

Studies on western Atlantic Octocorallia (Coelenterata: Anthozoa). Part 1: The genus *Chrysogorgia* Duchassaing & Michelotti, 1864

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Abstract.—The nine species of *Chrysogorgia* known from the western Atlantic are described and illustrated. One species is described as new (*C. herdendorfi*), three species are synonymized (*C. orientalis*, *C. affinis*, *C. elisabethae*), and two species are elevated in rank from variety to species (*C. multiflora* and *C. thyriformis*). Lectotypes are chosen for six of the species and a neotype for one, *C. desbonni*, the type species of the genus. A type species is also designated for the genus *Dasygorgia*, a junior synonym of *Chrysogorgia*. An identification key to the nine species is given, as well as a list of the 59 currently recognized species in the genus, along with their type locality, depth of capture, and branching sequence. The study was based on newly reported specimens from over 150 deep-water stations as well as re-examination of all historical material; additional records of *C. squamata* and *C. spiculosa* represent the first reports of these species since their original description in 1883.

Species of the genus *Chrysogorgia* are reputed to be among the most interesting and beautiful of the gorgonians (Agassiz 1888; Verrill 1883), their golden, iridescent branches and mathematically precise branching pattern making them truly elegant organisms. They occur exclusively in deep water (100–3375 m) and are found worldwide except off Antarctica. Members of this genus are extremely diverse in colony form and sclerite complement, the 59 recognized species (Table 1) representing the most speciose of the calcaxonian genera. The western Atlantic *Chrysogorgia* were reviewed by Verrill (1883) and Deichmann (1936); however, significant collections made after 1936 and improved methods of study have made a faunistic revision of this genus desirable. Indeed, the discovery of one such undescribed “golden corals” from the gold-carrying wreck of the S.S. *Central America* was the original motivation for this paper.

Materials and Methods

This study was based on an examination of previously unreported specimens collected from 157 stations within the western Atlantic (Table 2), most collected after Deichmann’s (1936) classic revision of the western Atlantic Octocorallia. These specimens are deposited primarily at the USNM and MCZ, the USNM material originating primarily from the prodigious collecting of the Rosenstiel School of Marine and Atmospheric Science, University of Miami in the 1970’s. Historically important specimens, including the types for all species discussed, were also examined; these specimens are deposited at the MCZ, USNM, and BM.

The terminology used for the descriptions follows Bayer, Grasshoff & Verseveldt (1983), whereas general methodology of specimen examination can be found in Bayer (1961) and Alderslade (1998). Synonymies for all species are purported to be

Table 1.—The 59 valid species of the genus *Chrysogorgia*, arranged by group, and within group by branching sequence and then date of description. Species from Western Atlantic in bold face. Type localities and depths also included.

Group A: "Spiculosae" (rods and/or spindles in body wall and tentacles)		
<i>C. cupressa</i> (Wright and Studer, 1889)	(Banda Sea, 256 m)	1/4L
<i>C. lata</i> Versluys, 1902	(Celebes Sea, 1901 m)	1/4L
<i>C. terasticha</i> Versluys, 1902	(Banda Sea, 204 m)	1/4L
<i>C. pusilla</i> Versluys, 1902	(Timor Sea, 520 m)	1/4L
<i>C. dispersa</i> Kükenthal, 1908	(Japan, depth?)	1/4L
<i>C. pyramidalis</i> Kükenthal, 1908	(Japan, "upper abyssal")	1/4L
= <i>C. aurea</i> Kinoshita, 1913		
<i>C. rotunda</i> Kinoshita, 1913	(Japan, 732 m)	1/4L
<i>C. papillosa</i> Kinoshita, 1913	(Japan, 730 m)	1/4L
<i>C. minuta</i> Kinoshita, 1913	(Japan, 146 m)	1/4L
<i>C. okinosensis</i> Kinoshita, 1913	(Japan, 366 m)	1/4L
<i>C. comans</i> Kinoshita, 1913	(Japan, 146 m)	1/4L
<i>C. sphaerica</i> Aurivillius, 1931	(Japan, 183–732 m)	1/4L
<i>C. desbonni</i> Duch. & Mich., 1864	(Lesser Antilles, 161 m)	2/5R (biflabellate)
= <i>C. occidentalis</i> Versluys, 1902		
<i>C. spiculosa</i> (Verrill, 1883)	(Lesser Antilles, 991 m)	2/5R
<i>C. elegans</i> (Verrill, 1883)	(Barbados, 433 m)	2/5R
= <i>C. affinis</i> Versluys, 1902		
<i>C. fewkesii</i> Verrill, 1883	(Lesser Antilles, 1048 m)	2/5R
<i>C. flexilis typica</i>	(Southern Chile, 220 m)	2/5R
(Wright & Studer, 1889)		
<i>C. flexilis</i> var. <i>africana</i> Kükenthal, 1908	(East Africa, "upper abyssal")	2/5R
<i>C. flexilis</i> var. <i>maldivensis</i>	(Maldive Ids., 229–914 m)	2/5R
Hickson, 1940		
<i>C. pentasticha</i> Versluys, 1902	(Timor Sea, 520 m)	2/5R
<i>C. anastomosans</i> Versluys, 1902	(Indonesia, 520–827 m)	2/5R
<i>C. arborescens</i> Nutting, 1908	(Hawaii, 722–914 m)	2/5R
<i>C. debilis</i> Kükenthal, 1908	(Japan, depth?)	2/5R
<i>C. quadruplex</i> Thomson, 1927	(Azores, 1022 m)	2/5R
<i>C. multiflora</i> Deichmann, 1936	(Lesser Antilles, 991 m)	2/5R
<i>C. thyriformis</i> Deichmann, 1936	(Barbados, 183 m)	2/5R
= <i>C. elisabethae</i> Bayer, 1951		
<i>C. herdendorfi</i> , n. sp	(off S. Carolina, 2178 m)	2/5R–3/8R
<i>C. pellucida</i> Kükenthal, 1908	(Japan, 100 m)	dichotomous
<i>C. squarrosa</i> (Wright & Studer, 1889)	(Philippines, 914 m)	irreg.
<i>C. orientalis</i> Versluys, 1902	(Indonesia, 918–924 m)	irreg.
<i>C. mixta</i> Versluys, 1902	(Celebes, 1165–1264 m)	irreg.
<i>C. indica</i> Thomson & Henderson, 1906	(Sri Lanka, 1038 m)	irreg.
<i>C. irregularis</i>	(Sri Lanka, 1271 m)	irreg. (1/3)
Thomson & Henderson, 1906		
<i>C. dichotoma</i>	(Bay of Bengal, 165 m)	irreg. (L)
Thomson & Henderson, 1906		
Group B: "Squamosae aberrantes" (rods and/or spindles in tentacles but not in body wall)		
<i>C. flavescens</i> Nutting, 1908	(Hawaii, 1688–1977 m)	1/3L
<i>C. expansa</i> (Wright & Studer, 1889)	(Kermadec Ids., 951 m)	1/4R
<i>C. octogonos</i> Versluys, 1902	(Timor Sea, 520 m)	1/4R
<i>C. versluysi</i> Kinoshita, 1913	(Japan, 732 m)	1/4R
<i>C. calypso</i> Bayer & Stefani, 1988	(Celebes, 732 m)	1/4R
<i>C. intermedia</i> Versluys, 1902	(Timor Sea, 250 m)	1/4R–1/7R
<i>C. squamata</i> (Verrill, 1883)	(Lesser Antilles, 431 m)	1/5R–1/7R
<i>C. bracteata</i> Bayer & Stefani, 1988	(Philippines, 329 m)	1/6R
<i>C. admete</i> Bayer & Stefani, 1988	(New Caledonia, 390 m)	1/7R

Table 1.—Continued.

<i>C. agassizii</i> (Verrill, 1883)	(Georges Bank., 2271 m)	2/5R
<i>C. curvata</i> Versluys, 1902	(Indonesia, 1089 m)	biflabellate
<i>C. chryseis</i> Bayer & Stefani, 1988	(Ceram Sea, 732 m)	biflabellate
<i>C. stellata</i> Nutting, 1908	(Hawaii, 649–678 m)	multiflabellate
Group C: "Squamosae typicae" (rods and/or spindles not present; only scales)		
<i>C. axillaris</i> (Wright & Studer, 1889)	(Phil./Kerm., 150, 1097 m)	1/3L
<i>C. geniculata</i> (Wright & Studer, 1889)	(Philippines, 150–187 m)	1/3L
<i>C. fruticosa</i> (Studer, 1894)	(Gulf of Panama, 837 m)	1/3L
<i>C. rigida</i> Versluys, 1902	(Philippines, 522 m)	1/3L
<i>C. sibogae</i> Versluys, 1902	(Banda Sea, 204 m)	1/3L
<i>C. excavata</i> Kükenthal, 1908	(Japan, "abyssal")	1/3L
<i>C. delicata</i> Nutting, 1908	(Hawaii, 536–1463 m)	1/3L
<i>C. cavea</i> Kinoshita, 1913	(Japan, 640–752 m)	1/3L
<i>C. ramosa</i> Versluys, 1902	(Philippines, 522 m)	1/4L
<i>C. acanthella</i> (Wright & Studer, 1889)	(Kermadec, 1097 m)	2/5L
<i>C. pendula</i> Versluys, 1902	(Banda Sea, 1595 m)	2/5L
<i>C. campanula</i> Madsen, 1944	(Iceland, 2448 m)	2/5L
<i>C. electra</i> Bayer & Stefani, 1988	(Paumotu Ids., 1485 m)	flabellate
<i>C. scintillans</i> Bayer & Stefani, 1988	(Hawaii, 1758–1937 m)	flabellate
<i>C. japonica</i> (Wright & Studer, 1889)	(Japan, 3375 m)	unknown

complete, including every reference to the species discussed. In the material examined sections for each species, the station number is followed by the number of specimens in that lot and then the catalog number. The SEM photomicrographs were taken by the author using an AMRAY 1810 scanning electron microscope.

The following abbreviations are used: Vessels: *Alb*—U. S. Fish Commission Steamer *Albatross*; *Atl*—*Atlantis* and *R/V Atlantis II*; *BL*—U. S. Coast Survey Steamer *Blake*; *CI*—*R/V Columbus Iselin*; *G*—*R/V Gerda*; *Gos*—*R/V Gosnold*; *GS*—*R/V Gilliss*; *O*—*M/V, R/V Oregon* and *R/V Oregon II*; *P*—*R/V Pillsbury*; *SB*—*M/V, R/V Silver Bay*.

Museums: *BM*—The Natural History Museum (London); *MBD BR*—Blake Ridge Expedition of the Museum of Biological Diversity (The Ohio State University, Columbus); *MCZ*—Museum of Comparative Zoology, Harvard (Cambridge); *USNM*—United States National Museum (now known as the National Museum of Natural History), Washington D. C.

Subclass Octocorallia

Order Alcyonacea

Suborder Calcaxonia Grasshoff, 1999

Family Chrysogorgiidae Verrill, 1883

Chrysogorgiidae Verrill, 1883: 21.—Nutting, 1908: 587.

Chrysogorgiidae Versluys, 1902: 2–4.—Kükenthal, 1919: 486–496 (key to genera); 1924: 38 (key to genera).—Deichmann, 1936: 220–222 (key to genera).—Hickson, 1940: 306–307.—Madsen, 1944: 44.—Bayer, 1949: 237–238; 1956: F216; 1961: 297–299 (key to genera); 1973: 84–86; 1974: 262–263.—Bayer & Muzik, 1976: 67–69 (key to genera).—Bayer, 1979: 876–878 (key to genera).—Bayer & Stefani, 1988: 257–259 (key to genera).—Williams, 1992a: 379; 1992b: 251.

Dasygorgiidae Studer, 1887: 39.—Wright & Studer, 1889: xxxix, 1.

Dasygorgiidae Hickson, 1904: 221.—Thomson & Henderson, 1906: 26.

Malacogorgiidae Hickson, 1904: 226.

Diagnosis.—Calcaxonians having an unjointed, solid (non-spicular), concentrically

Table 2.—Station list.

Station	Latitude (°N)	Longitude (°W)	Depth (m)	Date
<i>U.S.F.C.S. Albatross (Alb)</i>				
2034	39 27 10	69 56 20	2462	17 VII 1883
2035	39 26 16	70 02 37	2491	17 VII 1883
2129	19 56 04	75 48 55	501	27 II 1884
2220	39 43 30	69 23 00	1928	23 VIII 1884
2342	23 10 39	82 20 21	368	19 I 1885
2347	23 10 39	82 20 21	395	20 I 1885
2397	28 42 00	86 36 00	512	14 III 1885
2415	30 44 00	79 26 00	805	1 IV 1885
2573	40 34 18	66 09 00	3186	2 IX 1885
2655	27 22 00	78 07 30	618	2 V 1886
2751	16 54 00	63 12 00	1257	28 XI 1887
4151	Vicinity of Bird Id., Hawaii		572-1593	5 VIII 1902
5080	34 10 30	138 40 E	923	19 X 1906
<i>Atlantis and R/V Atlantis II (Atl)</i>				
266-40	30 53	78 47		
2980 B	22 48	78 48	402-412	10 III 1938
2999	23 10	81 29	265-421	17 III 1938
3306	23 04 30	82 37	604	23 III 1938
3326	22 09	81 09	485	4 IV 1939
3436	22 12	81 11 30	365-439	6 IV 1939
3437	23 05	79 32	476	2 V 1939
3438	23 05 30	79 37	485	2 V 1939
3479	23 10	81 26 30	384	11 V 1939
3480	23 10	81 28	366	11 V 1939
<i>U.S.C.S.S. Bibb</i>				
22	24 14 00	80 59 40	79	6 V 1868
<i>U.S.C.S.S. Blake (BL)</i>				
44	25 33	84 35	986	1877
55	22 09	82 21	443	1877
101	off Morro Light, Cuba		320-457	1878
190	15 18 12	61 26 32W	199	29 I 1879
195	14 42 35	61 13 15	917	5 II 1879
	14 31 55	61 07 28	863	7 II 1879

Table 2.—Continued.

Station	Latitude (°N)	Longitude (°W)	Depth (m)	Date
26549	27 17 30	79 12 30	370	30 II 1975
31281	26 53 54	79 07 18	320	III 1977
<i>R/V Easward</i>				
128	23 49	81 37	1390-1463	20 VI 1963
129	23 46	81 15	1280	20 VI 1963
130	23 59	81 10	1021	21 VI 1963
168	27 00	79 15 30	229-274	29 VI 1963
190	25 57	78 07	732-896	4 VII 1963
232	25 36	79 20 30	421-439	29 I 1964
233	25 40	79 21	402-421	30 I 1964
235	25 44	79 22	530	30 I 1964
246	26 57	79 12 30	512	5 II 1964
368	24 03	81 10	960-1015	15 IX 1964
369	24 03	81 10	960-1015	15 IX 1964
370	23 54	81 19	1280	16 IX 1964
371	23 53	81 22	1262	16 IX 1964
372	23 51	81 02	1107	16 IX 1964
387	27 17	79 15	412	19 IX 1964
391	27 20	79 12	46-91	19 IX 1964
403	27 49	78 50	823	20 IX 1964
503	26 31	78 51	366	4 II 1965
678	25 57	78 13	540-576	20 VII 1965
679	25 56	78 09	594-710	20 VII 1965
692	26 35	78 25	329-421	21 VII 1965
705	26 29	78 41	362-393	22 VII 1965
798	25 56	79 22	402	12 IX 1966
859	23 54	81 57	1161-1200	29 VIII 1967
889	20 55	86 28	177-220	10 IX 1967
893	21 10	86 21	241-320	10 IX 1967
897	20 59	86 24	210-293	10 IX 1967
898	21 04	86 19		10 IX 1967
899	20 57	86 34	40-165	10 IX 1967
925	25 58	78 29	439-457	29 IX 1967
927	26 15	78 48	476	29 IX 1967
<i>R/V Gerda (G)</i>				

Table 2.—Continued.

Station	Latitude (°N)	Longitude (°W)	Depth (m)	Date
936	26 35	79 20	603	1 X 1967
965	23 45	81 49	1394-1399	1 II 1968
1010	23 34	79 35	296-329	14 VI 1968
1111	23 51 54	80 42 42	1080-1089	30 IV 1969
1112	23 44	81 14	1245-1291	30 IV 1969
1125	26 45	79 05	494-531	13 VI 1969
1312	26 38 24	79 02 30	505-527	31 III 1971
1314	26 52 24	79 11 48	531-540	31 III 1971
134	N. Atlantic Ocean			5 V 1976
2385	30 57 12	78 54 36	779	27 VIII 1965
2387	28 17 36	86 14 48	603-640	16 IV 1984
2429	28 06 00	86 35 18	1170	18 IV 1984
S36	28 57 53	87 33 40	716-1852	VI 2000
MA2:04	38 45 48	72 39 06	2110-2180	2 VIII 1984
58-I-827	Between Rhode Id. and Bermuda			
489	27 44	85 09	565	29 IX 1951
548	27 01 24	96 16 48	366-512	18 IV 1952
549	26 58 30	96 06 42	229	18 IV 1952
2081	01 52	46 54	320	17 XI 1957
2636	17 36	63 32	439-476	30 IX 1959
2655	18 26	67 10 30	229	06 X 1959
4413	11 53	69 25	640	03 X 1963
4701	27 42	90 32 30	915	22 II 1964
4729	27 46	92 13	549	26 II 1964
4811	24 01	96 33	1829	11 IV 1964
4812	24 03	96 24	1646	11 IV 1964
4940	20 30	86 14	311-329	12 VI 1964
5021	11 21 12	60 38 42	165-183	21 IX 1964

R/V Gilliss (GS)

R/V Gosnold (Gos)

Cyre

R/V Knorr

M/V, R/V Oregon and Oregon II (O)

Table 2.—Continued.

Station	Latitude (°N)	Longitude (°W)	Depth (m)	Date
5419	20 50	73 29	311-329	25 V 1965
10849	20 50	73 23	311	13 XII 1969
10878	28 54	87 29	1829	16 I 1970
<i>R/V Pillsbury (P)</i>				
200	27 30	79 10	329-348	11 VIII 1964
208	27 12	79 17	512	12 VIII 1964
209	26 59	79 16	330-450	12 VIII 1964
391	10 03	76 29	1235-1768	16 VII 1966
394	9 28 42	76 26 18	421-641	16 VII 1966
478	11 34 24	62 10 42	586-608	2 VIII 1966
594	21 00 30	86 23	307-329	15 III 1968
607	18 30	87 37	715-787	15 III 1968
610	17 02 00	87 38 16	296-329	18 III 1968
611	16 50	87 37	750-990	18 III 1968
689	08 14 00	57 38	1372-1445	15 VII 1968
739	10 54 42	66 17 48	234-280	22 VII 1968
776	12 13 18	72 50 00	408-576	29 VII 1968
781	11 30 06	73 26 30	530-567	30 VII 1968
784	11 26 30	74 10	567-713	31 VII 1968
847	11 37 18	60 59 24	733-1281	2 VII 1969
848	11 22 00	61 26 24	146	2 VII 1969
850	11 45 30	61 29 30	798-985	3 VII 1969
857	12 23 30	61 21 36	9-348	3 VII 1969
877	13 16 42	61 05 36	389-467	6 VII 1969
881	13 20 48	61 02 30	576-842	6 VII 1969
890	14 05 36	60 51 24	198-430	7 VII 1969
892	14 17	60 45 12	1116-1354	7 VII 1969
904	13 45 30	61 05 42	201-589	9 VII 1969
907	14 26 48	60 58 18	115-214	9 VII 1969
919	16 05 18	61 19 18	689-733	12 VII 1969
931	15 31 12	61 12 18	146-494	15 VII 1969
984	18 26 24	63 12 36	393-451	22 VII 1969
988	18 29 18	63 24 36	686-724	23 VII 1969
991	18 47	64 46 48	205-380	23 VII 1969
1141	20 52	73 14	403-488	13 I 1970

Table 2.—Continued.

Station	Latitude (°N)	Longitude (°W)	Depth (m)	Date
1262	17 21 24	77 34 48	805-1089	15 VII 1970
1410	20 11 00	68 52 54	180	17 VII 1971
440	27 21 N	79 15	439-503	8 VI 1958
3497	20 53	73 44	265	4 XI 1961

MV, R/V Silver Bay (SB)

layered scleroproteinous axis. The axis of stem and branches may be branched or unbranched, arising from a root-like or discoidal, strongly calcified holdfast. The axial layers are not undulated and the axial surface is smooth (not longitudinally grooved); the axis usually displays metallic or iridescent reflections. Polyps contractile but not retractile, arranged in rows, never in whorls or on opposite sides of branch. Sclerites predominantly flat, smooth scales and plates, in some species accompanied by warty rods or spindles. Scales show concentric bands of interference colors in polarized light.

Remarks.—The Chrysogorgiidae is one of five families placed in the newly created suborder Calcaxonia (Grasshoff 1999). Previously placed in the suborder Holaxonia, these families differ in having an axis that does not have a cross-chambered, hollow central core, but rather a solid axis containing abundant calcareous material that is embedded in gorgonin or as purely calcareous segments. The taxonomic history of the family is integrated into the generic account.

Subfamily Chrysogorgiinae Verrill, 1883

Chrysogorginae Studer, 1887: 41.—Wright & Studer, 1889: xl, 4.

Chrysogorgiinae Versluys, 1902: 4, 17.—Nutting, 1908: 588.—Madsen, 1944: 49.—Bayer, 1956: F216.

Diagnosis.—Chrysogorgiids having branching colonies.

Remarks.—Two other subfamilies are currently recognized: the Lepidogorgiidae, for species having unbranched colonies and uniseriably arranged polyps, and the Chalcogorgiinae, for species having unbranched colonies and polyps arranged bi- or multiserially. However, over the last several decades, subfamilial classification has rarely been used.

Genus *Chrysorgia* Duchassaing & Michelotti, 1864

Chrysorgia Duchassaing & Michelotti, 1864: 13 (107).—Verrill, 1883: 21.—Stu-

der, 1887: 41.—Wright & Studer, 1889: xli, 23.—Versluys, 1902: 17–33.—Nutting, 1908: 588.—Kükenthal, 1919: 505–511 (key to species); 1924: 388–390 (key to species).—Deichmann, 1936: 227–228 (key to w. Atlantic species).—Hickson, 1940: 307.—Madsen, 1944: 49.—Bayer, 1956: F216.—Bayer & Stefani, 1988: 259 (key to species of “Squamosae aberrantes”).—Williams, 1992b: 252.

Dasygorgia Verrill, 1883: 21.—Studer, 1887: 41.—Wright & Studer, 1889: xli, 6–9, 278.

Diagnosis.—Sympodially branched chrysogorgiids, the branches subdividing dichotomously, either arising from a regular single, ascending spiral around the main stem or forming two parallel fans above a short main stem. Polyps large relative to branches on which they sit, few in number, and well separated from one another. Sclerites consist of spindles, rods and scales. Axis with a brilliant metallic luster, usually amber, yellow or golden in color.

Discussion.—Verrill (1883) established the family Chrysogorgiidae for three genera: *Chrysogorgia*, *Dasygorgia*, and *Iridogorgia*. He distinguished *Dasygorgia* from *Chrysogorgia* mainly by its longitudinal arrangement of sclerites in the body wall, *Chrysogorgia* having transversely and often curved sclerites. He included five newly described species in *Dasygorgia* but did not designate a type species. Thus, the first species described by Verrill, *D. agassizii*, is herein designated the type of that genus. In that paper Verrill (1883) described a majority of the chrysogorgiid species now known from the western Atlantic. Shortly thereafter, Studer (1887) unnecessarily rechristened the family Dasygorgiidae, arguing that the type species of *Chrysogorgia*, *C. desbonni*, could not be correctly identified. He also divided the family into two subfamilies, the Chrysogorginae containing all genera having branched colonies and thus including *Chrysogorgia*. Two years later, Wright & Studer (1889) informally suggested two groupings among the species of

Dasygorgia: the “Spiculosae” (species having spindles and/or rods) and the “Squamosae” (species having predominantly scale-like sclerites).

Based on the chrysogorgiids collected on the *Siboga* expedition, Versluys (1902) essentially monographed the genus *Chrysogorgia*, describing or redescribing the 36 species known at that time and presenting a lengthy and thorough discussion of the morphology of the species in this genus. He convincingly demonstrated that *Dasygorgia* was a junior synonym of *Chrysogorgia*, making Dasygorgiidae subordinate to Chrysogorgiidae. He adopted the species groupings suggested by Wright & Studer (1889), added a third group with intermediate characteristics, and formalized the diagnoses on these groupings. Thus, the “Spiculosae” (also called Group A) contained species having rods and/or spindles in both the body wall and tentacles, the “Squamosae typicae” (also called Group C) contained species having sclerites in the form of scales in both body wall and tentacles, and Versluys’ new grouping, the “Squamosae aberrantes” (also called Group B), contained species having scales in the body wall, but rods and/or spindles in the tentacles. Versluys further subdivided each of these groupings into two to four subgroups based on the branching sequence of each species. Although Kükenthal (1919, 1924) used the characteristics of these subgroupings in his species key, no author has ever suggested that the three major groupings or nine subgroupings be used as the basis for subgeneric taxa. Other significant works concerning the taxonomy of the species of *Chrysogorgia* include: Kinoshita (1913), a review of the Japanese species; Deichmann (1936), a review of the western Atlantic species; Madsen (1944), the *Ingolf* specimens from off Iceland; Bayer (1973), ecological remarks; and Bayer & Stefani (1988), new species from the western Pacific.

Type species.—*Chrysogorgia desbonni* Duchassaing & Michelotti, 1864, by monotypy.

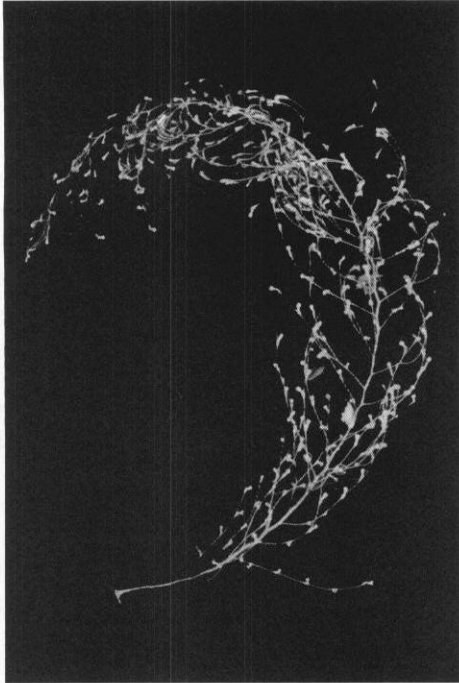


Fig. 1. *Chrysogorgia herdendorfi*, holotype, USNM 91934, height 20 cm.

Type species of *Dasygorgia*: *D. agassizii* Verrill, 1883, here designated.

Chrysogorgia herdendorfi, new species
Figs. 1–2

Description.—The holotype is 20 cm in height and about 3 cm in width, the colony being of a bottlebrush shape. Colonies are attached to the substrate by a roughly circular, thin, encrusting (not rhizoidal) holdfast 5–10 mm in diameter, the holdfast being milky white in color. The main stem just above the holdfast is circular in cross section, 0.9–1.1 mm in diameter, and of a metallic golden-brown luster. The main stem ascends in a tight, counterclockwise spiral (producing a zig-zag pattern), giving off branches in a regular manner in a predominantly 2/5R sequence; however, in parts of the colony a 3/8R sequence appears to hold. The lowest branch of the holotype occurs 16 mm above the holdfast, whereas the lowest branch of the paratype is at 60

mm height, but bears scars of broken branches as low as 30 mm. Branches occur approximately every 2.5–3.0 mm along the main stem, the distance between aligned branches (defined as the “orthostiche interval” by Versluys 1902) in the 2/5R sequence being 14–17 mm. The lowermost branches are often unbranched, up to 32 mm in length, and bear up to 6 polyps. The branches of the mid-portion of the colony usually have only one node, the first internode 6–7 mm in length, the terminal twigs up to 35 mm, producing a total branch length of about 42 mm. One polyp occurs on the first internode at or within 0.5 mm of the node, and 4–6 polyps occur on the terminal twigs. Branches toward the top of the colony usually have two nodes, the first internode about 4 mm in length, the second 6–7 mm, and the terminal twigs up to 30 mm, also producing a total branch length of about 42 mm. There is usually one polyp on the first and second internodes adjacent to the nodes, and 4–5 polyps on the terminal twigs. Branches near the growing tip of the colony also usually have two nodes, but the terminal twigs are shorter (about 10 mm), thus result in shorter branches. Hence, most branches of the colony are of the same total length, i.e., 40–45 mm, regardless of the number of internodes present or the location of the branch, except for those near the developing tip, which are shorter. No branches containing three internodes were noted. The branches arise at gradually increasing angles from the base upward, the lowest branches about 45° from the vertical, those toward the top of the colony 60–70° from the vertical. Branch internodes adjacent to the main stem are quite slender, about 0.08 mm in diameter; distal twig branch diameters are even smaller, about 0.04 mm. These slender branches produce a very flexible limp structure to the colony, such that when a colony is removed from fluid the branches will coalesce with one another. Corresponding internodes and terminal twigs of the same branch are of the same lengths. There is no anastomosis.

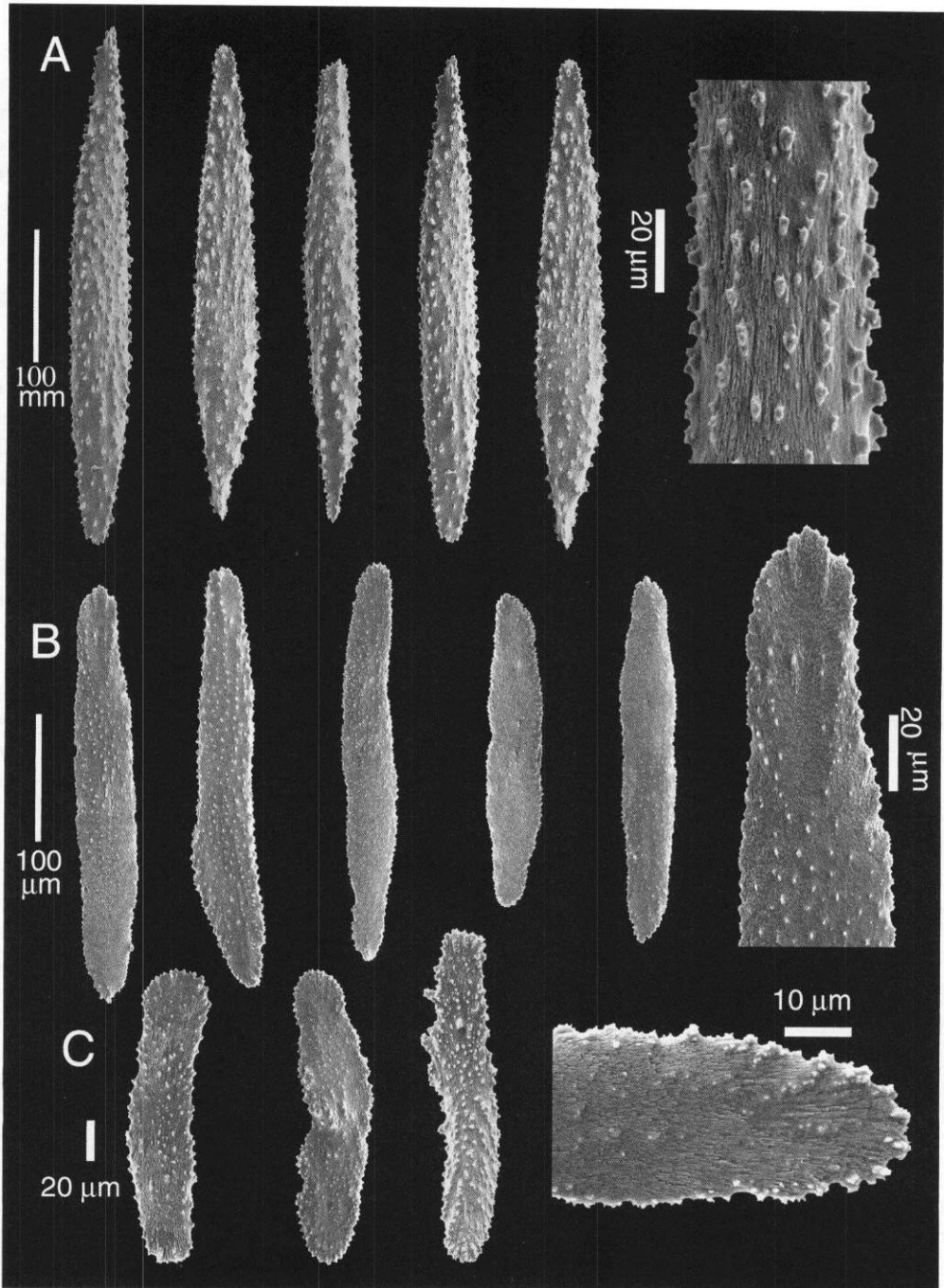


Fig. 2. *Chrysogorgia herdendorfi*, sclerites from holotype, USNM 91934. A, six spindles from body wall and tentacles; B, six coenenchymal scales; C, four pinnular scales.

The polyps are elongate, up to 2.3 mm in height and 0.6 mm in width, slightly constricted at mid-level, and diverge at an oblique angle to the branch. The thin coenenchyme covering both the main stem and branches contains straight, elongate scales that are usually blunt at each end, up to 0.43 mm in length and 0.06–0.07 mm in width. These scales have finely serrated edges and bear very small granules (1.8–2.5 μm diameter) on their faces. Toward the base of the polyps and continuing up the body wall the scales gradually change into longitudinally oriented, straight spindles of virtually the same size; the spindles are pointed at both ends and bear small compound warts, the warts 4–8 μm in diameter. Thus the body wall consists of both elongate scales and spindles of similar size and shape. The lower, backs of the tentacles also contain robust, finely-warted spindles, usually arranged three across a tentacle, up to 0.43 mm in length and 0.11 mm in width. The pinnules contain small, irregularly-rectangular scales, most about 0.15–0.20 mm in length. They have finely-serrated edges and virtually flat faces that bear very small granules, the largest only 1 μm in diameter.

Discussion.—At first glance, the branching sequence of *C. herdendorfii* appears to be a typical 2/5R, like the morphologically similar *C. elegans*. This branching formula, a shorthand notation developed by Versluys (1902), implies that five branches originate from the main stem in two counterclockwise revolutions up the main stem (i.e., counterclockwise, as viewed from the apex of the colony; and as moving to the “right”, as viewed for the side of the colony), such that every sixth branch will lie directly above the first, forming five rows of branches along the main stem. However, the branch correspondence was often found to be slightly off after two revolutions up the stem. But when branch origins were traced for three revolutions around the main stem, an exact correspondence was discovered, such that the branch sequence would appear to be 3/8R. This implies that there

are eight longitudinal rows of branches from the main stem, but that three revolutions of branch origins must occur before a branch (the 9th) lies directly above the first. The angular separation between adjacent branches is thus 135°, instead of 144°, the latter being typical of the 2/5 sequence. This is believed to be the first example of a chrysogorgiid branching sequence that requires three revolutions to achieve alignment.

Although two specimens are unquestionably assigned to this species, both from the wreck of the *Central America*, five *Chrysogorgia* colonies were collected from that site. Two of the other three specimens (USNM 91935 and BR127) are identical to *C. herdendorfii* in all characters described above, except that their body wall sclerites are longitudinally arranged, elongate scales, much like those in the lower body wall of *C. herdendorfii*, but never graduating to the spindle shape characteristic of the upper body wall of *C. herdendorfii*. This may represent variation in sclerite form, or a closely-related undescribed species, but, because of the paucity of specimens available and the uncertainty in interpreting this character, they are presented here as a non-type variety of *C. herdendorfii*. The fifth specimen (BR234) is even more perplexing in that it has sclerites similar to *C. herdendorfii* but it is a larger colony (36 cm height) with more nodes (0-2-5) and longer, flabellate branches. It may well represent an undescribed species and is probably the species most often figured *in situ* by Herdendorf, et al. (1995: 93–94, 111, 189, figs. 62–64, 66–67, 71–72, 83, 85, 89, 93–95, 99, 105, 109, 113 (also back cover), 128–129, 147), figure 89 being the actual specimen collected (BR234). But, until additional specimens are collected and examined, this species will remain undescribed.

Within the western Atlantic, *C. herdendorfii* is most similar to two species: *C. elegans* and *C. agassizii* (see Table 3). But, although similar in colony shape and spiculation, *C. elegans* differs in having a more

Table 3.—Distinguishing characteristics of the nine western Atlantic species of *Chrysoyorgia*.

	Colony shape; maximum height	Branching sequence	Distance between branches; orthostiche interval	Number of inter- nodes; length of 1st internode	Flexibility	Number of polyps on first inter- node	Group	Orientation of bw sclerites	Sclerite complement (coen. = coenochymal; bw = body wall; tent. = tentacular); measurements are maximum	Distribution and depth range in Western Atlantic
<i>C. herdendorfi</i>	bottlebrush; 22 cm	2/5R or 3/8R	2.5–3.0 mm; 14–17 mm	0-1-2; 4-7 mm	limp	1	A	long.	coen.: elongate scales, 0.43 mm bw: straight spindles, 0.43 mm tent.: straight spindles, 0.43 mm	off S. Carolina, 2178 m
<i>C. elegans</i>	bottlebrush; 16 cm	2/5R	1.0–1.5 mm; 7.0–7.5 mm	1-2-3; 6-8 mm	wiry	1	A	long.	coen.: elongate scales, 0.65 mm bw: rotund rods, 0.65 mm tent.: rods, 0.65 mm	Gulf of Mexico, se Caribbean, Brazil, 128–1716 m
<i>C. spiculosa</i>	bottlebrush; 25 cm	2/5R	3.5–4.5 mm; 20–25 mm	3-4-6; 15– 20 mm	wiry	3	A	long.	coen.: elongate scales, 0.60 mm bw: rotund rods, 0.96 mm tent.: rods, 0.54 mm	Gulf of Mexico, Lesser Antilles, 914–2265 m
<i>C. multiflora</i>	bottlebrush; 25 cm	2/5R	1-4 mm; 6– 22 mm	4-5-9; 10– 14 mm	wiry	2-4	A	trans.	coen.: elongate plates, 0.77 mm bw: curved spindles, 1.08/ 0.13	Antilles, Bahamas, 320–1280 m
<i>C. fewkesii</i>	bottlebrush; 23 cm	2/5R	3-6 mm; 17– 20 mm	5-6-10; 10– 12 mm	wiry	2-4	A	trans.	coen.: elongate plates, 0.95 mm bw: curved spindles, 0.71/ 0.06 mm	Antilles, Caribbean, 403–1200 m
<i>C. desbonni</i>	biflabellate; 16 cm	2/5R	0.6–1.0 mm; 5 mm	up to 40; 3-4 mm	wiry	1	A	trans.	coen.: elongate scales, 0.71 mm bw: curved spindles, 0.75 mm	Greater and Lesser Antilles, Bahamas, 155–595 m
<i>C. thyrsoformis</i>	bushy; 8 cm	2/5R	0.5–0.7 mm; 2.7–5.0 mm	up to 12; 5-8 mm	wiry	2-3	A	trans.	coen.: elongate scales, 0.54 mm bw: curved spindles, 0.71 mm tent.: rods, 0.24 mm	Greater and Lesser Antilles, Bahamas, 146–526 m

Table 3.—Continued.

Colony shape; maximum height	Branching sequence	Distance between branches; orthostiche interval	Number of inter- nodes; length of 1st internode	Flexibility	Number of polyps on first inter- node	Group	Orientation of bw sclerites	Sclerite complement (coen. = coenenchymal; bw = body wall; tent. = tentacular); measurements are maximum	Distribution and depth range in Western Atlantic
<i>C. agassizii</i> bottlebrush; 41 cm	2/5R	1.5–2.0 mm; 10–12 mm	2–3–5; 2–4 mm	limp	0	B	long.	coen.: elongate scales, 0.36 mm bw: elongate scales, 0.48 mm tent.: straight rods, 0.60 mm	off Georges Bank 1928–3700 m
<i>C. squamata</i> bottlebrush; 20 cm	1/5R to 1/7R	2.1–3.0 mm; 8.5–12 mm	2–3; 4–8 mm	wiry	0	B	trans.	coen.: scales, 0.45 mm bw: scales, 0.54 mm tent.: rods, 0.42 mm	Antilles, Yucatan, 431–1046 m

petite colony with much more closely spaced branches, a rhizoidal holdfast, a 2/5R branching sequence, branches with predominantly two nodes, relatively short terminal twigs, thicker terminal twigs that produce a wiry (not limp) colony, and larger and more rotund body wall sclerites (rods instead of spindles). Also, *C. elegans* is known only to the south of *C. herdendorfii* and at lesser depths. *C. agassizii* is similar in colony shape and branch flexibility, but differs in having more closely-spaced branches, longer branches with predominantly three nodes, slightly larger tentacular spindles, and the absence of “true spicules” (i.e., spindles or rods) in the body wall. The exclusive presence of flattened scales in the body wall of *C. agassizii*, in fact, places it in the a different subgroup of the genus, the “Squamosae aberrantes”.

Etymology.—This species is named in honor of Charles E. Herdendorf, biological coordinator aboard the R/V *Arctic Discoverer* during its recovery operations of the S.S. *Central America*.

Material examined (Types).—Holotype: USNM 91934, 1 colony, 31°35' N, 77°10' W, (270 km off Charleston, South Carolina), 2178 m, August 1990; Paratype: MBD BR-128, 1 colony, locality as above. Type Locality: wreck of the S.S. *Central America* (collected by the research submersible “Nemo” operated by the R/V *Arctic Discoverer*): 31°35' N, 77°10' W (approx. 270 km off coast of South Carolina), 2178 m.

Distribution.—Known only from the type locality.

Chrysogorgia elegans (Verrill, 1883)
Figs. 3–4

Dasygorgia elegans Verrill, 1883: 23.

Dasygorgia spiculosa Verrill, 1883: 23–24 (in part: BL-44, 1 of 2 specimens; BL-195, 1 of 2 specimens; BL-205, 1 specimen).

Dasygorgia spiculosa: Wright & Studer, 1889: 9–10, pl. 4, fig. 1, pl. 5, fig. 1.

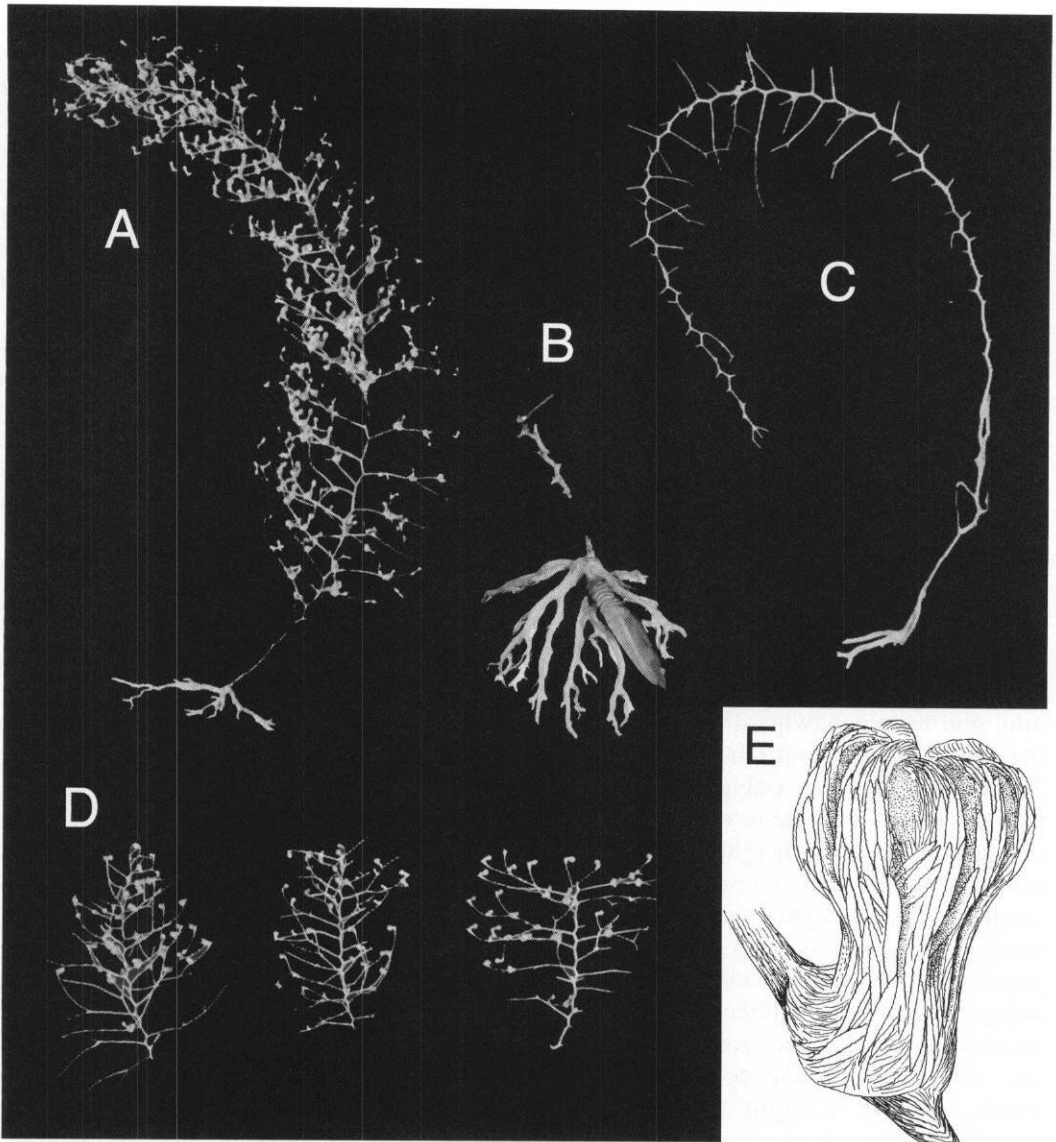


Fig. 3. *Chrysogorgia elegans*. A, colony from O-4812, USNM 52859, 14 cm in height; B, rhizoidal holdfast with attached cirripede, Citation-5505, USNM 89100, height 19 mm; C, lectotype, MCZ 4860, BL-283, 12 cm in height; D, three fragments of holotype of *C. affinis*, BM 89.5.27.5, tallest fragment 33 mm in height; E, line drawing of polyp from lectotype (courtesy of F. M. Bayer), polyp 1 mm in width.

Chrysogorgia affinis Versluys, 1902: 47–48, figs. 64–65.—Kükenthal, 1919: 521; 1924: 396.—Deichmann, 1936: 221–222.—Bayer, 1959: 29. [new synonym]
Chrysogorgia elegans: Versluys, 1902: 61.—not Nutting, 1908: 590.0—Kükenthal, 1919: 533, fig. 234; 1924: 405.—Deichmann, 1936: 231–232, in part: pl. 23, figs. 53–59:

BL-44 (in part), BL-195 (in part), BL-205, BL-283); not pl. 33, fig. 1 (= *C. spiculosa*).—Bayer, 1952: 189; 1954: 280 (listed); 1956: F216, fig. 155, 3a–c, 158,6; 1958: 389, 390 (listed).—?Tixier-Durivault & d'Hondt, 1974: 1409.—Grygier, 1984: 143 (*Oregon-548*).—?Grasshoff, 1986: 25.—Grygier, 1990: 667.

- ?*Chrysogorgia flexilis*: Thomson, 1927: 22.
Chrysogorgia agassizii: Deichmann, 1936:
 in part (pl. 34, figs. 1–2: labeled correctly
 as *D. elegans* in Verrill's unpublished
 plates).
Chrysogorgia sp. Grygier, 1984: 143 (*P*-
 781).

Description.—Colony bottlebrush-shaped, up to 16 cm in height, and possessing a rhizoidal holdfast. Main stem up to 1.1 mm in diameter, golden-brown in luster. Branching sequence consistently 2/5R: branches closely spaced, one every 1.0–1.5 mm; orthostiche interval 0–7.5 mm apart. Distal branch diameter 0.2 mm; branches wiry. Number of nodes per branch ranges from 1–3, but usually 2, producing 4 relatively short (4–6 mm) terminal twigs; some branches have 1 or even 3 nodes, but they are never without at least 1 node. First internode 6–8 mm in length; second, 2–5 mm, and terminal twigs 4–6 mm, producing a total branch length that rarely exceeds 25 mm. Usually one polyp occurs per internode, and 1–3 on the terminal twigs. Polyps up to 2.3 mm in height and 0.8 mm in diameter, the base of the polyps sometimes swollen. Coenenchymal sclerites sparsely warted, slender scales up to 0.65 mm in length and 0.09 mm in width, serrate on the edges. Body wall and tentacular sclerites longitudinally arranged, rotund rods 0.44–0.65 mm in length and up to 0.12 mm in width, usually straight but sometimes slightly curved. Body wall rods evenly warted, each compound wart about 7 μ m in diameter and composed of several smaller elements, each about 1.8 μ m in diameter. Pinnular and distal tentacle sclerites rectangular to medially-constricted scales 0.12–0.20 mm in greater length and 0.0–0.05 mm in width. Their faces are sparsely ornamented and their edges are finely serrate, an apex occurring about every 4.2 μ m.

Discussion.—Nutting (1908) reported *C. elegans* from three Albatross stations in the Hawaiian Islands; however, Kükenthal (1919) and most other authors have doubted

this identification based on the circumstantial evidence of its disparate location. These three specimens, all deposited at the USNM, were examined and confirmed to differ from *C. elegans* in branching pattern and spiculation, the Hawaiian specimens having only irregularly-shaped scales in their body walls, and thus pertaining to a different subgroup of *Chrysogorgia*, the "Squamosae aberrantes".

The holotype of *C. affinis* Versluys, originally described as *D. spiculosa* by Wright & Studer (1889), was based on a specimen 10 cm in length but apparently broken into three fragments by the time Versluys described it, the largest fragment 6 cm in length. The holotype is now in six fragments, the longest segment 44 mm in length. The holotype was examined and found to perfectly match the characteristics of *C. elegans*, and thus it considered to be a junior synonym, as implied by Bayer (1959). *C. affinis* has been reported only from its type locality.

Deichmann (1936) considered *C. affinis* (= *C. elegans*) and *C. spiculosa* to be synonymous; however, these species can be distinguished (see Discussion of *C. spiculosa* and Table 3). Versluys (1902) reaffirmed that distinction by renaming Wright & Studer's (1889) *D. spiculosa* as a new species, *C. affinis* (which is *C. elegans*), distinct from *C. spiculosa*.

Chrysogorgia elegans is reputed to occur in the eastern Atlantic off the Azores, Cape Verde, Bay of Biscay, and off Morocco (Thomson 1927 as *C. flexilis*, Tixier-Durivault & d'Hondt 1974, Grasshoff 1986) at depths of 946–3088 m. None of the specimens on which these reports were based was illustrated or described, nor have I examined them. Given the great depths of capture for some of the specimens and the gross similarity of various Atlantic species, these eastern Atlantic records remain to be confirmed.

Material examined.—Alb-2397, 3, USNM 49741; Atl-3306, 2, MCZ; G-403, 1, USNM 100885; G-1010, 1, USNM

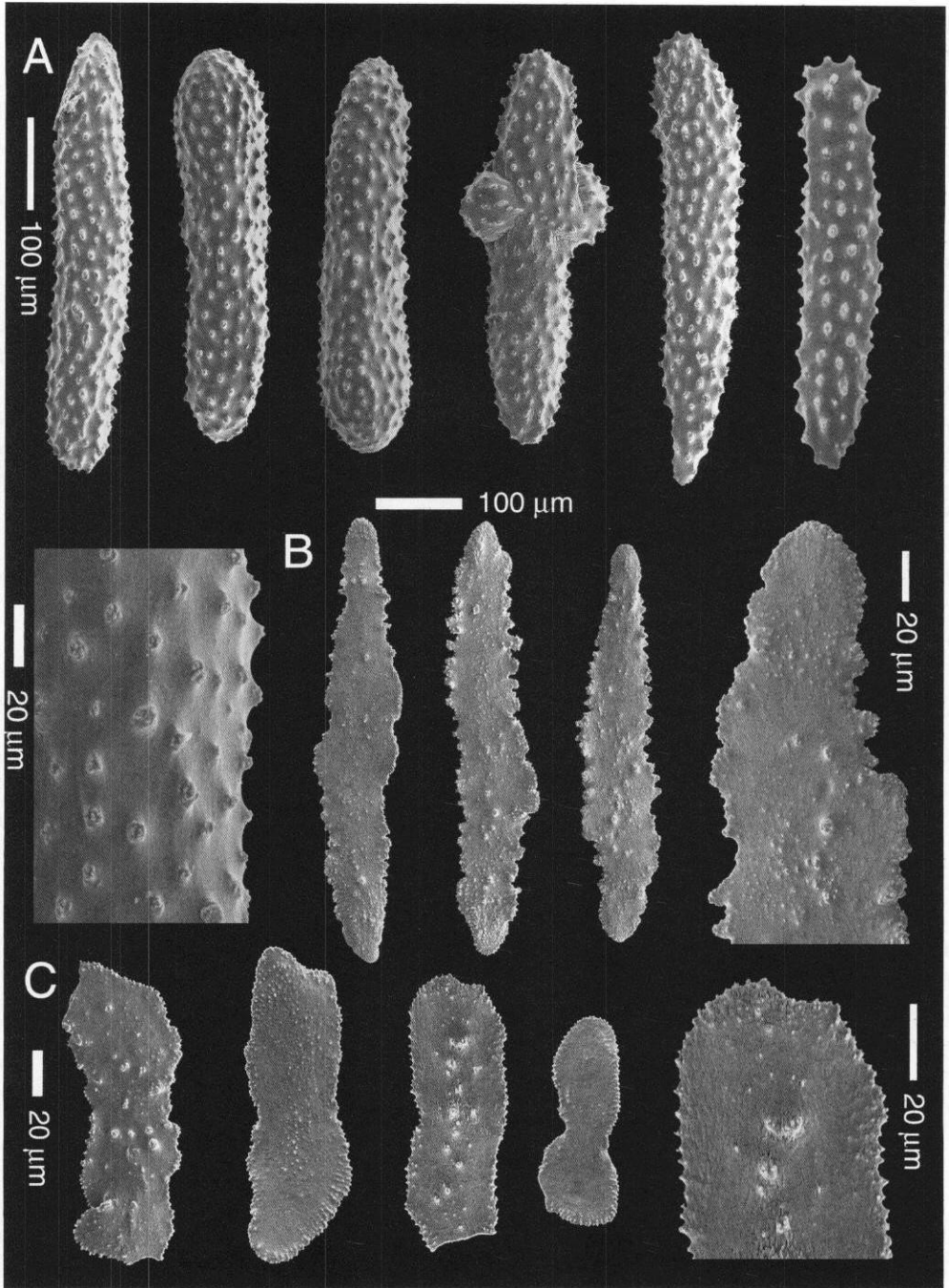


Fig. 4. *Chrysogorgia elegans*, sclerites from P-904, USNM 52865. A, seven rods from body wall; B, four coenenchymal scales; C, five pinnular scales.

100883; *Citation*-4502, over 30, USNM 89090; *Citation*-4504, 1, USNM 89091; *Citation*-4507, 18, USNM 89092; *Citation*-4508, over 100, USNM 89093; *Citation*-4509, over 50, USNM 89094; *Citation*-4510, over 50, USNM 89095; *Citation*-4511, over 50, USNM 89096; *Citation*-4512, 10, USNM 89097; *Citation*-4513, 3, USNM 89098; *Citation*-4514, 1, USNM 89099; *Citation*-5505, 44, USNM 89100; *Gyre*-2387, over 50, USNM 89089; *Gyre*-2429, 3 dry, USNM 89101; *Gyre*-S36, 3, USNM 100729; *O*-489, 5, USNM 49944; *O*-548, 3, USNM 50027, 52866; *O*-549, 8, USNM 50024; *O*-4413, 1, USNM 52860; *O*-4729, 2, USNM 52866; *O*-4812, 1, USNM 52859; *P*-394, 1, USNM 52864; *P*-478, 4, USNM 52863; *P*-776, 10, USNM 100884; *P*-781, 4, USNM 52908 (reported by Grygier, 1984 as *Chrysogorgia* sp.); *P*-784, 1, USNM 55919; *P*-847, 1, USNM 52849; *P*-850, 1, USNM 52861; *P*-881, over 70, USNM 52858; *P*-904, 3, USNM 52865; *P*-919, 1, USNM 52909; *P*-988, 2, USNM 52862; specimens reported by Deichmann (1936); types of *D. elegans* and *C. affinis* (see below).

Types.—Verrill based the species on six specimens (syntypes) collected at three Blake stations: one from *BL*-260 (unknown MCZ catalog number), two from *BL*-283 (MCZ 4860), and three from *BL*-284 (MCZ 4859), made off Grenada and Barbados at depths of 433–636 m. Deichmann (1936) restricted the type locality to *BL*-283, but did not choose a lectotype from among the five (not two) specimens from that station. A lectotype is therefore designated as one of the five syntypes collected at *BL*-283 (MCZ 4860), making the type locality consistent with Deichmann's statement, which is: 13°05'05"N, 59°40'50"W (west coast of Barbados), 433 m. The remaining four specimens from *BL*-283 (MCZ 4860a) and the specimens from *BL*-284 (MCZ 4859) and *BL*-260 are considered to be paralectotypes; however, the specimen from *BL*-260 appears to be lost, and only one of the

three specimens from *BL*-284 could be found.

The holotype of *C. affinis*, now in six pieces (see Discussion), is deposited at The Natural History Museum, London (89.5.27.5) Type locality: *Challenger*-122: 9°05'S, 34°50'W (off Pernambuco, Brazil), 640 m.

Distribution.—Disjunct distribution: northern Gulf of Mexico from Tamaulipas Province, Mexico to off Florida Panhandle; Little Bahama Bank; southeastern Caribbean throughout Lesser Antilles to border of Colombia and Panama; Pernambuco, Brazil; 128–1716 m, although most records between 500–800 m.? Eastern Atlantic; 946–3088 m (see text).

Chrysogorgia spiculosa (Verrill, 1883)

Figs. 5–6

Dasygorgia spiculosa Verrill, 1883 (in part: 1 of 2 specimens from *BL*-44, both specimens from *BL*-190, 1 of 2 specimens from *BL*-195, not *BL*-205, ?*BL*-222, ?*BL*-227), 23–24, pl. 2, fig. 5.—not Wright & Studer, 1889: 9–10 (= *C. affinis/elegans*).
Chrysogorgia sp. Agassiz, 1888: 144, fig. 456.—Bayer, 1973: fig. 18.
Chrysogorgia spiculosa: Versluys, 1902: 53, 60, 61.—not Nutting, 1908: 591.—Kükenthal, 1919: 537, fig. 235; 1924: 407–406.—Bayer & Macintyre, 2001: 342 (minerology).
Chrysogorgia elegans: Deichmann, 1936: 231–232 (in part: pl. 22, fig. 7, pl. 33, fig. 1: *BL*-44 (in part), *BL*-190, *BL*-195 (in part), *BL*-200, and MCZ 4861).

Description.—Colony bottlebrush-shaped (but with rather elongate branches), up to 25 cm in height; rhizoidal holdfast. Main stem up to 1.5 mm in diameter; golden-brown in luster. Branching sequence consistently 2/5R; branches well spaced, one every 3.5–4.5 mm; orthostiche interval 20–25 mm; branches diverge from main stem at 80–90° from the vertical. Terminal twig diameter 0.2 mm, producing a rigid to

wiry colony. Number of nodes per branch 3–6, but usually 4 on a well-developed branch. First internode long (15–20 mm); second through fourth internodes, 10–15 mm; terminal twigs can be much longer, resulting in a total branch length of 70–110 mm. Internodes and terminal twigs of a branch usually oriented in a horizontal plane, sometimes bent slightly downward distally. Three polyps usually present on first internode; 2 or 3 on successive internodes; 2–8 on terminal twigs. Polyps large, up to 3.0 mm in height, oriented perpendicular to branch, and often having a swollen basal region that encircles the stem. Coenenchymal sclerites elongate, slender, pointed scales up to 0.60 mm in length and 0.06 mm in width. Their edges are slightly serrate and their faces sparsely warted. Body wall sclerites primarily rotund rods and sometimes spindles (or rods with one blunt end and the other pointed), the rods straight to slightly bent, and up to 0.96 mm in length and 0.18 mm in diameter. Body wall sclerites bear small compound warts about 18 μm in diameter, each wart consisting of 10–15 smaller elements 3.6–4.2 μm in diameter. Tentacular sclerites also rods and spindles, but usually smaller, only up to 0.54 mm in length. Pinnular sclerites elongate scales about 0.20 mm in length, having serrate edges.

Discussion.—Deichmann (1936) synonymized *C. spiculosa* with *C. elegans*, implying that even Verrill was uncertain about their distinction. In her material examined for *C. elegans*, she listed most (but not all) of the type series of both *C. spiculosa* and *C. elegans*, as well as material from two other stations (see synonymy). Deichmann's confusion was justified, in that Verrill did include two species (*C. elegans* and *C. spiculosa*) in his type series of *C. spiculosa*, both species sometimes even occurring at the same station (see synonymies of respective species). Although *C. spiculosa* is similar to *C. elegans* in branching sequence, flexibility, and geographic distribution, it differs in several significant char-

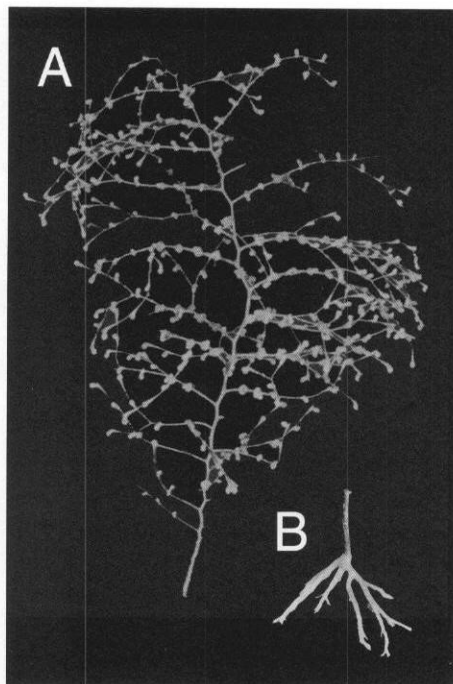


Fig. 5. *Chrysogorgia spiculosa*. A, colony from G-1112, USNM 52854, height 15 cm; B, holdfast from G-130, USNM 52856, height 18 mm.

acters as summarized in Table 3. Specimens of *C. spiculosa* are much more robust, having more widely spaced and longer branches; more nodes per branch; and more polyps per node. Furthermore, the body wall of *C. spiculosa* has much larger rods. Versluys (1902) also noted the difference between these two species by distinguishing his *D. affinis* (= *C. elegans*) from *D. spiculosa*. These are the first additional records of *C. spiculosa* since its original description.

Material examined.—Alb-2751, 1, USNM 44109; G-128, 3, USNM 52850; G-129, 2, USNM 52851; G-130, 14, USNM 52856; G-368, 4 dry, USNM 100875; G-370, 1, USNM 100876; G-371, 1, USNM 52855; G-372, 1 dry, USNM 100873; G-965, 3, USNM 52907; G-1112, 3, USNM 52854; GS-134, 1, USNM 100877; O-4701, 1, USNM 100878; O-4811, 1, USNM 52852; O-10878, 2, USNM 100879; P-391, 1, USNM 52853; misidentified specimen of Nutting (1908), Alb-4151, USNM 25356;

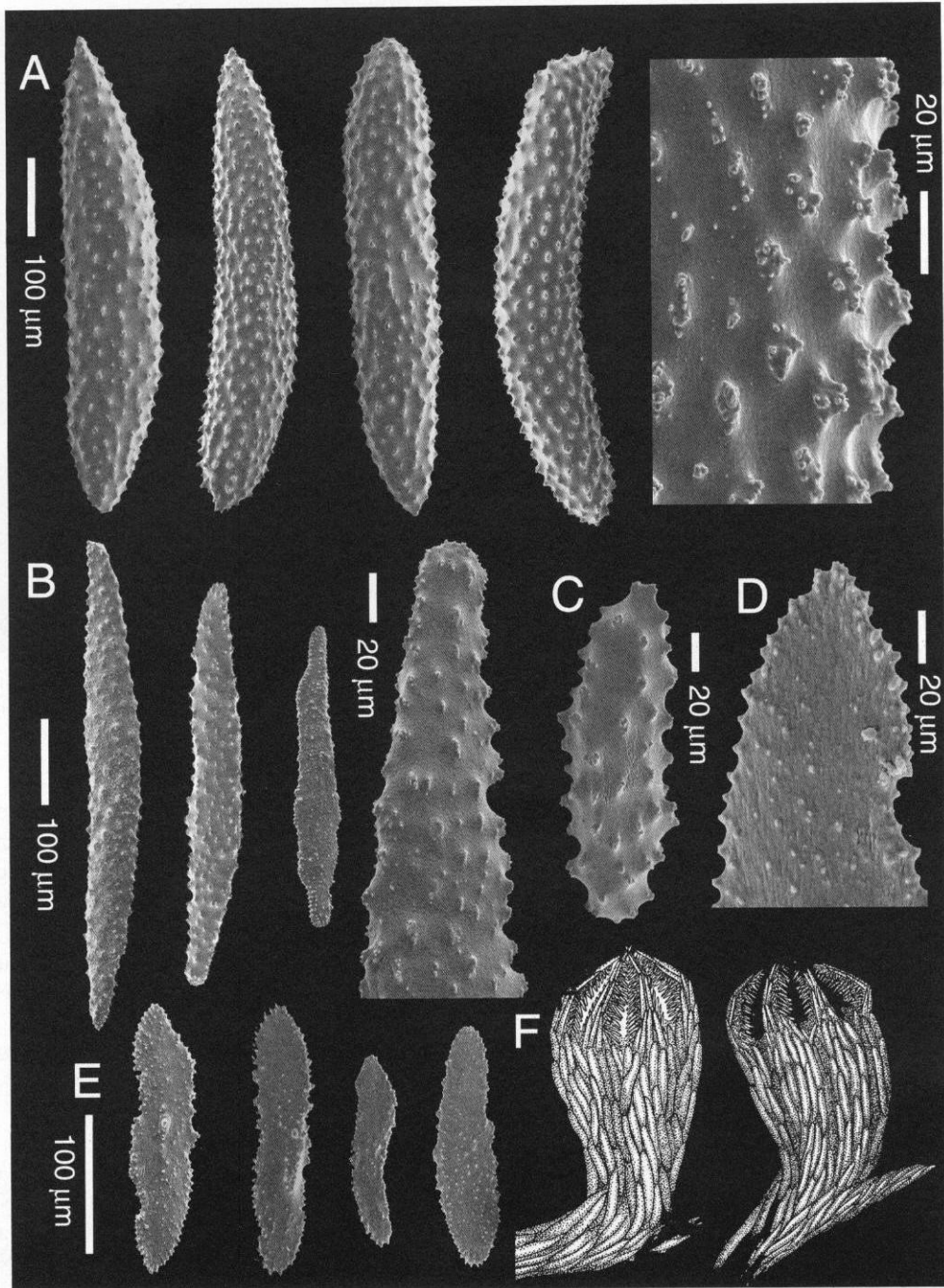


Fig. 6. *Chrysogorgia spiculosa*, sclerites from G-130, USNM 52856. A, five rods from body wall; B, four coenenchymal scales; C, a tentacular rod; D-E, pinnular scales; F, two polyps, width of polyps 1.2–1.3 mm (from Verrill, unpublished plates).

specimens listed by Deichmann (1936); types of *D. spiculosa* (see below).

Types.—Verrill (1883) reported nine specimens plus some fragments from six Blake stations in his original description, all of which must be considered to be syntypes: *BL-44*, 2, MCZ 4855; *BL-190*, 2, MCZ 4856 and 4856a; *BL-195*, 2, MCZ 4857; *BL-205*, 1, MCZ 4859; *BL-222*, 1; and *BL-227*, 1. However, because Verrill included both *C. elegans* and *C. spiculosa* in his syntype series (see synonymies of these two species), a lectotype is chosen from *BL-190* (MCZ 4856), a specimen 5.5 cm tall that is consistent with the more robust species originally envisioned and described by Verrill. The other syntypes thus become paralectotypes; however, the specimens from *BL-222* and *BL-227* could not be found at the MCZ in 2001. Type Locality (as restricted by lectotype): 15°18'12"N, 61°26'32"W (off western Dominica, Lesser Antilles), 991 m.

Distribution.—Disjunct distribution: northern Gulf of Mexico from Tamaulipas Province, Mexico to Havana, Cuba; Lesser Antilles from Dominica to St. Vincent; off Colombia; 914–2265 m.

Chrysogorgia multiflora Deichmann, 1936
new rank
Figs. 7-8

Chrysogorgia fewkesi var. *multiflora* Deichmann, 1936: 231, pl. 22, fig. 6, pl. 23, figs. 51–52.—Bayer, 1959: 27–29, fig. 13a–i.

Description.—Colonies bottlebrush-shaped, but somewhat bushy; colonies up to 25 cm in height. Colony attached by an encrusting holdfast; main stem up to 2.1 mm in diameter, golden-brown in luster. Branching sequence consistently 2/5R; branches well spaced, one every 3.5–4.0 mm; orthostiche interval 20–22 mm; however, some colonies are diminutive (indicated with an asterisk in the Material examined section), having branches separated from one another by only about 1 mm and

an orthostiche interval of 6 mm. Branches usually diverge from main stem at 90–110° from the vertical, thus projecting perpendicular to slightly downward from the direction of growth, and often giving a false impression of the top and bottom of the colony, especially if the holdfast is missing. Branches gently curve upward after the first several internodes; fusion of branches occasionally occurs. First internode robust (up to 1.3 mm in diameter), whereas terminal twigs are quite delicate (0.1 mm in diameter), but altogether producing a robust, wiry colony. Number of nodes per branch up to nine, although usually only 5 or 6, the first internode being 10–14 mm in length, subsequent internodes 5–6 mm in length, and terminal twigs of variable lengths, resulting in branches up to 90 mm in length. Internodes and terminal twigs not arranged in a plane but as a bush. Two to 4 polyps usually present on first internode; 1 or 2 on all successive internodes; and a variable number on the terminal twig, depending on length. Polyps small, up to 1.5 mm in height. Coenenchymal sclerites of main stem elongate, flattened plates, up to 0.65 mm in length and 0.06 mm in width, bearing prominent, compound warts up to 24 m in diameter. Coenenchymal sclerites of branches also flattened plates, but usually more elongate (up to 0.77 mm), with pointed ends and less prominent warts. Lower body wall sclerites obliquely arranged; upper body wall sclerites transversely arranged. Most body wall sclerites curved spindles, the curvature corresponding to the circumference of the polyp wall, the largest spindles up to 1.08 mm in length and 0.07–0.13 mm in width, although smaller spindles are interspersed. Body wall spindles sparsely covered with compound warts up to 9 μm in diameter. Tentacular sclerites longitudinally arranged, curved spindles, but usually shorter (up to 0.86 mm). Pinular sclerites finely granular, often medially-constricted, rectangular scales up to 0.20 mm in length.

Discussion.—Grasshoff (1981) legiti-

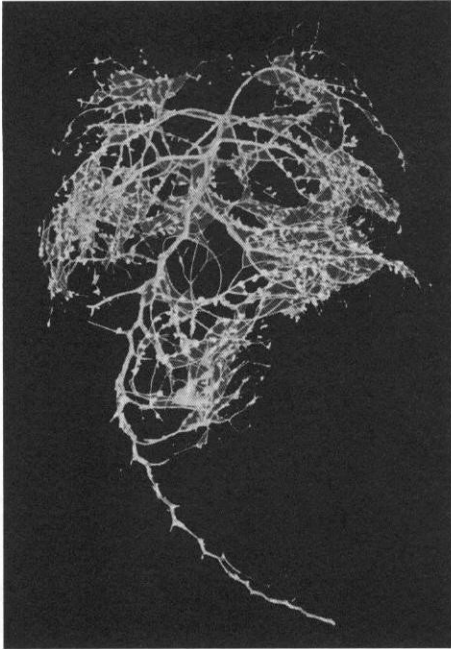


Fig. 7. *Chrysogorgia multiflora*, colony from G-859, USNM 52846, height 20 cm.

mized and elevated the distinction of variety *multiflora* by synonymizing it with *C. quadruplex* Thompson, 1927, a species heretofore known only from the eastern Atlantic (Azores, Bay of Biscay, Atlantis Seamount, Celtic Sea; 507–2682 m) Examination of the types of *C. fewkesii* and variety *multiflora* show small but consistent differences (see Discussion of *C. fewkesii*). The synonymy of *C. multiflora* with *C. quadruplex* may be correct but I have not verified it. Until this is proven, I choose to recognize Deichmann's western Atlantic variety *multiflora* as a distinct species, but only marginally different from *C. fewkesii* (see "Discussion" of *C. fewkesii* and Table 3 for their distinctions). The records reported herein are the first from the western Atlantic since its original description.

Material examined.—*Alb-2415, 3, USNM 44128 and 52841; *Atl-266-40, 1, USNM 100880; CI-15, 1, USNM 100881; CI-46, 1, USNM 100882; G-130, 4, USNM 52847; *G-403, 1, USNM 52839; G-859, 2, USNM 52846; G-1111, 3, USNM 52842;

*Gos-2385, 1, USNM 56896; O-2081, 4, USNM 50907 (reported by Bayer, 1959); *O-2636, 1, USNM 51579; P-892, 2, USNM 52844; Waldo Schmitt station 65-32, off Dry Tortugas, 1064 m, USNM 50094; specimens reported by Bayer (1959); types of *C. fewkesii multiflora* (see below).

Types.—Deichmann alluded to "some" specimens of *C. fewkesii* var. *multiflora* from Blake-190, which are considered as syntypes (MCZ 4854). These specimens consist of several small, poorly-preserved branches, not including any complete colonies. Type locality: 15°18'12"N, 61°26'32"W (off southwestern Dominica, Lesser Antilles), 991 m.

Distribution.—Disjunct distribution: off mouth of Amazon River, Brazil; Lesser Antilles (St. Christopher to St. Lucia), Straits of Florida, and Tongue of the Ocean, Bahamas; 320–1280 m.

Chrysogorgia fewkesii Verrill, 1883

Figs. 9–10

Chrysogorgia Desbonni: Pourtalès, 1868: 131–132.

Chrysogorgia Fewkesii Verrill, 1883: 26.

Chrysogorgia fewkesii: Wright & Studer, 1889: 24.

Chrysogorgia fewkesii: Versluys, 1902: 55–56.—Kükenthal, 1919: 533–534; 1924: 405.—?Thomson, 1927: 21–22, pl. 1, figs. 6–7.—Deichmann, 1936: 222, 230–231, pl. 23, figs. 41–50.—Tixier-Durivault & d'Hondt, 1974: 1409.

Description.—Colonies bottlebrush-shaped, but bushy; colonies up to 22.5 cm in height. Nature of holdfast unknown; basal branch diameter up to 2.9 mm. Branching sequence consistently 2/5R; branches well spaced, one every 3–6 mm; orthostiche interval 17–20 mm. Branches diverge from main stem at 100–110° from the vertical, thus projecting slightly downward at first. First internode robust; terminal twigs quite narrow, altogether producing a wiry colony. Number of nodes per branch usually 5–7,

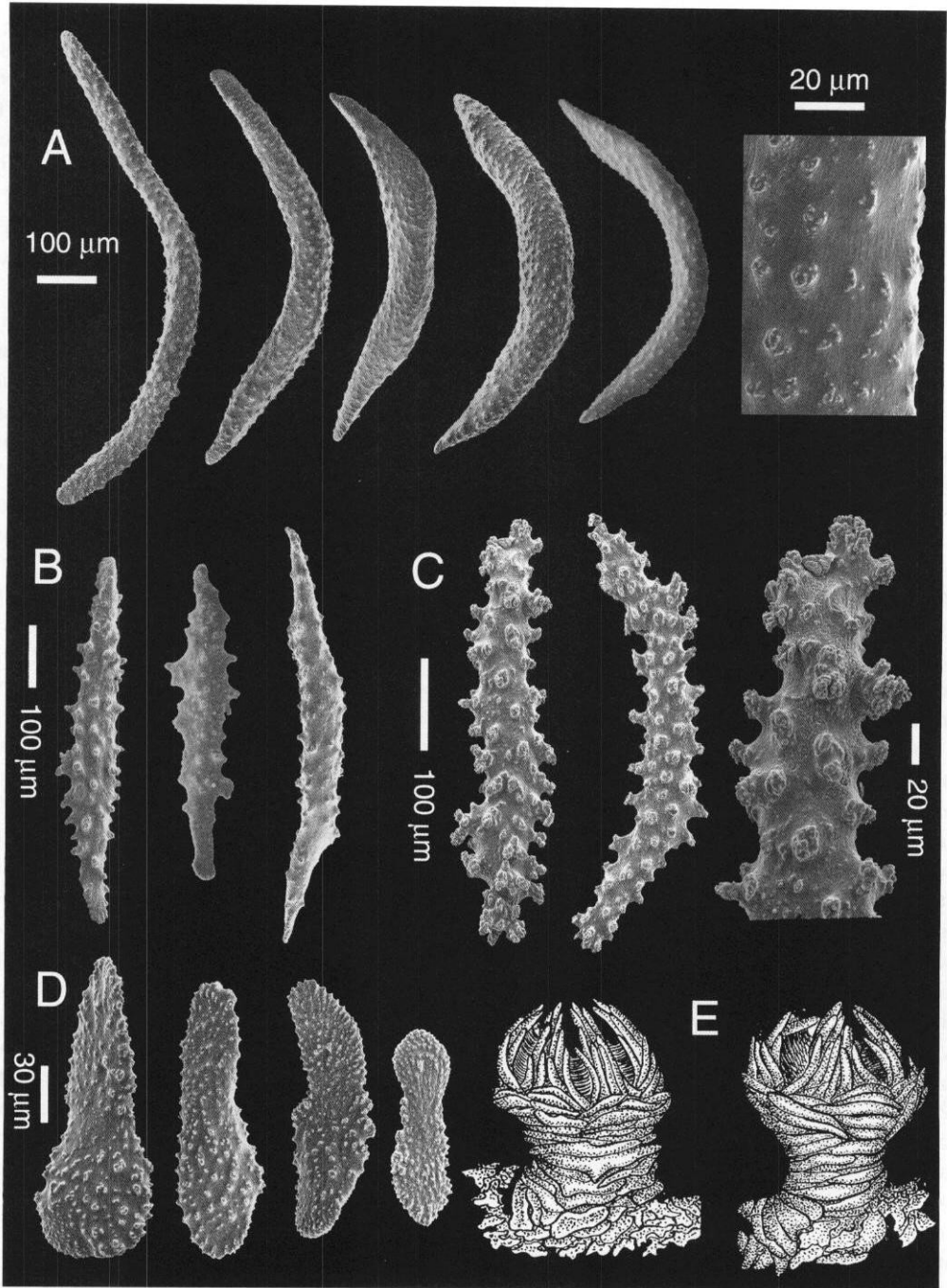


Fig. 8. *Chrysogorgia multiflora*. A–D, sclerites from G-859, USNM 52846. A, six curved spindles from body wall; B, coenenchymal platelets from side branch; C, coenenchymal platelets from main stem; D, pinnular scales. E, two polyps, MCZ “5796”, width of polyps 0.68 mm (from Verrill, unpublished plates).

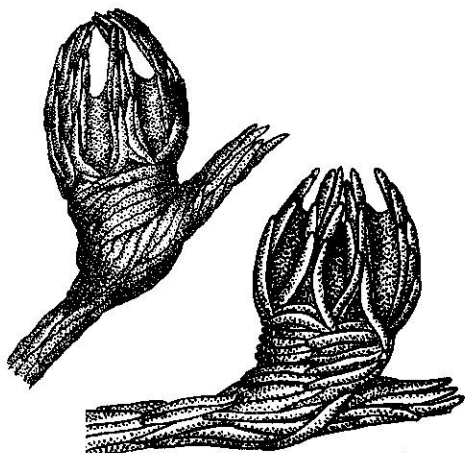


Fig. 9. *Chrysogorgia fewkesii*, two polyps from lectotype, MCZ 4850, polyps 0.5–0.7 mm in width (from Verrill, unpublished plates).

although may be up to 10, the first internode being 10–12 mm in length and remaining ones 6–8 mm, resulting in branch lengths of up to 100 mm. Internodes and terminal twigs not arranged in a plane. Two to four polyps occur on each internode, a variable number on terminal twigs. Polyps small, about 1 mm in height. Coenenchymal sclerites of main stem and branches flattened, elongate, pointed plates up to 0.95 mm in length and 0.05–0.06 mm in width, having prominent compound warts on their faces and edges. Body wall sclerites transversely arranged, consisting of curved, slightly flattened spindles, up to 0.71 mm in length and 0.04–0.06 mm in width. Body wall spindles bear multiheaded warts up to 12 μ m in diameter and often have one or both distal ends strongly flattened. Tentacular sclerites similar to those of body wall but longitudinally arranged and also containing some shorter blunt rods 0.18–0.30 mm in length and 0.04–0.06 mm in diameter. Pinnular sclerites finely granular, rectangular scales 0.10–0.15 mm in greater length.

Discussion.—*Chrysogorgia fewkesii* and *C. multiflora*, the two western Atlantic species having transverse sclerites in the body wall and downward projecting branches,

are very similar (Table 3). In fact, the colony form is so similar that the colony figure of *C. multiflora* (Fig. 7) may serve for both species. Deichmann (1936) established the variety *C. fewkesii* var. *multiflora* for several specimens collected off Dominica (BL-190) that differed from typical *C. fewkesii* in three ways: the variety was purported to have a more robust colony, its body wall sclerites were “better developed”, and its coenenchymal sclerites were larger (0.45 vs 0.35 mm in length for the typical form) and more warty. Concerning point one, there seems to be little or no difference in colony size between the two species. Concerning point two, Deichmann’s illustrations of the body wall sclerites of these two taxa showed the variety to have slightly wider sclerites (i.e., 0.07–0.08 mm vs 0.035–0.05 mm for the typical form) but no difference in length. This difference was borne out by re-examination of the type material, the width of the body wall spindles being even greater than Deichmann illustrated (i.e., up to 0.13 mm). Furthermore, the body wall sclerites of *C. fewkesii* are somewhat shorter, slightly flattened, and have very flattened, rounded distal ends; those of *C. multiflora* are rotund with pointed ends. Concerning point three, the coenenchymal scales of both *C. multiflora* and *C. fewkesii* are warty and of approximately the same size; no difference in degree of “wartiness” could be discerned, although it was noted that the coenenchymal scales on the main stem of *C. multiflora* were more warty than those on the branches. Indeed, the coenenchymal scales of *C. fewkesii* are, in general, longer (not shorter) than those of *C. multiflora* (see Table 3).

The few specimens of *C. fewkesii* reported from the eastern Atlantic by Thomson (1927) and Tixier-Durivault & d’Hondt (1974) were based on fragmentary specimens or were simply listed without description or comment. In view of the subtle differences among the chrysogorgiid species, these records are not accepted until the original specimens can be examined.

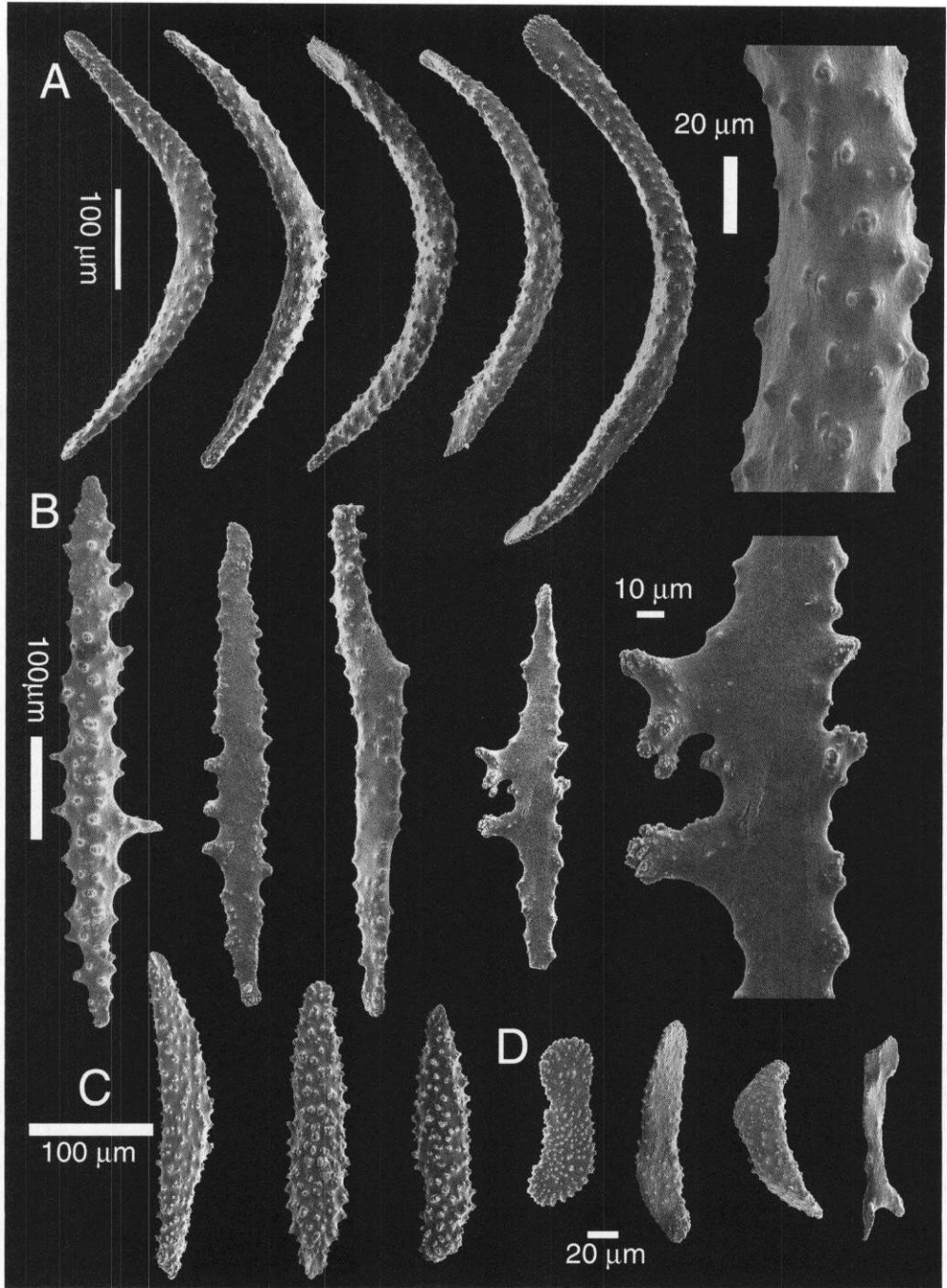


Fig. 10. *Chrysogorgia fewkesii*, sclerites from lectotype, MCZ 4850. A, six spindles with flattened tips from the body wall region; B, five coenenchymal scales; C, three tentacular rods; D, four pinnular scales.

Material examined.—BL-190, 1, USNM 49317 (former MCZ 4852); G-190, 1, USNM 52789; G-936, 1, USNM 52807; P-391, 1, USNM 52845; P-689, 5, USNM 52848; P-984, 3, USNM 52835; P-1262, 4, USNM 52843; specimens reported by Deichmann (1936); types of *C. fewkesii* (see below).

Types.—In his original description, Verrill (1883: 26) cited several specimens from *Blake-227*, as well as material from “several other localities in the same region, and off Cuba”, the Cuban specimen probably the one described by Pourtalès (1868) from *Bibb-22*, which Verrill later identified as *C. fewkesii*. However, Deichmann (1936) designated the “type” as MCZ 4850, a specimen from *BL-227*, which restricts the type locality. However, there is more than one specimen from the type lot of *BL-227*; it includes 2 colonies, several branches, and a slide to which a branch is glued. Thus, one of the colonies is chosen as lectotype (MCZ 4850); the other specimens from this station becoming paralectotypes (MCZ 4850a). The specimens from *Bibb-22* are also considered as paralectotypes, but could not be found at the MCZ in 2001. No other paralectotypes can be unequivocally determined. Type locality as restricted by lectotype: 13°10'10"N, 61°18'15"W (off southwestern St. Vincent, Lesser Antilles), 1048 m.

Distribution.—Western Atlantic: Straits of Florida, Northwest Providence Channel, Jamaica, Lesser Antilles, off Guyana, off Colombia; 430–1200 m.? Eastern Atlantic: purportedly (see Discussion) from Azores and off Morocco; 1022–2165 m (Thomson 1927, Tixier-Durivault & d'Hondt 1974).

Chrysogorgia desbonni Duchassaing & Michelotti, 1864
Figs. 11-12

Chrysogorgia Desbonni Duchassaing & Michelotti, 1864: 13 (107), 21 (115), pl. 1, figs. 7–8, pl. 4, fig. 5.—not Pourtalès, 1868: 131–132 (= *C. fewkesii*).—Duchas-

saing, 1870: 17.—Verrill, 1883: 25–26, pl. 2, figs. 6, 6a, 6b.

Chrysogorgia desbonni: Wright & Studer, 1889: 24.—Hargitt & Rogers, 1901: 281, pl. 1, figs. 1–5.—Versluys, 1902: 85–86.—Kükenthal, 1919: 532; 1924: 404.—Deichmann, 1936 (in part: not specimens from *BL-101*, *BL-297* or *BL-“XIII”* (the latter actually *BL-55*) and not pl. 35, fig. 1, which are *C. thyrsiformis*), 228–230, pl. 22, fig. 5, pl. 23, figs. 19–27.—Bayer, 1954: 280 (listed); 1958: 389 (listed).

Chrysogorgia occidentalis Versluys, 1902: 56, 86.—Kükenthal, 1919: 523–524, fig. 232; 1924: 398. [new synonym]

Chrysogorgia desbonhi (sic): Grygier, 1984: 165.

Description.—Colonies biflabellate, two equal-sized, parallel to slightly convex, roughly circular flabella originating 15–20 mm above the base; colonies up to 16 cm in height and 12 cm in width. Holdfast encrusting, disc-shaped. Main stem up to 1.6 mm in diameter. Main stem bronze to dark brown; branches paler. Branching sequence 2/5R, but present only in basal 15–20 mm of colony, the two major and several minor flabella being uniplanar and dichotomously-branched; anastomosis of branches common, sometimes producing a fine reticulum. Branches extremely closely spaced, only about 0.6–1.0 mm apart, producing an orthostiche interval of about 5 mm; only 3 or 4 orthostiche intervals occur before the distal, dichotomously branched flabella originate. In large colonies, up to 40 nodes may be present in each flabellum, the internodes being 3–4 mm in length, resulting in flabellar branches up to 12–15 cm in length. Flabellar branches gradually decrease in diameter, being quite thick proximally (as thick as the main stem) and decreasing to about 0.12 mm on terminal twigs, resulting in a wiry construction. Dichotomous branching usually unequal, one side of each dichotomy usually much thicker than the other. One polyp, sometimes 2, present on

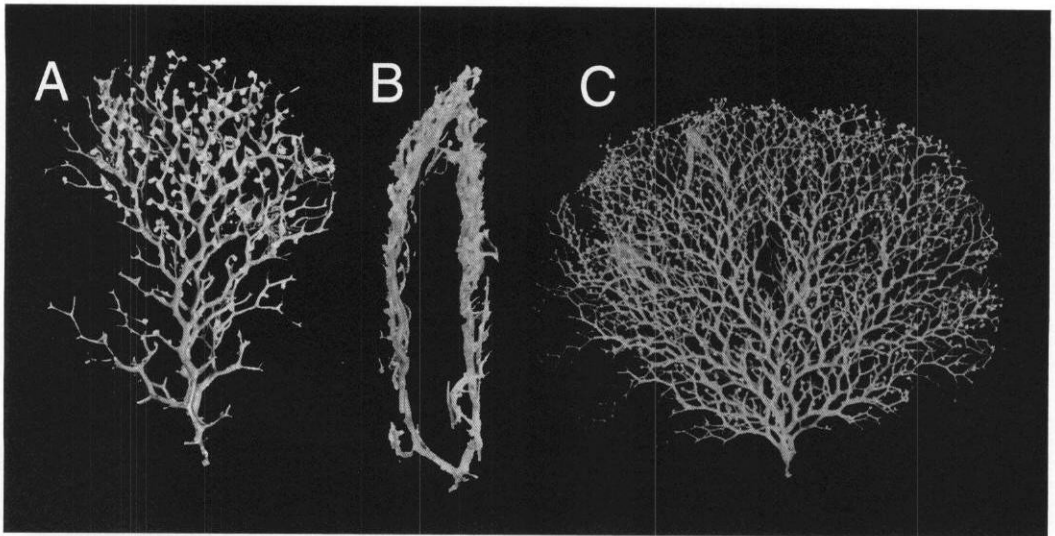


Fig. 11. *Chrysogorgia desbonni*. A–B, neotype, BL-232, MCZ 4839, lateral and edge views, colony 5.5 cm tall. C, colony from G-391, USNM 52797, height 10 cm, two galatheid crabs attached within flabella.

each internode, the polyps usually oriented such that they project perpendicular to the flabella and in an outward direction. Polyps small, cylindrical, about 1.5–1.8 mm in height. Coenenchymal sclerites elongate, warty scales with very irregular margins, up to 0.71 mm in length and 0.06 mm in width, although most scales are shorter, i.e., 0.42 mm in length. Warts of coenenchymal scales about 11–17 μm in diameter and multiheaded. Body wall sclerites transversely arranged spindles, often strongly curved and somewhat flattened, their distal ends being pointed or sometimes flattened like a scale. Body wall sclerites up to 0.75 mm in length and 0.05–0.07 mm in width, bearing small, compound warts 7–9 μm in diameter. Tentacular sclerites straight and rod-shaped, up to 0.24 mm in length and 0.02–0.04 mm in diameter. Pinnular sclerites typical rectangular scales, most 0.11–0.14 mm in length and 0.02 mm in width, often slightly medially-constricted.

Discussion.—When a colony is held on edge, a space 5–10 mm wide can often be seen between the two parallel flabella, or an enclosed cavity may be detected in those specimens that have convex flabella. In the latter case, the flabella resemble the two

halves of a clam, the enclosed space sometimes providing refuge for galatheid crabs. Aplacophoran mollusks are also sometimes found attached to the branches of the flabellum (e.g., O-5419).

Chrysogorgia desbonni is easily recognized as the only western Atlantic species to have a flabellate colony form (Table 3). Comparisons to *C. thyriformis* are made in the discussion of that species.

For reasons not understood, Duchassaing & Michelotti (1864) described the genus *Chrysogorgia* and its type species *C. desbonni* twice independently in the same publication, as species 18 and 87. Both specimens were from Guadeloupe and both descriptions might even have been based on the same specimen; however, species 18 was reported as 10–13 cm tall, whereas species 87 as 8 cm tall. Duchassaing (1870) later confirmed that both descriptions pertained to the same species. The relatively shallow purported depth at which the specimen(s) was collected (300–400 m, see Duchassaing & Michelotti 1864: 101) would suggest only two possibilities: *C. desbonni* or *C. thyriformis*. The brief French and Latin descriptions of the species are not adequate to distinguish the two, and the types

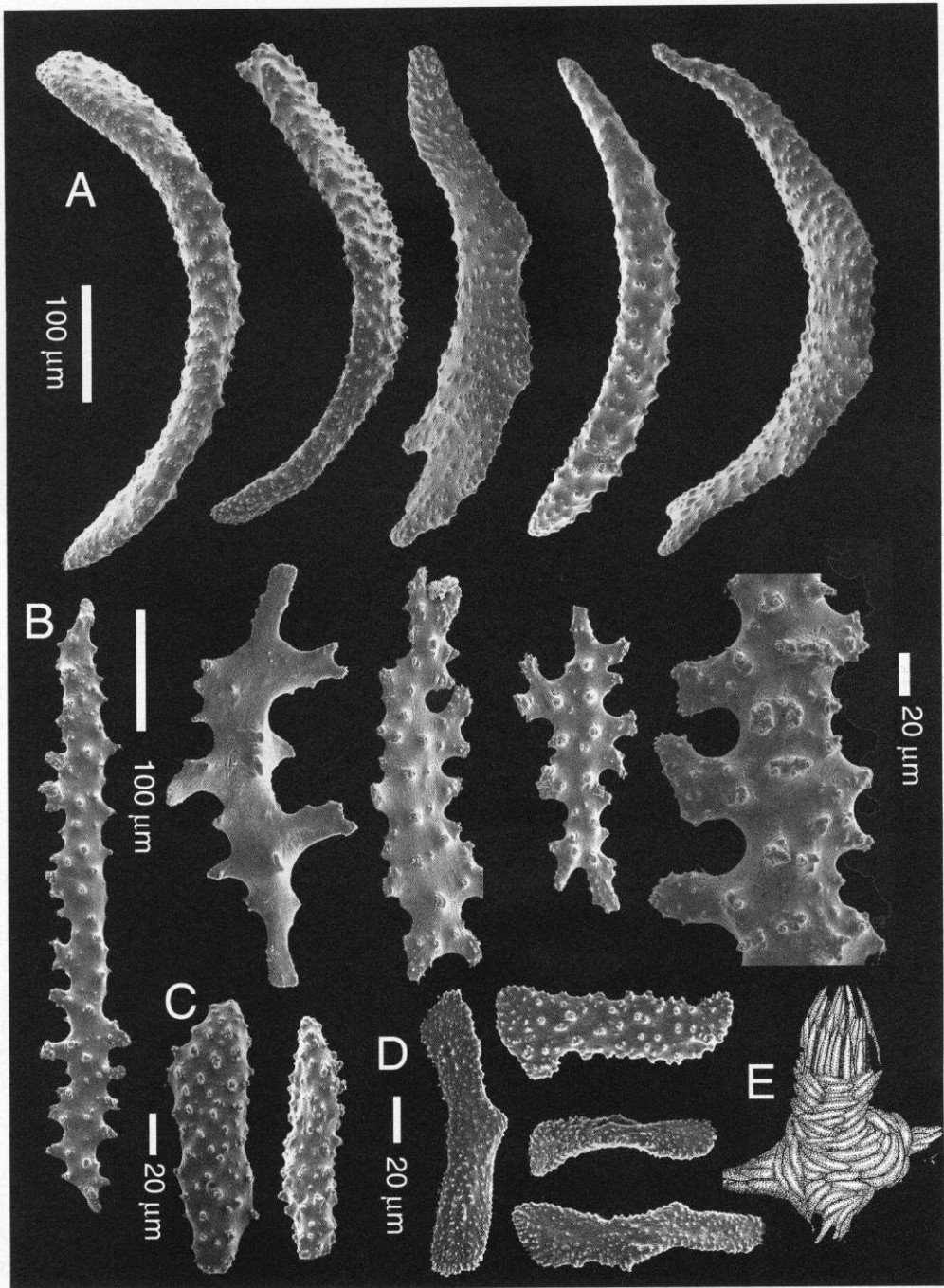


Fig. 12. *Chrysogorgia desbonni*. A–D, sclerites from neotype, MCZ 4839. A, five curved spindles from body wall; B, five coenenchymal scales; C, two tentacular rods; D, four pinnular scales. E, polyp from neotype, width 0.67 mm (from Verrill, unpublished plates).

are lost (Wright & Studer 1889), but the figure of the colony of species 87 appears to be the biflabellate taxon (i.e., *C. desbonni* as understood in this paper and *C. occidentalis* sensu Versluys and Kükenthal), and the number of polyps per internode as well as the length and number of internodes are also consistent with that species. Consequently a neotype of the biflabellate species collected near the type locality has been chosen to represent the species (see Types).

Verrill (1883) also recognized *C. desbonni* as a flabellate species, reporting it from "numerous" but largely unspecified locations in the Caribbean (see Types of *C. occidentalis*, below). Wright & Studer (1889) were convinced that Duchassaing & Michelotti (1864) had described two very different species under the same name, opting to recognize the second of the descriptions, the flabellate species 87, as the name bearer. Hargitt & Rogers (1901) clearly reported the biflabellate form as their *C. desbonni*. However, based purely on the literature, Versluys (1902) concluded that Verrill's *C. desbonni* was a different species from the one described by Duchassaing & Michelotti, proposing the name *C. occidentalis* for Verrill's specimens. Versluys did not designate type specimens for *C. occidentalis* nor did he actually see any specimens, but simply relied on the specimens examined of *C. desbonni* by Verrill, all of which must be considered as syntypes of *C. occidentalis* (see "Types"). Kükenthal (1919) followed the taxonomy of Versluys and apparently examined at least one of Verrill's specimens at the MCZ and illustrated a branch, but he still did not have a firm comprehension of true *C. desbonni*. Comparing crude illustrations and poor descriptions without recourse to examining specimens is ill-advised as a basis in taxonomy. But, since the types of *C. desbonni* are lost, the nomenclatural issue may be simply resolved by designating a biflabellate specimen from the syntype series of *C. occidentalis* as the lectotype of that species as well as the neotype of *C. desbonni*, making *C. occidentalis* a

junior objective synonym of *C. desbonni*. Such a specimen is chosen from BL-232 (MCZ 4839).

Because *C. desbonni* has flattened spindles in its body wall and tentacles, it belongs to *Chrysogorgia* (Group "Spiculosae").

Material examined.—Alb-2342, 3, USNM 44139; Alb-2347, 1, USNM 44140; Atl-2980B, 1, MCZ 3866; Atl-2999, 3, MCZ 3867; Atl-3326, 9, MCZ 3719-22; Atl-3436, 1, MCZ 3705; Atl-3437, 1, MCZ 3698; Atl-3438, 3, MCZ 3752; Atl-3479, 1, MCZ 3756; Caroline-43, 2, USNM 43791; Combat-447, 1, USNM 50802; G-232, 1, 52816; G-235, 1, USNM 52791; G-241, 3, USNM 52792; G-242, 1, USNM 52793; G-246, 2, USNM 52794; G-261, 1, USNM 52795; G-387, 1, USNM 52796; G-391, 6, USNM 52797; G-678, 2, USNM 52799; G-679, 1, USNM 52817; G-692, 2, USNM 52800; G-798, 1, USNM 52801; G-889, 2, USNM 52802; G-897, 1, USNM 52804; G-898, 1, USNM 52834 (specimen reported by Grygier, 1984); G-899, 1, USNM 52805; G-925, 2, USNM 52806; G-927, 1, USNM 52819; G-936, 2, USNM 52807; G-1125, 1, USNM 52905; G-1312, 2, USNM 52833; G-1314, 1, USNM 52832; Eastward-31281, 1, USNM 80097; Nutting Iowa Bahama Expedition, 1893, 1, off Havana, USNM 91861; O-4940, 1, USNM 52813; O-10849, 1, USNM 52837; P-200, 2, USNM 52808; P-208, 1, USNM 52824; P-209, 1, USNM 52809; P-594, 3, USNM 52810; P-610, 5, USNM 52811; P-611, 1, USNM 52812; P-857, 1, USNM 52826; P-877, 1, USNM 52827; P-890, 2, USNM 52828; P-931, 1, USNM 52830; P-1141, 2, USNM 52836; SB-440, 2, USNM 51263; off Sanibel Island, Florida, depth unknown, 3, USNM 52814; specimens reported by Verrill (1883), Deichmann (1936), and Grygier (1984); neotype.

Types.—The type of *C. desbonni* is not present at the Museo Regionale di Scienze Naturali, Torino (Wright & Studer 1889, L. Levi, pers. comm., 2001) or the Museum of Florence, and thus is presumed to be lost.

Indeed, none of the specimens reported by Duchassaing & Michelotti (1864) have ever been found (F. M. Bayer, pers. comm.). To resolve the taxonomic confusion about this species (see Remarks), a neotype of 5.5 cm height is chosen from BL-232 (MCZ 4839). Original type locality: Harbor of Moule, Guadeloupe, Lesser Antilles (depth 300–400 m?). Type locality (as redefined by neotype): 13°06'45"N, 61°06'55"W (east of St. Vincent, Lesser Antilles), 88 fms (=161 m).

The syntypes of *C. occidentalis* Versluys, 1902, must be considered to be the material reported by Verrill (1883: 26) as *C. desbonni*, which reads: "numerous localities in the Caribbean Sea and among the Antilles, in 88 to 163 fathoms, by the *Blake*, in 1878–1979, and off Cuba, in 288 fathoms, in 1880." From the station list of the *Blake*, at least three stations correspond to these requirements: BL-232 (the shallow end range), BL-241 (the deep end range), and BL (Bartlett)-V (the Cuban specimen). Thirteen additional *Blake* stations are listed by Deichmann (1936), all of which Verrill probably examined. Specimens from all of these stations are still present at the MCZ, except for BL (Bartlett)-V. A lectotype is chosen from BL-232 (MCZ 4839), which corresponds to one of the extremes of the bathymetric range reported by Verrill, and certainly one of the specimens he examined. Because it is the same specimen chosen for the neotype of *C. desbonni*, *C. occidentalis* becomes a junior objective synonym of *C. desbonni*. Type Locality: same as listed for *C. desbonni* above.

Distribution.—Fairly continuous distribution from off Turneffe, Belize, clockwise throughout the Antilles to Grenada, including the Bahamas; 155–595 m.

Chrysogorgia thyriformis Deichmann,
1936 new rank
Figs. 13-14

Chrysogorgia desbonni var. *thyriformis*
Deichmann, 1936: 230.

Chrysogorgia desbonni: Deichmann, 1936:
in part (BL-101, BL-297, BL-55, the latter
reported as BL-XIII), pl. 35, fig. 1.

Chrysogorgia elisabethae Bayer, 1951:
269–272, pl. 9, figs. 56–57; 1952: 189
[new synonym]; 1954: 280 (listed).

Description.—Colonies bushy, rarely more than 8 cm in height and 8–9 cm in width. Holdfast encrusting, disc-shaped. Main stem slender (1.1–1.7 mm in diameter), straight, and rarely more than 3 cm in length; color of main stem golden-brown or bronze. Branching sequence 2/5R; branches extremely closely spaced, only about 0.5–0.7 mm apart, producing an orthostiche interval of 2.7–3.5 mm on lower part of colony and about 5 mm near distal portion of main stem. First two internodes of each branch form a plane that is roughly horizontal to the substrate (i.e., perpendicular to the main stem); however, at the second internode the orientation of the branch is usually twisted 45–90°, the plane of the remaining branch, which usually remains uniplanar to the terminal twigs, being vertical (i.e., parallel to the main stem). This twisting of the plane of branching and equal development of branches around the main stem produces a bushy colony form. Well-developed branches consist of about 10–12 internodes, each 5–8 mm in length, resulting in branch lengths of up to 75 mm. Dichotomous branching usually results in equal-sized sub-branches throughout each branch; angle between sub-branches fairly small (about 30°). Branches arise from the main stem oriented in an upward direction, about 45° from the vertical; branch anastomosis rare. Branches quite thick near main stem but gradually decrease in thickness, ending in terminal twigs of 0.12 mm in diameter; general tensile strength wiry. Two to 3 polyps occur on each internode, often more on the terminal twigs. Polyps small (up to 1.2 mm in height) and often have a highly constricted base; they project perpendicular to the branches or sometimes appear to angle backward toward the main

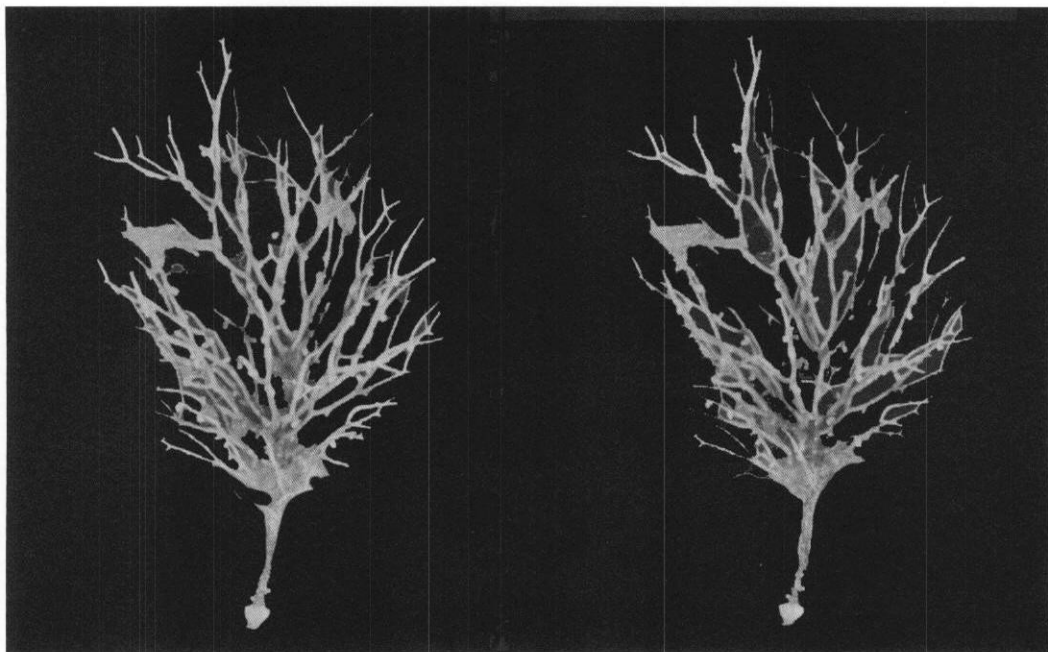


Fig. 13. *Chrysogorgia thyrsoformis*, stereo view of lectotype, MCZ 4849, height 5.5 cm.

stem. Sclerites similar to those of *C. desbonni*. Coenenchymal sclerites elongate, warty scales (warts about $8\ \mu\text{m}$ in diameter) $0.36\text{--}0.54\ \text{mm}$ in length and $0.05\text{--}0.08\ \text{mm}$ in width, having pointed distal ends and highly irregularly-shaped edges. Body wall sclerites transversely arranged, curved and/or irregularly-shaped, finely-warty spindles up to $0.71\ \text{mm}$ in length and $0.06\text{--}0.07\ \text{mm}$ in width. These sclerites are slightly flattened, particularly at their distal ends, but are not interpreted to be scales. Tentacular sclerites longitudinally arranged rods similar in shape to those of body wall but smaller (i.e., $0.21\text{--}0.42\ \text{mm}$ in length). Pinnular sclerites typical rectangular scales $0.18\text{--}0.21\ \text{mm}$ in length.

Discussion.—Although described as a variety of *C. desbonni*, *C. thyrsoformis* differs from that species in several consistent characters, warranting its elevation to the species level. *C. thyrsoformis* differs in having a bushy colony (not flabellate), fewer and longer internodes (see Table 3), more polyps per internode, slightly shorter and flatter body wall spindles, and more nu-

merous irregularly-shaped spindles in the body wall (in addition to the curved, regularly-shaped, flattened spindles). As described above, although the branches of *C. thyrsoformis* are basically uniplanar, there is often a twisting of the orientation at the second node, and the distalmost 8–12 branches that diverge from the main stem produce major branches. In contrast, all branches that diverge from the main stem of *C. desbonni* are exclusively uniplanar, only the distalmost two forming the two large uniplanar flabella having numerous nodes. Because *C. thyrsoformis* has flattened, curved spindles in its body wall and tentacles, it should, along with *C. desbonni*, be placed in *Chrysogorgia* (Group Spiculosae). Bayer (1951:272) placed *C. thyrsoformis* (as *C. elisabethae*) in the “Squamosae aberrantes”, apparently interpreting the flattened tentacular spindles/rods as scales, although he clearly noted in his description that both body wall and tentacles possessed rods, which would place it in Group A.

Aplacophoran mollusks are sometimes

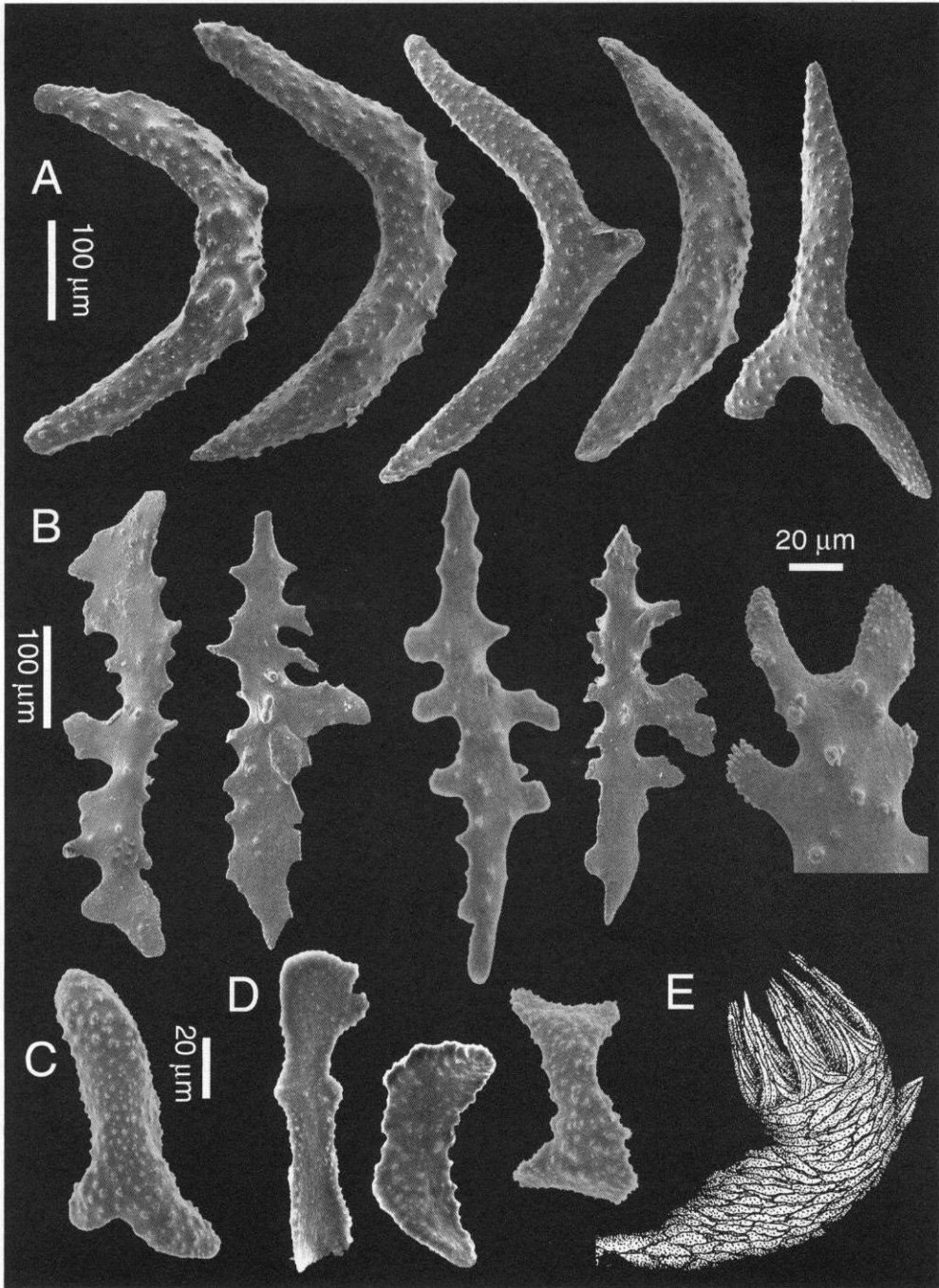


Fig. 14. *Chrysogorgia thyriformis*. A–D, sclerites of lectotype, MCZ 4849. A, five curved spindles from body wall; B, five coenenchymal scales; C, a tentacular rod; D, three pinnular scales. E, polyp of lectotype, 1 mm in width (from Verrill, unpublished plates).

found attached to branches of this species (e.g., G-503).

Material examined.—*Alb*-2655, 4, USNM 44129; *Atl*-3320, 1, MCZ; *Atl*-3480, 1, MCZ 3670; *BL*-(Sigsbee), 2 miles east of Havana, 1, USNM 49501; *Caroline*-102, 2, USNM 100888; *R/V Cape Florida*, 27°31'N, 79°15'W, 350–400 m, 2, USNM 73940; *CI*-37, 2, USNM 54816; *G*-168, 1, USNM 52788; *G*-233, 10, USNM 52790; *G*-503, 5, USNM 52798; *G*-705, 1, USNM 52818; *G*-893, 1, USNM 52803; *G*-936, 1, USNM 100886; *Eastward*-26549, 7, USNM 100889; *O*-2655, 2, USNM 59807; *O*-5021, 2, USNM 52821; *O*-5419, 1, USNM 53034; *P*-200, 3, USNM 100887; *P*-739, 6, USNM 52815; *P*-848, 2, USNM 52825; *P*-907, 2, USNM 52829; *P*-991, 1, USNM 52831; *P*-1410, 1, USNM 54815; *SB*-3497, 1, USNM 100890; University of Iowa, off Havana, 1, USNM 49489 (reported by Bayer, 1952); types of *C. thyrisiformis* and *C. elisabethae*; specimens reported as *C. desbonni* by Deichmann (1936).

Types.—Deichmann cited a type of this variety from a *Hassler* station off Barbados (MCZ 4849) and another specimen from *BL*-281 (MCZ 4867); however, there are two specimens in lot 4849. Thus one specimen from MCZ 4849 is chosen as the lectotype, the other becoming a paralectotype (MCZ 4849a). The specimen from *BL*-281 is also considered to be a paralectotype. Type Locality: “off Barbados,” 183 m.

The holotype of *C. elisabethae* was collected at *Alb*-2129, and is deposited at the USNM (7552). Type locality: 19°56'04"N, 75°48'55"W (off Santiago, Cuba), 501 m.

Distribution.—Fairly continuous distribution from Grand Bahama Bank throughout the Antilles to Isla Tortuga, Venezuela, including Yucatan Peninsula (off Cozumel) and the Bahamas; 146–526 m.

Chrysogorgia agassizii (Verrill, 1883)

Figs. 15-16

Dasygorgia Agassizii Verrill, 1883: 22–23, pl. 2, figs. 4, 4a–b(c–e); 1884: 220; 1885:

511–512, pl. 9, fig. 199.—Agassiz, 1888: 143–144, fig. 455.—?Roule, 1896: 304–305.

Chrysogorgia agassizii: Versluys, 1902: 60.—not Nutting, 1912: 55–56.—Küenthal, 1919: 530, fig. 233; 1924: 403.—Deichmann, 1936: 222, 233–234, pl. 23, figs. 34–40, but not pl. 34, figs. 1–2 (= *C. elegans*).—Madsen, 1944: 49–54, figs. 42–47.—?Tyler & Zibrowius, 1992: 217.

Chrysogorgia agassizi: Kinoshita, 1913: 3 (listed).—?Tixier-Durivault & d'Hondt, 1974: 1409.—?Grasshoff, 1982a: 748 (map 4); 1982b: 949, figs. 22–24.—Vinogradov, 2000: 101–103, figs. 1–2.

?*Chrysogorgia pentasticha*: Thomson, 1927: 22.

?*Chrysogorgia (sic) agassizi*: Pasternak, 1985: 32.

Description.—Colony bottlebrush-shaped, up to 41 cm in height, and attached by an encrusting or rhizoidal holdfast. Main stem up to 2.5 mm in diameter; golden-brown in luster. Branching sequence consistently 2/5R: branches closely spaced, one every 1.5–2.0 mm; orthostiche interval 10–12 mm; branches diverge from main stem at about 70° from the vertical. Terminal twig branch diameter quite small (0.1 mm), producing a flexible, limp colony. Number of nodes per branch ranges from 2–5, but are usually 3, the first 2 internodes being short (2–4 mm), the third 4–6 mm, and the terminal twigs being up to 50 mm in length, combining to produce a total branch length of 60–65 mm. Branching dichotomy not always symmetrical, the internodes and terminal twigs of a branch usually arranged in a horizontal plane. Polyps usually absent from first 2 internodes, one occurring near the third internode, and up to 11 polyps on the terminal twigs. Polyps cylindrical, up to 2.5 mm in height and about 0.75 mm in diameter, obliquely arranged on the branches. Coenenchymal sclerites smooth, elongate scales with rounded distal ends and finely serrate edges, up to 0.36 mm in length and 0.04 mm in width. Body wall

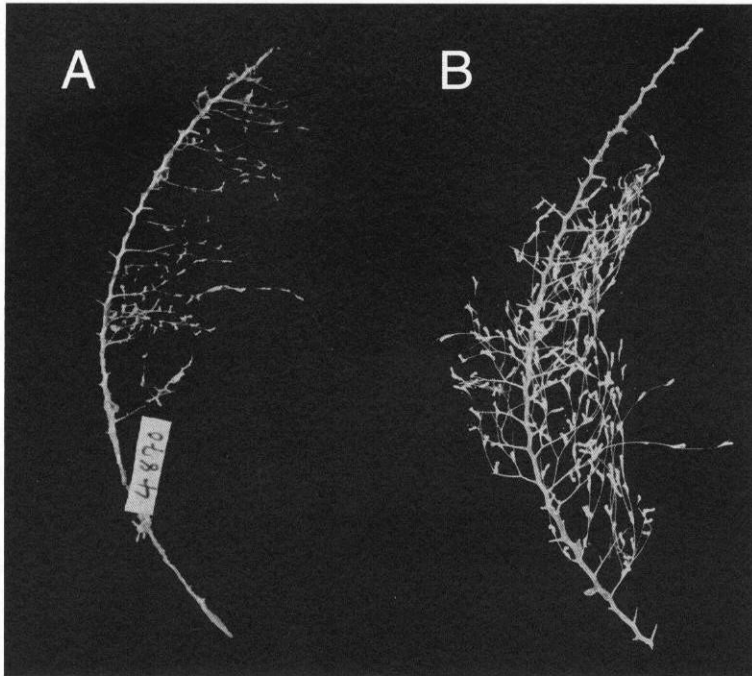


Fig. 15. *Chrysogorgia agassizii*. A, lectotype, BL-308, MCZ 4870, height 15 cm; B, paralectotype, BL-308, MCZ 5748, height 10.5 cm.

sclerites similar to coenenchymal sclerites but slightly larger: 0.42–0.48 mm in length and 0.06–0.07 mm in width. Body wall scales longitudinally arranged, with smooth to finely granular (but not warted) faces and finely serrate edges. Bluntly-tipped, finely-granular, straight rods 0.42–0.60 mm in length and 0.08–0.13 mm in width occur at the base of the tentacles, but are quite rare, perhaps occurring with a frequency of one per tentacle. Tentacular rods bear small compound warts, each about 8 μ m in diameter, which are composed of smaller elements. Pinnular sclerites smooth elongate scales up to 0.21 mm in length and 0.04 mm in width, having finely-serrate edges.

Discussion.—This species is exhaustively described, figured, and discussed by Madsen (1944), based on several specimens collected south of Iceland; however, the eastern Atlantic records of *C. agassizii* (see “Distribution”) have been little more than unfigured and undescribed listings of the

species. Since I have not examined them, their synonymy records are queried.

It is of interest to note that the specimens from the four *Albatross* stations reported herein were originally identified but not reported by A. E. Verrill.

Based on repeated photographs of a specimen attached to the bow rail of the *R. M. S. Titanic*, Vinogradov (2000) calculated the growth rate of this species to be about 1 cm per year.

Material examined.—*Alb*-2034, 1, USNM 9150; *Alb*-2035, 4, USNM 17253; *Alb*-2220, 1, USNM 7920; *Alb*-2573, 2, USNM 11854; *Knorr* 58-I-827, 1, USNM 59808; *Gyre* MA2:04, 1, USNM 88109; Nutting’s (1912) misidentification, *Alb*-5080, USNM 30170; types of *D. agassizii* (see below).

Types.—The larger of the two syntypes is deposited at the MCZ (4870) and a smaller one is at the USNM (5748). Deichmann (1936), in designating MCZ specimen 4870

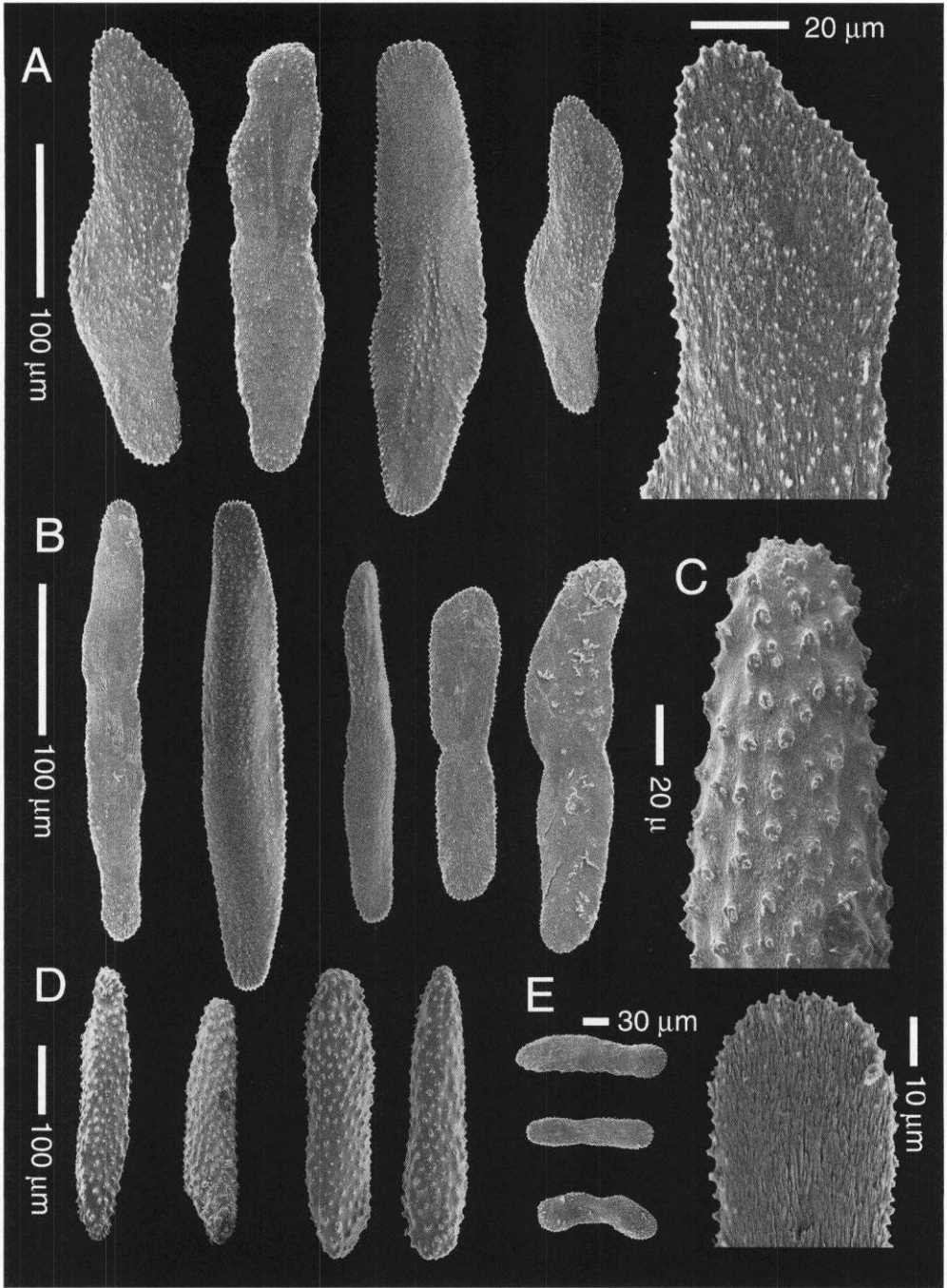


Fig. 16. *Chrysogorgia agassizii*, sclerites from paralectotype, BL-308, MCZ 5748. A, five scales from body wall; B, five coenenchymal scales; C, enlargement of tip of tentacular rod; D, four tentacular rods; E, four pinnular scales.

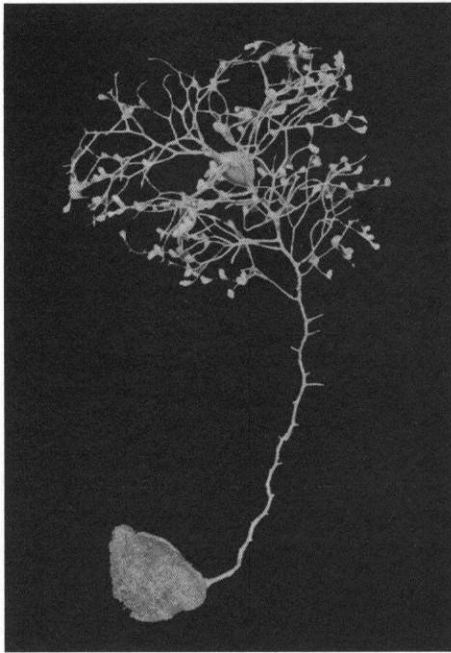


Fig. 17. *Chrysogorgia squamata*, lectotype, BL-283, MCZ 4862, height of colony 10.5 cm.

as the type, effectively makes it the chosen lectotype for the species, the USNM specimen thus becoming a paralectotype. Type Locality: *Blake-308*: 41°04'45"N, 65°35'30"W (off Georges Bank), 2271 m.

Distribution.—Western Atlantic: off continental slope of northeastern United States and Newfoundland from 39–42° N latitude, 1928–3700 m. North and eastern Atlantic: off Iceland (Madsen 1944);? west of Ireland (Tyler & Zibrowius 1992);? Bay of Biscay (Roule 1896, Grasshoff 1982a);? Azores (Thomson 1927);? Atlantis Seamount (Pasternak 1985); 1425–2860 m.

Chrysogorgia squamata (Verrill, 1883)
Figs. 17–18

Dasygorgia squamata Verrill, 1883: 24.

Chrysogorgia squamata: Versluys, 1902: 85.—Kükenthal, 1919: 538; 1924: 408.—Deichmann, 1936: 232–233, pl. 22, fig. 8, pl. 23, figs. 28–33.

Description.—Colonies bottlebrush-shaped, up to 20 cm in height and 6 cm in

width, attached by an encrusting holdfast. Main stem up to 1.6 mm in diameter, yellowish-amber in luster, and, along with the internodes, covered with numerous, slender cnidal papillae up to 0.2 mm in height. Branching sequence predominantly 1/5R, although the occasionally the sequence shifts to 1/6 or even 1/7R. Branches occur every 2.1–3.0 mm, resulting in an orthostiche interval for the 1/5 sequence of 8.5–12.0 mm. Branches diverge from main stem at 70–90° from the vertical. Distal branch diameter 0.25 mm; branches and colony wiry in construction. Number of nodes per branch 2 or 3. First internode 4–8 mm in length; second, 4–5 mm; third, 4–5 mm, and terminal twigs up to 10 mm, resulting in a total branch length up to 28 mm. Polyps sparse, usually absent from the first 2 internodes, only 1 on the third internode, and 1 or 2 on the terminal twigs. Polyps cylindrical, up to 1.8 mm in height. Coenenchymal sclerites elongate (up to 0.45 mm in length and about 0.07 mm in width), smooth scales, rounded on their distal ends, with finely serrate edges, and often slightly constricted medially. Body wall sclerites transversely arranged, elongate (up to 0.54 mm in length and 0.08–0.09 mm in width), smooth scales, also with rounded distal ends and finely serrate edges, the apices of the serrations of uniform height (1–2 μm) and quite regularly spaced (every 3–4 μm). Backs of tentacles, adjacent to the naked space at the base of each tentacle, filled with longitudinally-placed, warty rods, up to 0.42 mm in length and 0.07 mm in diameter. Smaller rods (0.20–0.25 \times 0.06 mm) occur in the distal tentacles. Pinnular scales quite small, somewhat rectangular and usually slightly medially constricted. Pinnular scales up to 0.17 mm in length and 0.09 mm in width, but may be much smaller, e.g., 0.08 \times 0.02 mm.

Discussion.—Deichmann's (1936) redescription of this species, which must have been based on the type material, was somewhat misleading, in that she indicated a branching sequence of 1/7, branches with

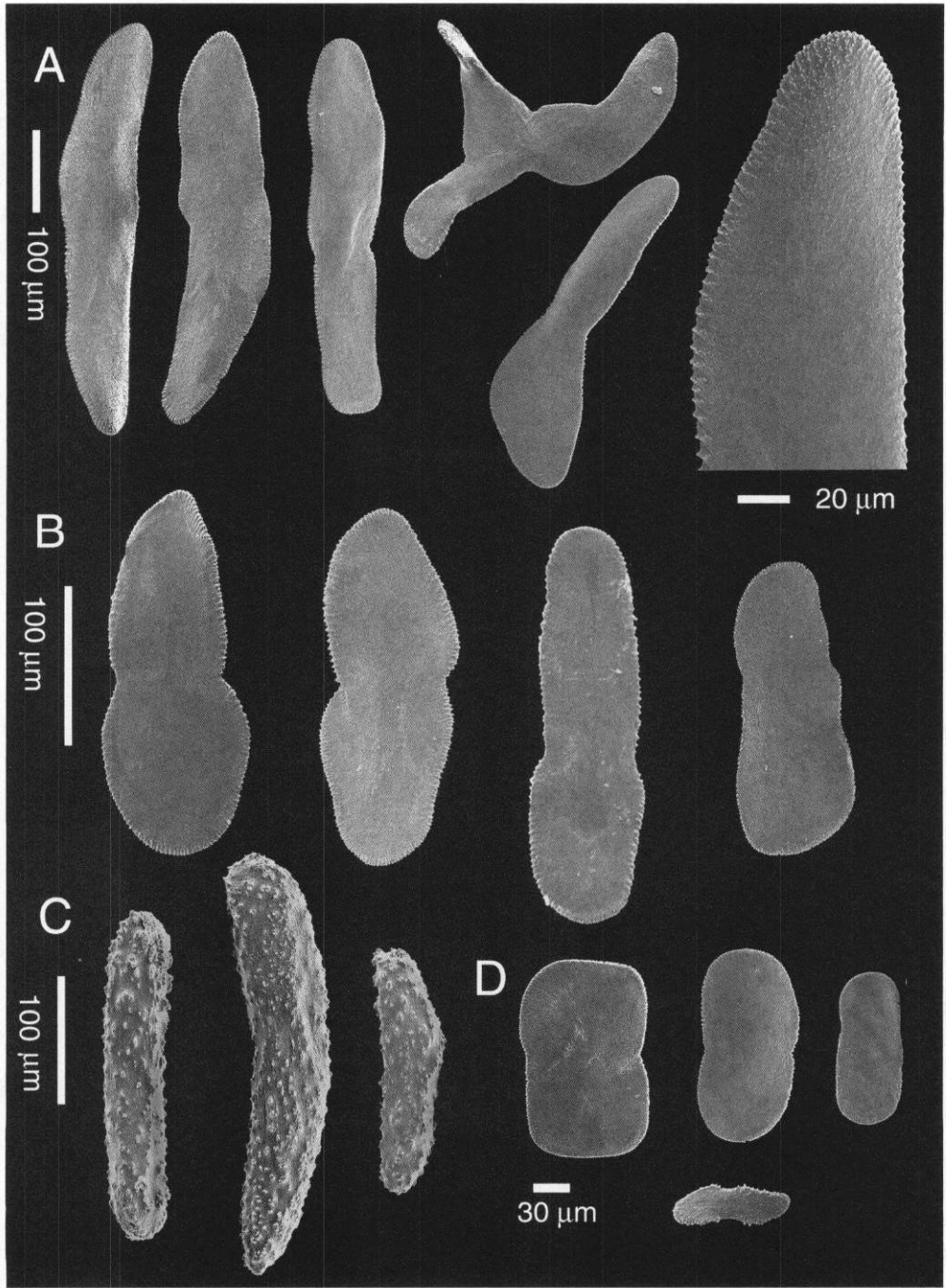


Fig. 18. *Chrysogorgia squamata*, sclerites from lectotype, MCZ 4862. A, six scales from body wall; B, four coenenchymal scales; C, three tentacular rods; D, four pinnular scales.

5–6 nodes, and longitudinally arranged body wall sclerites. As reported in the description, the branching sequence is predominantly 1/5, branches usually have 2–3 nodes, (never as many as 6), and body wall sclerites are transversely arranged. Versluys (1902) tentatively placed *C. squamata* in the group “Squamosae typicae”, but acknowledged that he did not have knowledge of the tentacular sclerites. Since the tentacles of this species contain well developed rods, it thus belongs in the group “Squamosae aberrantes”.

Chrysogorgia squamata is a very rarely collected species, the specimens listed below being the first new records since its original description. It is easily distinguished from other western Atlantic species by having a 1/5R branching sequence and cnidal papillae. Indeed, no other species in the “Squamosae aberrantes” group has a 1/5R branching sequence (Table 1).

Material examined.—Atl-3326, 1, MCZ (unnumbered); P-607, 1, USNM 52840; types of *D. squamata* from BL-283 (see below).

Types.—Verrill reported three specimens from two Blake stations, which must be considered as syntypes: one from BL-227 and two from BL-283 (MCZ 4862). Deichmann (1936) restricted the type locality to BL-283, but did not designate a lectotype. Thus, one of the three (not two) specimens from BL-283 (MCZ 4682) is herein designated as the lectotype: not the largest colony of 20 cm height, but the smaller of 12 cm height that is attached to the substrate. The remaining two specimens from BL-283 (MCZ 4682a) and that from BL-227 are thus paralectotypes; however, the latter specimen could not be found at the MCZ in 2001. Type locality: 13°05'05"N, 59°40'50"W (off southwestern Barbados, Lesser Antilles), 431 m.

Distribution.—off Banco Chinchorro, Yucatan Peninsula; southwestern Cuba; Lesser Antilles (Barbados and St. Vincent); 431–1046 m.

Key to the western Atlantic species of *Chrysogorgia*

The two previous keys (Deichmann 1936; Bayer 1951) to the western Atlantic species of *Chrysogorgia* relied on the position and/or kind of sclerites in the body wall as the first couplet. The following key emphasizes the more gross and easily recognized characters such as colony shape and branching sequence, reserving characteristics of sclerite position, shape and size for the terminal couplets.

1. Colones bottlebrush-shaped; distance between branches over 1 mm 2
- 1'. Colonies bushy or flabellate; distance between branches less than 1 mm 8
2. Sclerites of body wall longitudinally arranged 3
- 2'. Sclerites of body wall transversely arranged 6
3. Branching sequence 2/5R 4
- 3'. Branching sequence 3/8R *C. herdendorfi*, n. sp.
4. Body wall sclerites exclusively scales *C. agassizii*
- 4'. Body wall sclerites includes spindles and/or rods 5
5. Number of nodes per branch 0–2, usually 1; distance between branches 2.5–3.0 mm *C. herdendorfi*, n. sp.
- 5'. Number of nodes per branch 1–3, usually 2; distance between branches 1.0–1.5 mm. *C. elegans*
- 5". Number of nodes per branch 3–6, usually 4; distance between branches 3.5–4.5 mm *C. spiculosa*
6. Branching sequence 2/5R 7
- 6'. Branching sequence 1/5R *C. squamata*
7. Body wall sclerites cylindrical spindles up to 0.06 mm in width *C. fewkesii*
- 7'. Body wall sclerites flattened spindles up to 0.13 mm in width *C. multiflora*
8. Colony bushy; up to 12 internodes per branch *C. thyriformis*
- 8'. Colony flabellate (biflabellate); up to 40 internodes per branch *C. desbonni*

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