,9 (14 —11)	6,7 (7 —5½)	31 (35—30)
275	Solito	10	10	3,8 (4½—3½)	14,1 (16 —11)	7,0 (8 —6)	31 (40—30)
276	Heintje Croes	20	10	3,8 (6 —3½)	13,1 (16 —10½)	6,7 (7½—5½)	32 (40—30)
75	Populations	3560	2330	*4,0* (4,6 — 3,4)	*14,3* (17,8 — 11,5)	*7,3* (9,7 — 6,1)	*34* (44—30)

pressed and slightly rounded; they are narrower than their interspaces. Spiral-ridges laterally compressed and angular, well developed; they are surmounted by the growth-sculpture; the intersections are developed as small, tooth-like projections. Operculum rounded at the apex. Outer-surface distinctly concave; inner-surface very slightly convex. Colour usually vivid.

Curaçao: Confined to the Tafelberg, a limestone hill in eastern Curaçao, abundant in favourable localities. A fossil specimen of quaternary age has been found in a pocket of phosphate at Hato, Middle Curaçao.

A terrestrial or slightly subarboreal subspecies, which usually aestivates buried under rocks and in crevices of the talus, coming to the surface during rains or dew and climbing often the moistened trunks of trees and shrubs.

Material of Tudora megacheilos — arranged according to the classification of H. B. Baker — with notes on the distribution and occurrence of the different forms (abundant, a; common, c; often, o; rare, r).

1a Altitude of shell, excluding apical-whorls, about 1,5 times minor-diameter; apical-angle of retained whorls generally 50—65° ..... **Tudora megacheilos pilsbryi** [type-locality of *T. pilsbryi* Baker: Tafelberg St. Barbara, Curaçao = St. 206]

St. 206, a, with five specimens of *megacheilos* and one old spec. of *rondeklipensis*; Hato, near St. 217, fossil in phosphate-pocket; see also St. 204A, 207.

1b Altitude of shell, excluding apical-whorls, about 2 times minor-diameter; apical-angle of retained whorls generally 30—45° ..... **Tudora megacheilos megacheilos** ..... 2 [type-locality of *Cyclostoma megacheilos* Pot. et Mich. unknown, assigned to Curaçao]

2a Apical-angle generally *34—40—44°*, average altitude 14—17½ mm; from East and Middle Curaçao, fossil in Aruba ..... *Tudora megacheilos,* Baker 3

2b Apical-angle generally *30—40—44°*, average altitude 12—15½ mm; from West Curaçao and Aruba ..... *Tudora fossor* Baker 7

3a Intersections of spiral-ridges developed as small tooth-like projections or rounded elevations, apical-angle *30—39—45°*; from St. Michielsberg—Seroe Largoe, Curaçao ... *T. megach. spreitensis* Baker [type-locality: S. Spreit = St. 215]

St. 215, a, several spec. practically identical with *meg.* and *kabriet.*

3b Intersections of spiral-ridges developed as very small angular projections or flattened elevations, apical-angle *30—41—50°*; from East and Middle Curaçao, fossil in Aruba 4

4a Peristome very extensively expanded; from the North-east part of West Curaçao ... *T. megach. rondeklipensis* Baker [type-locality: S. Ronde Klip = St. 201]

St. 201, a; St. 201A, c, very often resembling *meg.* and *fossor*; St. 202, a, about ten p.c. with very weak or nearly undeveloped

spiral-ridges (f. *desculpta*), they are smaller and somewhat more slender than the other spec. (av. altit. 15,3 mm, min.-width 8,2 mm, ap--angle 39°); St. 203, a, several with very weak or nearly undeveloped spiral-ridges (f. *desculpta*).

4b Peristome rather extensively expanded; from the South and North part of West Curaçao, fossil in Aruba 5

5a From Aruba

Cave of Quadirikiri, o, fossil in phosphate and cave-deposits; Rooi Spoki, near St. 255, o, fossil in cave-deposits and loose soil.

5b From Curaçao 6

6a From East of Jan Tiel; intersections of spiral-ridges usually with very small angular projections or small elevations ... *T. megach. kabrietensis* Baker [type-locality: Fort Beekenburg = St. 211]

St. 204A, o, several *meg.*, one spec. intergrading with *pilsbryi*; St. 205, r; St. 207, a, ten spec. intergrading and five pract. identical with *pilsbryi*, other spec. often like *meg.*; St. 210, a, often like *meg.*; St. 211, c.

6b From Jan Tiel—Evertszberg—Groote Berg—Seroe Kabritoe, Hato—San Pedro; intersections of spiral-ridges usually without angular projections, often with small elevations ... *T. megach. megacheilos* Baker [type-locality: unknown, assigned to Schaarloo = St. 212]

6b' Spiral-ridges absent ... *T. meg.* f. *desculpta* Baker [type-locality: Schaarloo = St. 212]

St. 212, a, several spec. with weak or pract. undeveloped spiral-ridges (f. *desculpta*); Fort Nassau, a; St. 213, a, sev. spec. slightly resembling *rondeklip.*, few spec. with nearly no spiral-ridges (f. *desculpta*); St. 213A, a; St. 214, a, sev. spec. like *kabriet.*, few spec. like f. *desculpta*; St. 217, a, slightly intergrading with *rondeklip.*, two old spec. identical with those of St. 202; Cave of Hato, a, subfossil, slightly intergrading with *spreit.* and *fossor*; St. 220, c, often resembling *fossor*; St. 221, a, sev. spec. slightly intergrading with *spreit.* and *fossor*; St. 222, c, sev. spec. resembling *fossor*; St. 223, c, many spec. resembling *spreit.* and *fossor*; St. 224, a, intergrading with *djerim.*, one old spec. of *meg.* as from St. 212; St. 226, c, resembling *westpunt.* and *djerim.*, some spec. with weakly developed spiral-ridges.

7a From West Curaçao 8

7b From Aruba 10

8a From the central region of West Curaçao; intersections of spiral-ridges often with small angular elevations, average apical-angle 32° ... *T. foss. fossor* Baker [type-locality: between Seroe Palomba and S. Hoendoe = near St. 236]

St. 230, o, sev. spec. resembling *westpunt.* and *djerim.*; St. 231, c, intergrading with *westpunt.*; St. 232, c, very like *westpunt.* and *djerim.*; St. 233, o, id.; St. 236, o, id.; St. 245A, c, practically the same as *djerim.*

8b From the peripheral region of West Curaçao; intersections of spiral-ridges rarely with small angular elevations, average apical-angle *34°* 9

9a From St. Marie Baai — North of Plaja Abau ... *T. foss. djerimensis* Baker [type-locality: North of Plaja Djerimi = St. 242A]
St. 225, c, intergrading with *meg.*; St. 225a, c, intergrading with *meg.* and *spreit.*; St. 240, a; St. 241, o; St. 242, a, often resembling *fossor*; St. 242A, a, id.; St. 243, a, few spec. intergrading with *fossor*; St. 243A, c, resembling *fossor*; St. 244, a, sev. spec. resembling *fossor*.

9b From North of Plaja Abau — Seroe Bartool ... *T. foss. westpuntensis* Baker [type-locality: North of Plaja Abau = St. 240A]
St. 227, c, intergrading with *fossor* and *meg.*; St. 228, c, resembling *meg.*; St. 229, c, intergrading with *fossor*; S. Bartool, c, id.; St. 229A, o, id.; St. 237, o; St. 239, a; St. 240A, c, sev. spec. resembling *fossor*.

10a From South Aruba, East of Spaansch Lagoen ... *T. foss. arubana* Baker [type-locality: near Rooi Spoki = St. 255]
St. 246, c; St. 247A, c, resembling *djerim.* and *westpunt.*; St. 248, a, somewhat resembling *djerim.* and *westpunt.*, often *kabriet.*; St. 249, a; St. 250, o, resembling *fossor*; St. 253, c, somewhat resembling intergradations of *westpunt., djerim.* and *meg.*; St. 253A, c, id.; St. 254, o, old; St. 254A, c; St. 255, a, about one-half with weakly developed spiral-ridges, about one-fifth nearly without (f. *desculpta*); St. 256, o, resembling *fossor*; St. 257, o, id.; St. 258, a, id.; St. 259, c, id.; St. 260, a, resembling *fossor*; Shidaharaka, c, id.; St. 260B, c, id.; St. 261, c.

10b From North and Middle Aruba, West of Spaansch Lagoen ... *T. foss. canashitensis* Baker [type-locality: Seroe Canashito = St. 266]
St. 262, c, identical with the spec. from St. 261; St. 262A, c, resembling *fossor*, few spec. almost without spiral-ridges (f. *desculpta*); St. 263, c, resembling *fossor*; St. 264, c; St. 265, c; St. 265A, c; Baca Morto, c; St. 266, c, resembling *fossor*; St. 267, c, id.; Seroe Canashito, o, fossil in cave-deposits and loose soil, resembling *fossor* but with weak or pract. undeveloped spiral-ridges (f. *desculpta*); St. 268, o, not different from *fossor*; St. 270, c, apparently identical with *fossor*; Rooi Tamboe, c, id.; St. 271, o, resembling *fossor*; St. 272, c, resembling *djerim.* or *westpunt.*; St. 272A, c, id.; St. 275, c, id.; St. 276, c, resembling *djerim.* intergrading with *fossor*.

Tudora rupis H. B. Baker, 1924

Shell conical, often somewhat acuminate, altitude 2—*2,2*—2,6 times minor-diameter, (18½—) *15,0—13,7—12,1* (—9) by (8—) *6,9—6,1—5,5*— (4) mm (excluding the apical-whorls, which in adult specimens are usually lacking), very narrowly or nearly unperforated, usually solid, generally cancellated or decussated. Average males (alt. *11* mm) distinctly smaller than the females (alt. *15* mm), measurements of sexes usually not intergrading. Whorls 9—8, of which 8½—*6,3*—5½ are usually retained, rather slightly compressed in

transversal direction, in cross-section subovate, sometimes subcircular; apical-whorls often more slowly increasing than the later ones. The first 2—3 whorls, often forming a slightly acuminate cone, usually lacking in adult specimens; the later ones, forming an acute cone with an apical-angle of (40—) *32—30—28* (—25)°, gradually increasing as far as the last part of the body-whorl, which generally widens more rapidly and is somewhat ascending at the peristome. Suture distinct, rather deeply or deeply impressed, not channelled. Umbilical-channel gradually increasing, ¼—¾ mm wide, narrowing or, more rarely, even closing in the ultimate whorl. Aperture vertical or nearly vertical, subovate or subcircular, angular at the apex, flattened at the parietal side, with long-axis at about 20° to that of the shell. Peristome continuous; margin usually thin, slightly or not undulated, sometimes with a rather marked palatal sinus, gradually expanded in palatal and basal portions, shorter and more reflected in columellar region; parietal and basal angle generally produced. Sculpture of last whorl usually a combination of vertical or somewhat reclined growth-riblets or costae and several spiral-ridges. Growth-riblets quite regular, small, numerous and closely spaced, costae quite irregular, large, few and widely spaced, with various transitions, 8—1 per 1 mm, very low and flattened or more laterally compressed and somewhat angular, they may be broader or narrower than their interspaces. The growth-riblets sometimes show a tendency to form small sutural buttresses at their summit. Spiral-ridges about 15—10 per whorl, broad and flattened, broader or narrower than their interspaces; they are often weakly developed or, with exception of the umbilical region, practically absent. The spiral-ridges, which are usually more prominent than the growth-riblets, are surmounted by the growth-sculpture; in certain cases the intersections are developed as rounded elevations or tooth-like projections, which give the shell a coarse, granulate appearance. Occasionally practical smooth specimens occur. Operculum about 3—3½ whorls, subovate, angular at the apex; nucleus very markedly eccentric. Calcareous-plate rather thick, not or fragmentary present on the initial whorls, smaller than the chondroic-plate, outer-margin of the whorls usually much corroded. Outer-surface slightly or very slightly concave but with the last half-whorl slightly convex along a line more or less parallel to the palatal side; inner-surface slightly concave. Colour usually quite a complicated mixture of pink, brown, blue and yellow, often with a varying number of spiral-bands which may be broken, often with more or less irregular vertical flammulations. Ground-colour usually greyish, pinkish or brownish to dull or rather vivid yellow, yellowish-brown or orange; sometimes almost colourless specimens are to be found, which have a somewhat bleached appearance. Apex occasionally much darker or differently coloured. Sculpture usually more lightly coloured or white-tipped. Spiral-bands clearly visible, obscure or mostly lacking, 1—6 or more, varying in width, either continuous or broken into square or rounded blotches, sharply defined or diffuse, usually brown. Blotches of broken spiral-bands often arranged in vertical rows or united into more or less distinct, sometimes very dark, vertical bands. Aperture internally light-orange to brown; as a rule showing the spiral-bands. Peristome white. Operculum yellowish-white or pinkish.

Curaçao. Rather common on limestone but irregularly distributed, abundant in favourable localities; only found on or very near limestone.

TABLE 5.

Shell - measurements in *Tudora*.

Species	*T. megacheilos megacheilos*	*T. megacheilos pilsbryi*	*T. aurantia*	*T. rupis rupis*	*T. rupis muskusi*	*T. maculata*
Station	212	206	184	206	242	191
Number of specimens . .	120	80	120	80	80	20
Number of whorls retained	4,3 (5 — 3½)	3,6 (4½— 3)	5,9 (7 — 5½)	5,7 (7 — 5)	6,3 (7½— 5½)	4,1 (4½— 4)
Altitude, in mm	16,3 (20 —12½)	14,1 (16½—11½)	15,2 (18 —11)	12,3 (16½— 9½)	13,8 (16½—11)	8,2 (9½— 7)
Minimum-diameter, in mm	8,3 (10½— 6)	8,9 (10½— 7½)	7,1(9 — 5)	5,8 (7½— 4½)	6,4 (7½— 5)	3,4 (4 — 3)
Maximum-diameter, in mm	11,1 (13½— 8)	11,7 (13½—10)	8,7 (10½— 6½)	7,3 (9 — 6)	7,3 (8½— 5)	4,3 (5 — 4)
Width of penultimate whorl, in mm	4,8 (6 — 3½)	4,1 (5 — 3½)	4,6 (6 — 3)	3,4 (5 — 3)	4,2 (5½— 3)	2,1 (2½— 1¾)
Altitude of peristome, in mm	8,0 (10 — 6)	8,1 (9½— 6½)	6,1 (7½— 4)	5,6 (7 — 4)	5,3 (6½— 4)	2,2 (2½— 1¾)
Apical-angle of retained whorls, in degrees . .	41 (50—35)	56 (70—45)	32 (40—25)	30 (40—25)	31 (40—25)	18 (25—15)

An arboreal or subterrestrial species, which usually aestivates glued to the larger branches or trunks of shrubs and trees, but also often found under rocks and in crevices of the talus.

The animals of this species group themselves into large colonies within an ecological apparent homogeneous territory. If the centres of the different forms should be isolated, e.g. by inundation of the interlying regions, then most malacologists would, without hesitation, distinguish at least five species: *rupis, hatoensis, grandiensis, bullenensis* and *muskusi,* — each species being confined to a single island or to several neighbouring islands of the archipelago. The present state of affairs, however, shows a clear intergrading between the different forms; with exception of *T. rupis rupis,* owing to the isolation of its area.

Hybrids of species have only been observed between *Tudora megacheilos megacheilos* and *Tudora rupis muskusi,* — cf. Hummelinck, 1940, p. 93.

Tudora rupis rupis H. B. Baker, 1924

Tudora rupis Baker, 1924 (Naut.), p. 93 [Curaçao]; Baker, 1924, (p. 49...) p. 111... [Classification, Variation, Distribution]; Baker, 1925, p. 43.

Tudora rupis rupis, Baker, 1924, p. 49..., fig. 29, tab. 12 fig. E [Variation]; Hummelinck, 1940, p. 90, tab. 15; Hummelinck, 1940 (Zoogeogr.), p. 117, 120, 124.

Tudora rupis newportensis Baker, 1924, p. 50..., fig. 30, tab. 12 fig. D [Curaçao; Variation].

Tudora rupis muskusi H. B. Baker, 1924

[?] *Cyclostoma costatum* Pfeiffer, 1846 (Rev.), p. 47 "C. *costatum* Menke ined. ... Nahe verwandt mit C. megacheilum Grat."; Pfeiffer, 1848 (Conch. Cab.), p. 64, tab. 9 fig. 9—10 ed. 1847; Reeve, 1860, p. 198.

[?] *Tudora costata* (Pfeiffer) Pfeiffer, 1852 (Monogr.), p. 244; Pfeiffer, 1858, p. 126; Pätel, 1889, p. 473; Baker, 1924 (Naut.), p. 94; Baker, 1924, p. 53; Jutting, 1925, p. 30.

[?] *Cistula costata* (Pfeiffer) Adams et Adams, 1856, p. 294.

Tudora costata, Vernhout, 1914, p. 180 [Curaçao]; Schepman, 1915, p. 480.

Tudora muskusi Baker, 1924 (Naut.), p. 93 [Curaçao]; Baker, 1924, (p. 51 ...) p. 111 ... [Classification, Variation, Distribution]; Jutting, 1925, p. 30.

Tudora muskusi muskusi, Baker, 1924, p. 51..., fig. 31, 41, 43, tab. 12 fig. C. [Radula, Variation].

Tudora rupis, Jutting, 1925, p. 30 [Curaçao, Hato; identical with *T. musk. bullenensis* Baker].

Tudora rupis muskusi Baker, Hummelinck, 1940, p. 91, tab. 15; Hummelinck, 1940 (Zoogeogr.), p. 120, 124.

TABLE 6.

Measurements in *Tudora rupis*.

STATION:		Nrs. coll.:	Nrs. meas.:	Whorls retained:	Altitude, in mm:	Minimum diameter, in mm:	Apical-angle, in degrees:
206	Tafelberg St. B. . . .	90	80	5,7 (7 —5)	12,3 (16½—14—11— 9½)	5,8 (7½—4½)	30 (25—40)
207	Newport	30	30	6,0 (6½—5½)	15,0 (18 —14— 12)	6,6 (8 —5½)	32 (30—35)
217	Hato	20	20	6,6 (7 —6)	14,2 (17½—15—12—11½)	6,1 (7 —5)	28 (25—30)
224	S. Kabritoe	10	10	6,4 (7½—6)	12,6 (16 — 10)	5,9 (7 —5)	31 (30—35)
225	S. Cabajé	150	140	6,1 (7 —5½)	12,1 (15½—13—11— 9)	5,5 (7 —4)	30 (25—35)
226	San Pedro	400	160	6,7 (8 —5½)	14,9 (18½—16—11— 9½)	6,9 (8 —4½)	30 (25—35)
227	S. di Cueba	30	20	6,4 (7 —5½)	13,4 (16½—15—11—10½)	5,9 (7 —4½)	30 (25—30)
228	Calbas Boshi	30	30	6,1 (6½—5½)	13,0 (15½—14—11—10½)	5,8 (7 —4½)	30 (25—35)
229	S. Bartool	60	60	6,1 (7 —5½)	14,1 (17 —15—12—11)	6,1 (7½—5)	30 (25—35)
s.n.	S. Bartool	60	60	6,4 (7 —5½)	14,7 (18½—15—12—11)	6,2 (7½—5)	29 (25—30)
237	Boca Tabla	250	60	6,4 (8½—5½)	12,9 (16 —14—11— 9½)	5,7 (7 —4½)	30 (25—35)
242	S. Djerimi	90	80	6,3 (7½—5½)	13,8 (16½—15—11—11)	6,4 (7½—5)	31 (25—40)
242A	S. Djerimi	90	60	6,4 (7 —5½)	14,6 (17 —15—12—11)	6,7 (8 —5)	32 (30—40)
243	St. Kruis Baai	90	60	6,3 (7 —5½)	13,8 (16 —15—11—10½)	6,2 (7½—4½)	32 (25—35)
14	Populations	1400	870	*6,3* (8½—5½)	*13,7* (18½—*15*—*11*— 9)	*6,1* (8—4)	*30* (25—40)

Tudora rupis grandiensis H. B. Baker, 1924

Tudora muskusi grandiensis Baker, 1924, p. 53..., fig. 32, tab. 12 fig. F [Curaçao; Variation].
Tudora muskusi bullenensis Baker, 1924, p. 54..., fig. 33, tab. 12 fig. G [Curaçao; Variation].
Tudora rupis grandiensis Baker, Hummelinck, 1940, p. 91, tab. 15; Hummelinck, 1940 (Zoogeogr.), p. 120, 124.

Tudora rupis hatoensis Hummelinck, 1940

Tudora rupis hatoensis Hummelinck, 1940, p. 91, tab. 15 [Curaçao]; Hummelinck, 1940 (Zoogeogr.), p. 120, 124.

Material of Tudora rupis — with key to the subspecies — arranged according to the classification of H. B. Baker — with notes on the distribution and occurrence of the different forms (abundant, a; common, c; often, o; rare, r).

1a Axial-sculpture consists of growth-riblets which are quite regular in size and place, they are small, low and rounded, about as broad as their interspaces, generally 9—6 per mm; spiral-ridges usually narrower than their interspaces, broader than the growth-riblets; from East Curaçao .... **Tudora rupis rupis** 2

1b Axial-sculpture consists of growth-costae which are quite irregular in size and place, they are small or large, low and rounded or high and rather angular, broader or narrower than their interspaces, generally 6—1 per mm; spiral-ridges broader or narrower than their interspaces, broader or narrower than the growth-costae; from Middle and West Curaçao 3

2a Sculpture well-developed ... *T. rup. rupis* Baker [type-locality: Tafelberg St. Barbara = St. 206]
St. 206, a, few specimens intergrading with *newportensis.*

2b Sculpture very weak or practically undeveloped ... *T. rup. newportensis* Baker [type-locality: Newport = St. 207]
St. 207, c, few spec. intergrading with *rupis.*

3a Axial-sculpture dominating the spiral-sculpture; from West Curaçao .... **Tudora rupis muskusi** 4

3b Axial-sculpture nor spiral-sculpture dominating; from Middle Curaçao and the northern part of West Curaçao ..... **Tudora rupis grandiensis** 5

3c Spiral-sculpture dominating the axial-sculpture; from Middle Curaçao .... **Tudora rupis hatoensis** [type-locality: Hato, St. 217]
St. 217, c, spiral-sculpture and axial-sculpture both well or rather well developed; St. 223, c, more or less resembling *grandiensis.*

4a Axial-sculpture well-developed ... *T. musk. muskusi* Baker [type-locality: near Knip Baai = St. 242A]
St. 242, a; St. 242A, a; St. 243, a, sev. spec. with weakly developed sculpture.

TABLE 7.

Variation in *Tudora rupis*.

Altitude of shell, in mm	*T. rupis rupis* from Stat. 206.											*T. rupis grandiensis* from Stat. 225.										
	Minimum-diameter of shell, in mm									Totals	Mean diam.	Minimum-diameter of shell, in mm									Totals	Mean dian.
	4	4½	5	5½	6	6½	7	7½	8			4	4½	5	5½	6	6½	7	7½	8		
9										—	—	1		males							1	4.0
9½			1		males					1	5.0		1								1	4.5
10		2	1							3	4.7		11	1							12	4.5
10½			5							5	5.0		15	11	1						27	4.7
11			11	4						15	5.1		6	19							25	4.9
11½			7	3	1					11	5.2			6							6	5.0
12			1	6	4					11	5.6			3							3	5.0
12½					3	1				4	6.1			2		1					3	5.3
13					5	3				8	6.2					13	6				19	6.1
13½					1	3	1			5	6.5					7	5				12	6.2
14					2	7				9	6.4					3	10	1			14	6.4
14½						2				2	6.5					1	5	2			8	6.6
15							3			3	7.0						4	3			7	6.7
15½								1		1	7.5						1	1			2	6.8
16								1		1	7.5										—	—
16½						1				1	6.5					females					—	—
17					females					—	—										—	—
17½										—	—										—	—
18										—	—										—	—
18½										—	—										—	—
Totals	—	2	26	13	16	17	4	2	—	80	5.8	1	33	42	1	25	31	7	—	—	140	5.5
Mean alt.	—	10.0	11.0	11.6	12.7	13.9	14.6	15.7	—	12.3		9.0	10.4	11.1	10.5	13.3	14.0	14.8	—	—	12.1	

4b Axial-sculpture weakly-developed.
St. 227, c, many spec. intergrading with *bullenensis*; St. 228, c, most spec. intergrading with *muskusi* or *bullenensis*.

5a Axial-sculpture and spiral-sculpture both well-developed ... *T. musk. grandiensis* Baker [type-locality: Seroe Grandi = North of St. 225]
St. 224, c, some spec. somewhat resembling *hatoensis*; St. 225, a, very few spec. of *muskusi* or intergrading with *muskusi*; St. 226, a, some *muskusi*, sev. resembling *muskusi* and *bullenensis*; St. 237, a, sev. intergrading with *muskusi*.

5b Axial-sculpture and spiral-sculpture both weak, very weak or practically undeveloped ... *T. musk. bullenensis* Baker [type-locality: Seroe Largoe = West of St. 224]
St. 229, c, many spec. practically smooth, sev. intergrading with *grandiensis* and *muskusi*, very few *grandiensis*; S. Bartool, a, many spec. pract. smooth, sev. resembling *muskusi*.

Tudora aurantia (Wood, 1828) Smith, 1898

Turbo aurantius Wood, 1828 (Suppl.), p. 19, tab. 6 fig. 23 [Type in British Museum Nat. Hist. "Type. aurantiaca, *Wood* Bonaire Id.", mounted on wood with one ?paratype.].

Cyclostoma aurantium (Wood) Wood, 1828 (Refer.), p. 36.

non Cyclostoma aurantium Anton, 1839, p. 54 [teste Pfeiffer, 1846 (Nachtr.), p. 82].

Cyclostoma aurantiacum Sowerby I, 1843, p. 103, tab. 24 fig. 46—47; Pfeiffer, 1846 (Rev.), p. 33.

non Cyclostoma aurantiacum Deshayes, 1834, Voyage Indes-Orient. Bélanger, Zool., p. 416, tab. 1 fig. 16—17.

non Cyclostoma aurantiacum (Schumacher) Pfeiffer, 1848 (Conch. Cab.), p. 31.

Cyclostoma versicolor Pfeiffer, 1846 (Rev.), p. 33 [Substituted for C. *aurantiacum* on account of *Annularia aurantiaca* Schumacher, 1817.]; Pfeiffer, 1848 (Conch. Cab.), p. 65, tab. 9 fig. 13—14; Hanley, 1854—58, fig. 51—52; Reeve, 1860. p. 198.

Cyclostoma carneum Pfeiffer, 1848 (Conch. Cab.), p. 65, tab. 9 fig. 11—12.

Cistula versicolor (Pfeiffer) Gray, 1850, p. 58; Adams et Adams, 1856, p. 294.

Tudora versicolor (Pfeiffer) Pfeiffer, 1852 (Consp.), p. 38; Pfeiffer, 1852 (Monogr.), p. 244; Mörch, 1852, p. 40 [Antilles]; Pfeiffer, 1858, p. 126; Bland, 1869, p. 192 [First Bonaire record.]; Pätel et Schaufuss, 1869, p. 96; Pätel, 1873, p. 122; Pfeiffer, 1876, p. 184; Pätel, 1889, p. 473; Kobelt, 1880, p. 257.

Tudora versicolor var. *carneum*, Pfeiffer, 1852 (Consp.), p. 39.

Tudora aurantiaca (Wood) Smith, 1898, p. 113, 116; Hartert, 1902, p. 295; Vernhout, 1914, p. 180, 185.

Tudora aurantia, Schepman, 1915, p. 480; Baker, 1924, (p. 45...) p. 111... [Classification, Variation, Distribution]; Werner, 1925, p. 552; Hummelinck, 1940, p. 93, tab. 16b; Hummelinck, 1940 (Zoogeogr.), p. 116, 117, 120, 123.

Tudora aurantia aurantia, Baker, 1924, p. 45..., tab. 12 fig. A [Variation].
Tudora aurantia wassauensis Baker, 1924, p. 48..., fig. 28, tab. 12 fig. B, [Bonaire, Klein Bonaire; Variation].
Cyclostoma megachile Pot. et Mich., Pijpers, 1933, p. 45.

Shell conical or slightly conoidal, often somewhat acuminate, altitude *2—2,2*—2,5 times minor-diameter, (20—) *16,6—15,3—14,5* (—11) by (9—) *7,4—6,9—6,5* (—5) mm (excluding the apical-whorls, which in adult specimens are usually lacking), narrowly or rather narrowly perforated, usually solid, mostly cancellated or, less often, reticulated. Average males (alt. *13* mm) distinctly smaller than the females (alt. *16* mm), measurements of sexes slightly intergrading. Whorls 8½—8, of which *7½—5,9*—5 are usually retained, slightly compressed in transversal direction, in cross-section subovate or subcircular; apical-whorls often more slowly increasing than the later ones. The first 2—3 whorls, forming an acuminate cone, usually lacking in adult specimens; the later ones, forming a more or less acute cone with an apical-angle of (40—) *32—31—30* (—25)°, gradually increasing as far as the last part of the body-whorl, which generally widens more rapidly and is somewhat ascending at the peristome. Suture distinct, rather deeply or deeply impressed, not channelled. Umbilical-channel gradually increasing, ½—1 mm wide, narrowing in the ultimate whorl. Aperture vertical or nearly vertical, subovate or subcircular, somewhat angular at the apex, somewhat flattened at the parietal side, with long-axis at about 20° to that of the shell. Peristome continuous; margin usually rather thick, slightly or not undulated, sometimes with a rather marked palatal sinus, gradually expanded in palatal and basal portions, very short in columellar region; parietal angle produced. Sculpture of last whorl usually a combination of numerous vertical or somewhat reclined growth-riblets and several spiral-ridges. Growth-riblets closely or more widely spaced, 2—6 per 1 mm, low, broadly-rounded or more laterally compressed and somewhat angular, they may be broader or, more often than not, narrower than their interspaces. In young whorls the growth-riblets often form small sutural buttresses at their summit. Spiral-ridges about 30—40 per whorl, usually very narrow and small, much narrower than their interspaces, only in umbilical region generally broad and flattened and often broader than their interspaces; they are often weakly developed or practically absent, in the umbilical region however, they are usually more prominent than the surmounting growth-sculpture. Operculum about 3—3½ whorls, subovate, angular at the apex; nucleus very markedly eccentric. Calcareous-plate rather thick, only fragmentary present on the initial whorls, smaller than the chondroic-plate, outer-margin of the whorls usually somewhat corroded. Outer-surface rather distinctly concave but with the last half-whorl quite markedly convex along a line more or less parallel to the palatal side; inner-surface distinctly concave. Colour often quite a complicated mixture of pink, brown and yellow, rather often with a varying number of spiral-bands which may be broken, more rarely with more or less irregular vertical flammulations. The brightest colours and the most marked designs occur, as a rule, in thin or young shells and in male individuals. Ground-colour usually greyish, pinkish or yellowish, to dull or rather vivid brown, blue or orange; occasionally very dark specimens occur, more often almost colourless specimens are to be found, which sometimes have a somewhat bleached appear-

ance. Apex occasionally much darker or differently coloured. Sculpture usually whitish or white-tipped. Spiral-bands clearly visible, obscure or mostly lacking, 1—4 or more, varying in width, either continuous or broken into elongated or rounded blotches, sharply defined or diffuse, usually brown. Blotches of broken spiral-bands often arranged in vertical rows, tending to unite into more or less distinct vertical bands. Aperture internally orange, yellowish or whitish; as a rule showing the spiral-bands. Peristome white. Operculum whitish or yellowish.

Bonaire: Almost everywhere on limestone, abundant in favourable localities; often occurring in more or less wooded places in the region of the porfirite and the diabase. Subfossil or fossil specimens of quaternary age have been found in pockets of phosphate and limestone beds. Klein Bonaire: Practically everywhere, abundant in favourable localities; on limestone. Also fossil.

A terrestrial or subarboreal species, which usually aestivates buried under rocks and in crevices, often climbing the moistened trunks and larger branches of trees and shrubs.

Material of Tudora aurantia — arranged according to the classification of H. B. Baker — with notes on the distribution and occurrence of the different forms (abundant, a; common, c; often, o).

1a From South and North-east Bonaire; spiral-ridges, in outer-columellar region, mostly obscure or rather obscure, often rather distinct or distinctly marked ... *T. aur. aurantia* [type-locality: unknown, probably Kralendijk, Bonaire = near St. 186 and 185A].

St. 181, c, often with very weakly developed sculpture, more rarely nearly smooth (f. *desculpta*); St. 184, a, often with well-developed sculpture; St. 184A, a, id.; St. 185A, c, sometimes with rather marked spiral-sculpture; St. 186, c, id.; Lima, fossil; St. 187, c, often with marked spiral-ridges; Porta Spanjó, c, sometimes with rather marked spiral-ridges.

1b From North-west Bonaire and Klein Bonaire; spiral-ridges, in outer-columellar region, mostly distinctly or rather distinctly marked, often rather obscure or obscure ... *T. aur. wassauensis* Baker [type-locality: Seroe Wassau near Goto].

St. 190, o, sometimes with rather marked spiral-ridges; St. 195, a, often with distinctly marked spiral-sculpture; St. 196, a, id.; St. 197, o, often with distinctly marked spiral-ridges; St. 199, a, often with rather distinctly or distinctly marked spiral-sculpture; St. 199A, a, id.; Klein Bonaire, fossil.

Tudora maculata H. B. Baker, 1924

Tudora maculata Baker, 1924 (Naut.), p. 92 [Bonaire]; Baker, 1924, p. 42..., fig. 22—24, 40; Hummelinck, 1940, p. 93, tab. 16b; Hummelinck, 1940 (Zoogeogr.), p. 116, 120, 123.

TABLE 8.

Variation in *Tudora rupis*.

Altitude of shell, in mm	*T. rupis grandiensis* (with some *muskusi*) from Stat. 226.											*T. rupis muskusi* from Stat. 242.										
	Minimum-diameter of shell, in mm									Totals	Mean diam.	Minimum-diameter of shell, in mm									Totals	Mean diam.
	4	4½	5	5½	6	6½	7	7½	8			4	4½	5	5½	6	6½	7	7½	8		
9										—	—										—	—
9½		1		males						1	4.5										—	—
10		4	1							5	4.6				males						—	—
10½		1	3							4	4.9										—	—
11		1	6							7	4.9			7	2	1					10	5.2
11½			10							10	5.0			6	3						9	5.2
12			3	2						5	5.2			3	5						8	5.3
12½			1	1						2	5.3				2						2	5.5
13				1						1	5.5				1						1	5.5
13½						1				1	6.5						1	1			2	6.8
14						2	1			3	6.7						1	3			4	6.9
14½						5	1			6	6.6						1	6			7	6.9
15						8	9			17	6.8						1	11	4		16	7.1
15½					1	3	16			20	6.9							8	3		11	7.1
16						6	27	2		35	7.0							6	2		8	7.1
16½							14	7		21	7.2							2			2	7.0
17							8	5		13	7.2										—	—
17½							2	3		5	7.3							females			—	—
18				females			2	1		3	7.2										—	—
18½									1	1	8.0										—	—
Totals	—	7	24	4	1	25	80	18	1	160	*6.9*	—	—	16	13	1	4	37	9	—	80	*6.4*
Mean alt.	—	10.1	11.3	12.4	15.5	15.1	16.0	16.8	18.5	*14.9*		—	—	11.4	11.9	11.0	14.3	15.1	15.4	—	*13.8*	

Shell conical, somewhat acuminate, altitude 2,2—*2,4*—2,6 times minor-diameter, 10—*8,2*—7 by 4—*3,4*—3 mm (excluding the apical-whorls, which in adult specimens are usually lacking), rather narrowly perforated, rather fragile, cancellated. Average males somewhat smaller than females, measurements of sexes intergrading. Whorls 7—6½, of which 4½—*4,1*—4 are usually retained, not or nearly not compressed in transversal direction, in cross-section circular or subcircular; apical-whorls often more slowly increasing than the later ones. The first 2½—3 whorls, forming an acuminate cone, usually lacking in adult specimens; the later ones, forming an acute cone with an apical-angle of 25—*18*—15°, gradually increasing. Suture distinct, very deeply impressed, not channelled. Umbilical-channel gradually increasing, ¼—½ mm wide, narrowing in the ultimate whorl. Aperture vertical or nearly vertical, circular or subcircular, with long-axis, at about 15—20° to that of the shell. Peristome continuous; margin usually slightly thickened, straight, not expanded. Last half-whorl descending, slightly tangential, often somewhat constricted, soluted for 1½—2½ mm. Sculpture of last whorl consists of vertical or somewhat reclined growth-riblets, sometimes with several weak spiral-ridges. Growth-riblets rather closely or more widely spaced, 6—10 per 1 mm, low and rounded, sometimes higher and more laterally compressed, they are much narrower than their interspaces. The higher growth-riblets are often crested near their summit; they are closely crowded together near the peristome. Spiral-ridges very weakly developed or absent, 4—12 or more, widely spaced, very fine threadlets which sometimes crenulate the growth-riblets; not especially prominent in the umbilical-region. Operculum about 4—4½ whorls, almost circular; nucleus very slightly eccentric. Calcareous-plate rather thick, only fragmentary present on the intitial whorls, somewhat larger than the chondroic-plate. Outer-surface slightly or rather distinctly convex; inner-surface rather distinctly concave. Colour light-brown to rather dark-brown or yellowish-brown, with several broken, darkly-coloured spiral-bands. Spiral-bands usually clearly visible, 4—8 or more, somewhat varying in width, generally broken into elongated, rounded or somewhat angular blotches, sharply defined or diffuse, usually dark-brown. Blotches of broken spiral-bands arranged in vertical rows, often tending to unite into more or less distinct vertical bands. Aperture internally not or lightly coloured. Operculum light-brownish.

Bonaire: Often occurring in the more or less wooded parts of the limestone region; only found on limestone. Klein Bonaire: Rather often occurring; on limestone.

A terrestrial species, which usually aestivates buried under rocks and in crevices.

Material of Tudora maculata.

Bonaire: St. 184, often; St. 187, often; St. 190, common; St. 190A, common; St. 191, common; St. 194, often.
Klein Bonaire: St. 199, often.

In order to obtain some statistical idea of the amount and the character of variation in *Tudora megacheilos, T. rupis, T. aurantia* and *T. maculata,* data were taken from a representative series of shell from nearly all localities. In tables 4, 6 and 9 the number of the retained whorls, the altitude, the minimum-

TABLE 9.

Measurements in *Tudora aurantia*.

STATION:	Nrs. coll.:	Nrs. meas.:	Whorls retained:	Altitude, in mm:	Minimum diameter, in mm:	Apical-angle, in degrees:
181 Zuidpunt	40	40	6,3 (7 —6)	16,2 (20 —17—15—13)	7,4 (9 —6)	31 (30—40)
184 Lima	150	120	5,9 (7 —5½)	15,2 (18 —17—13—11)	7,1 (9 —5)	32 (25—40)
184A Lima	60	40	5,9 (7 —5½)	15,5 (19 —17—13—11)	7,1 (9 —5)	31 (30—35)
185A Baca	50	40	5,9 (6½—5)	14,5 (18 —15—13—11)	6,6 (8½—5)	31 (30—35)
186 Deenterra	10	10	6,1 (6½—6)	15,1 (18 — 12)	7,2 (8½—5½)	31 (30—35)
187 Spelonk	20	20	5,8 (6½—5)	14,6 (17½—15—12—11½)	6,6 (8 —5)	30 (25—35)
195 Boca Onima	110	50	5,8 (6½—5)	14,8 (17½—16—12—11)	6,7 (8½—5)	31 (30—35)
196 Boca Onima	180	120	5,8 (6½—5)	14,6 (19 —16—12—11)	6,5 (8 —5)	31 (30—35)
197 *Brandaris*	50	50	6,1 (7 —5½)	16,6 (19 —17—12—12)	7,2 (8½—5)	30 (25—35)
199 Klein Bonaire	20	20	5,9 (6 —5½)	15,8 (19 —16—12—12)	7,3 (8½—6)	32 (30—40)
199A Klein Bonaire	50	30	5,9 (7½—5½)	15,0 (17½—17—13—11)	6,7 (8 —5)	30 (30—35)
11 Populations	740	540	*5,9* (7½—5)	*15,3* (20 —*16*—*13*—11)	*6,9* (9 —5)	*31* (25—40)

TABLE 10.

Variation in *Tudora aurantia*.

Altitude of shell, in mm	from Stat. 184.											from Stat. 196.										
	Minimum-diameter of shell, in mm									Totals	Mean diam.	Minimum-diameter of shell, in mm									Totals	Mean diam.
	5	5½	6	6½	7	7½	8	8½	9			5	5½	6	6½	7	7½	8	8½	9		
11	1	2	males							3	5.3	6		males							6	5.0
11½		1								1	5.5	5	6								11	5.3
12		3	4							7	5.8	9	4								13	5.2
12½		2	7							9	5.9		5	2							7	5.6
13			5	2						7	6.1	1	4	2							7	5.6
13½			6	3						9	6.2		1	1							2	5.7
14			1	5	2					8	6.6			1	1						2	6.2
14½				1	1					2	6.7				1	1	1				3	7.0
15					1	3				4	7.4					7	1				8	7.1
15½					1	4	1			6	7.5					8	1				9	7.1
16					1	12	3			16	7.6			1		12	3	1			17	7.1
16½					1	4	5	1		11	7.8					3	6	3			12	7.5
17						4	13	1	1	19	8.0					1	11	4			16	7.6
17½						2	8		1	11	8.0						1	2			3	7.8
18					1		2	4		7	8.1							3			3	8.0
18½										—	—										—	—
19						females				—	—					females		1			1	8.0
Totals	1	8	23	11	8	29	32	6	2	120	*7.1*	21	20	7	2	32	24	14	—	—	120	*6.5*
Mean alt.	11.0	11.8	12.8	13.7	15.4	16.1	17.0	17.6	17.3	*15.2*		11.6	12.2	13.5	14.2	15.7	16.5	17.3	—	—	*14.6*	

diameter and the apical-angle are listed. The stations which are printed in ordinary type, are situated on limestone or on other soil with scattered debris of limestone; stations printed in italics, are deprived of any limestone within a hundred meters or more; where only the station-number has been printed in italics, this indicates a locality not situated on calcareous soil, but limestone may be found within a distance of twenty to eighty meters.

The measurements in *Tudora*, which were more extensively studied in six localities (cf. Table 5), did not show any unusual mutual relation (cf. Table 7—8, 10).

Hybrids of species have only been observed between *T. megacheilos megacheilos* and *T. rupis muskusi* — cf. Hummelinck, 1940, p. 93.

In *Tudora* the direct influence of the environment is obscure. In certain cases we observe, that, within comparable units, there exists an inverse proportion between the size and the thickness of the shell and the richness of the habitat; in other cases however, there is no question about such a relation. It is only clear, that a certain richness of the habitats vegetation, and perhaps also too a non-calcareous soil, generally induce a comparatively thin shell. The chief types of shell-sculpture and the most striking differences in shell-form are certainly not of an ecological nature.

Conspicuous cases of individual variation may be indicated as *forma*. We could, in this manner, distinguish the various specimens with reduced sculpture as *T. megacheilos megacheilos* f. *desculpta* H. B. Baker, *T. rupis rupis* f. *newportensis* H. B. Baker, *T. rupis grandiensis* f. *bullenensis* H. B. Baker and *T. aurantia* f. *desculpta* nov.

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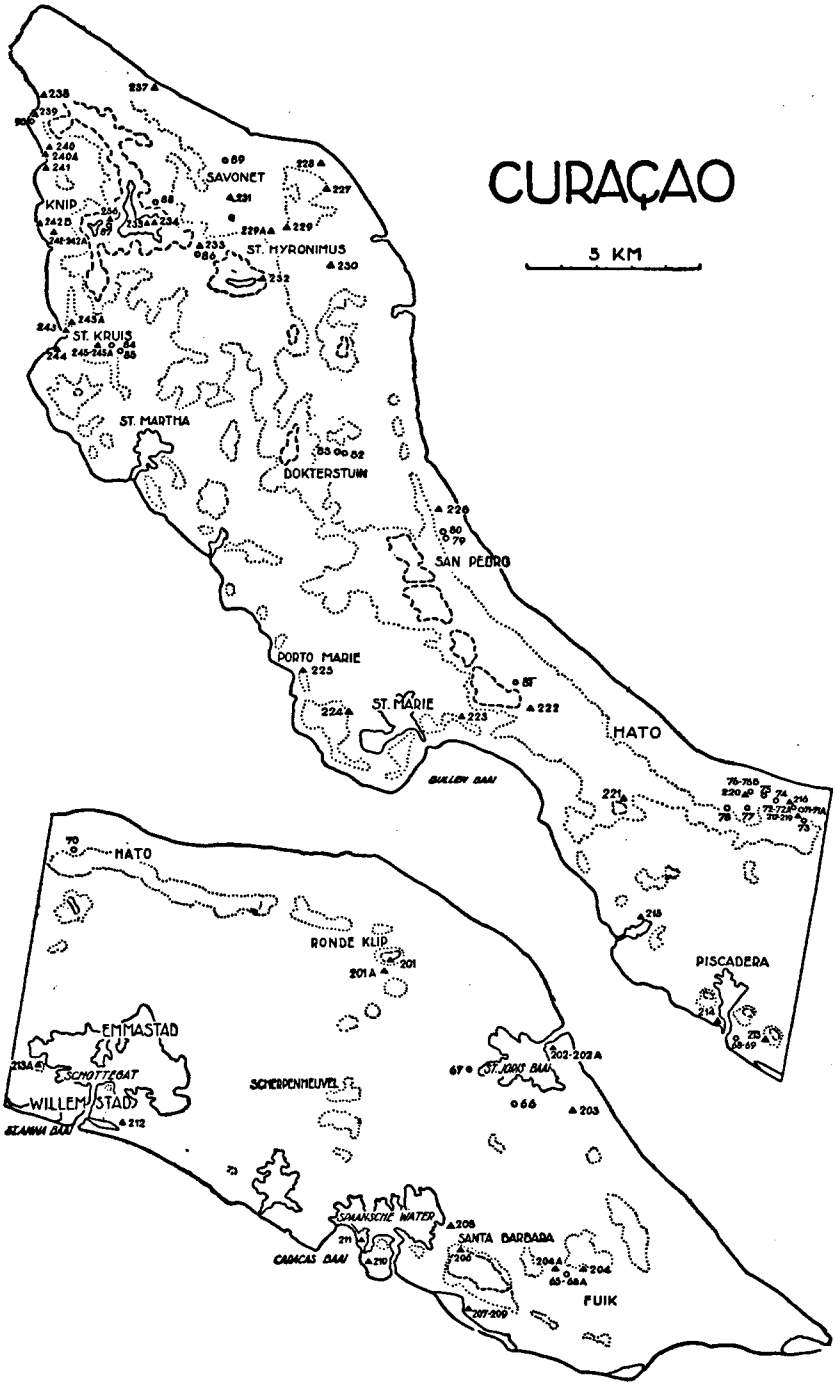

Fig. 8. Curaçao; with stations, contour intervals of 50, 100 and 200 m.

Fig. 9. Aruba; with stations, contour intervals of 50, 100 and 150 m.

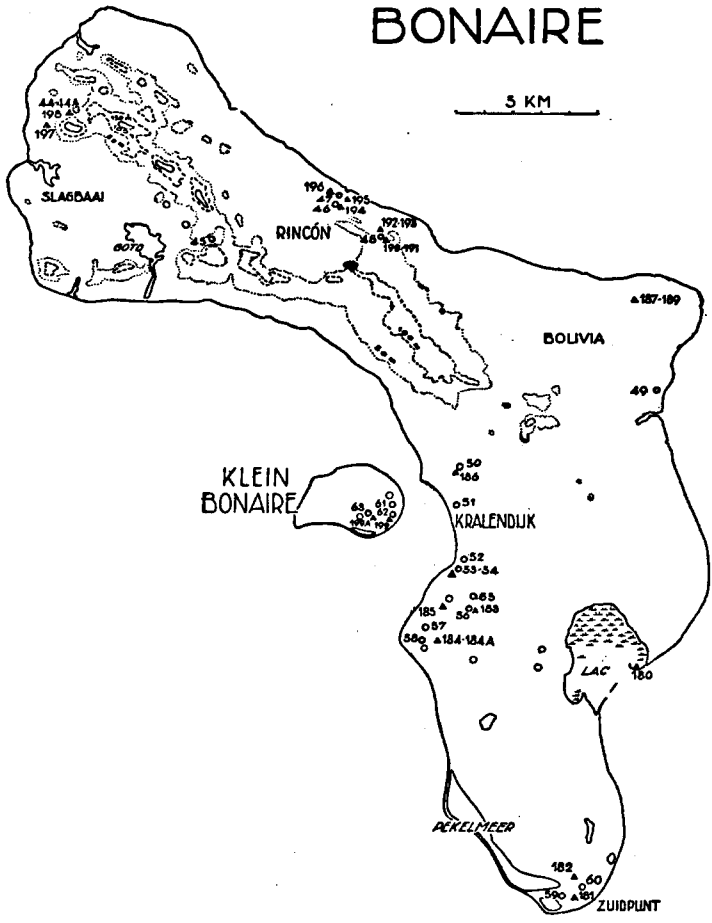

Fig. 10. Bonaire; with stations, contour intervals of 50, 100 and 150 m.