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# STUDIES ON THE GENUS OF *DICTYOTA* LAMOUROUX FROM THE COAST OF KARACHI, PAKISTAN

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**Abstract**

Eco-taxonomic study of 4 species of *Dictyota* (Dictoyotales, Phaeophyta) dealing with the revision of *D. dichotoma, D. haukiana* Nizam but *D. dichotoma* var. *intricata* and *D. dimensis* as new records for the coast of Karachi, Pakistan is reported.

## Introduction

*Dictyota* is one of the largest genus of the order dictyotales (Phaeophyta) which has not been studied in detail from the coast of Karachi, Pakistan. Few scientists described it from different parts of the Arabian Sea. Boergesen (1934) only listed two species of *Dictyota*, *D. atomaria* Hauck (=*Dictyota haukiana*, Nizam.), *D. dictotona* (Huds) Lamourax from the coast of Karachi. Boergesen (1932, 1935, 1937) reported *D. atomaria* Hauck and *D. dichotoma* (Hudson) Lamouroux (1937) from Indian Ocean. Durairatnam (1961) described *D. indica* Sonder, *D. atomaria* Hauck, *D. dichotama* (Hudson) Lamour from Ceylon, Sri Lanka. Misra (1966) described *D. indica* Sonder, *D. atomaria* Hauck, *D. dichotoma* (Hudson) Lamouroux and *D. dichotoma* (Hudson) Lamouroux var. *intricata* (C. Agardh) Greville from the eastern coast of Arabian Sea (West coast of India). Shaikh & Shameel (1995) recently reported *D. dichotoma, D. dumosa, D. haukiana, D. indica, D. maxima* from the coast of Pakistan. Present attempt is made to study the dominant genus *Dictyota* in detail dealing with the taxonomy and ecology of 4 species viz., *D. dichotoma* (Huds) Lamour, *D. haukiana* Nizam., *D. dimensis* Kütz., *D. dichotoma* Lamour. var. *intricata* (C. Ag.) Grev. The last two species are reported for the first time from the coast of Pakistan.

## Material and Methods

Materials were collected either living or as drift during 1982-1996 from different localities of Karachi coast. Specimens were either fixed in 4% formalin sea water solution for anatomical study and mounted on herbarium sheets.

Identification were based on the morphoanatomical observations of each collection, free hand sections were cut from upper, middle and lower parts of the plant. Diagrams were made by using Camera lucida.

***Dictyota* Lamouroux:** Plants mostly grow in clusters, attached by irregular holdfast or by rhizoids arising from the lower parts of the thallus; erect portion flattened, ribbon like, strap-shaped, membranous. Thallus dichotomously, sub-dichotomously or irregularly divided; surface smooth or rough; growth by a single dome-shaped apical cell and the surface cells twice longer than broad, arranged in longitudinal rows. This genus exhibits a bluish or greenish irradiance in strong sun light.

In cross section thallus composed of three layers of cells, central single layer of large medullary cells, surrounded by single layer of small squarish assimilatory cells.

Reproductive organs occur on the upper surface, few on the lower surface. Tetrasporangia scattered or in groups of 2-(-3), round to spherical, stalked or sessile; oogonia and antheridia occur in round, oval or irregular sori. Oogonia elongate or globular, stalked, induciate. Antheridia elongate or cylindrical, stalked, induciate, with small compartments. Hairs multicellular, unbranched, rarely branched and uniseriate. Sporangia bear 4 spores.

**Key to the species**

1. Margin dentate ……..…. 2
1. Margin entire ……. 3

2. Segment broad dense up to 7mm broad, plant cuneate below, apices acute, incurved ……..……... *D. diemensis*

2. Segment 10-40mm broad, strap-shaped, apices round, acute ……... *D. hauckiana*

3. Segment 4-8 (-10mm) broad, plant regularly dichotomously branched, apices round, obtuse or blunt ...…… *D. dichotoma*
3. Segment narrow 0.5-1mm broad, twisted, linear, entangled, acute, divaricated ……. …….. *D. dichotoma* var. *intricata*

***Dictyota diemensis* Kütz (Figs. 1-2)**

**Syn:** *D. naevosa sensu* Harvey 1862, PI. 186. Womersley 1967: 209, 1987: 192.

Plants upto 17cm high, attached by rhizoidal holdfast, cuneate below. Plant dichotomously branched; segments become 15mm broad before bifurcaton, otherwise more or less uniform in width 7mm throughout the thallus. Lower segments broad, thick and greenish brown; upper ones thin, yellowish to greenish brown. Apices narrow, acute, incurved; sinuses deep, narrowly round; margin slightly wavy, rarely bear dentations and proliferations at the lower part of the thallus.

In C.S. upper part of the thallus 90-110 µm thick; medullary cells 78-80 µm high and broad. Lower part 130-140 µm thick; medullary cells 90-100 µm high, 120 µm broad; assimilatory cells 12-16 µm high and broad.

Antheridial sori yellowish brown and ovoid in C.S. Antheridia 50 µm high, 15 µm broad; involucres 55 µm high, 12 µm broad.

**Ecology:** Collected as drift.

**Local distribution:** Manora (Leg. M. Begum & N. Khatoon, 29. 12. 1983).

**Geographical distribution:** Arabian Sea: Karachi (Pakistan). Pacific Ocean: Australia, Tasmania.

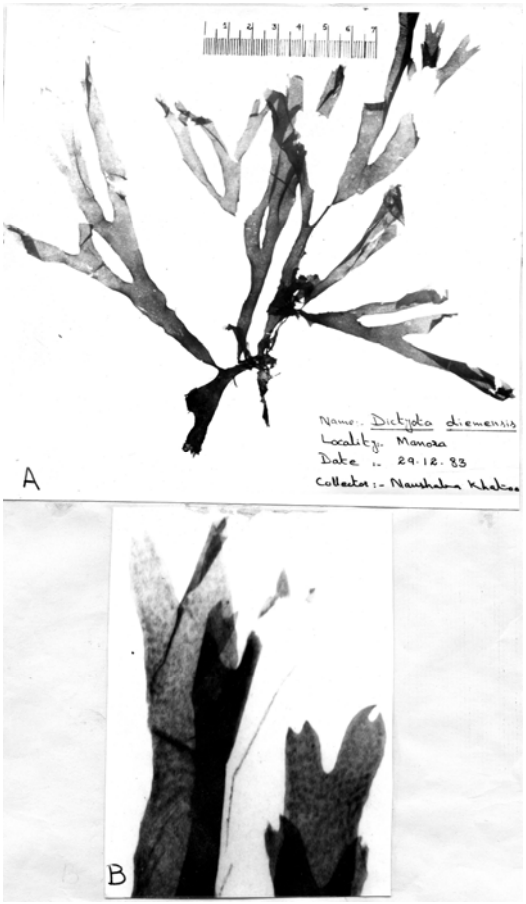


Fig. 1. *Dictyota diemensis* kuetzing.
A. Habit of the plant; B. segments showing acute incurved apices and antheridial sori.

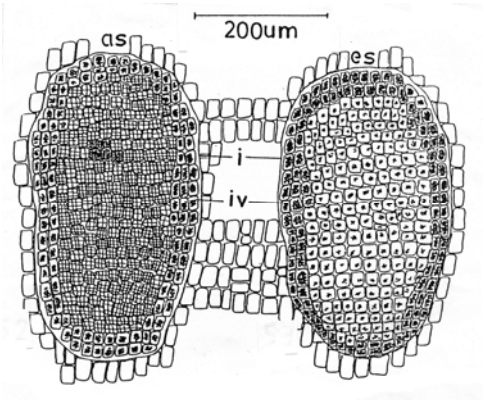


Fig. 2. *Dictyota diemensis* Kuetzing.
Surface view showing antheridial mature and empty sori.

Pakistani specimens of *Dictyota diemensis* resembles the South Australian specimens described by Womersley (1987) in all aspects. He reported two forms i.e., narrow (from rocky pools) and broad forms (from deeper water), due to their growth in different habitats and tide levels. Pakistani specimens are broader form (4-7mm) and was collected as drift, may be growing in deeper water. Womersley (1987) also reported it as the inhabitant of deeper water.

***Dictyota hauckiana* Nizam (Figs. 3-5)**

**Syn.** *Dictyota atomaria* Hauck 1884: 235. Boergesen, 1932: 69; 1935: 39; 1937: 27. Durairatnam, 1961: 38; Misra, 1966: 141. Nizamuddin, 1975: 349; Shameel, 1987: 513; 1989; 179. Begum & Khatoon, 1988: 296; Shaikh & Shameel, 1995: 38

Plants tufted, large, 12-45cm high erect, thin, yellowish to greenish brown; attached by rhizoidal holdfast; stipe small 1-2 x 1-2mm. Thallus cuneate below, 2-5mm broad, smooth, thick, blackish brown, 1-2 times dichotomously branched, gradually increasing in width upwards; middle to upper part of the thallus thin, strap-shaped, 1-4cm broad, 1-5 times dichotomously branched. Apices mostly bifid, irregular or round, rarely acute; sinuses broadly round to obtuse. In younger plants surface smooth and margin entire or denticulate or spinose; older plants with rough or wavy surface, margin dentatate or proliferated (mostly at the lower part of the thallus. Proliferations leafy, with bifid round to acute apices; surface smooth; margin denticulate.

In C.S. upper part of the thallus 120 µm thick; medullary cells 10 µm high, 95-100 µm broad; assimilatory cells 16 µm high and broad. Lower part 170 µm thick; medullary cells 105 µm high, 95 µm broad; assimilatory cells 28 µm high and broad. Rhizoids uniseriate, septate, simple (-branched), 15 µm broad.

Tetrasporangia blackish brown, large, round to globular in shape. In C.S. round to spherical and globular, 110 µm high, 105 µ m broad. Oogonial sori squarish to elongate, oogonia blackish, elongate to pear-shaped in S.V., in C.S. broadly elongate with broad apex, 85µm broad, stalked (1-celled). Antheridial sori squarish, elongate and oval in shape, yellowish brown. Antheridia narrowly elongate, 80 µm high, 45 µm broad, involucres 85 µm high, 45 µm broad, induciate and stalked.

**Ecology:** *D. hauckiana* commonly occurs at Karachi coast and is the inhabitant of sand covered rocks, sandy bottom pools and flat sandy and stony areas from mid to lower water mark at the coast of Manora and Buleji. It was always collected as drift from Hawkes Bay and Paradise Point. It also grows in association of *Spatoglossum variabile* Fig. *et* De Not.

**Local distribution:** Manora (Leg. M. Nizamuddin, 6 IL. 1961; 8.2. 1963; 28.8; 1968; M. Begum & N. Khatoon, 31.3. 1982; 9.4. 1982; 5.5. 1982; 9.10. 1982; 1.11. 1982; 19.12. 1982; 7.1. 1983; 19.2. 1983; 27.3. 1983; 7.4. 1983; 8.5. 1983; 5.5. 1983; 29.11. 1983; 19.12. 1983; 17.1. 1984; 11.2. 1984; 7.3.1984; 4.5. 1984; 21.3. 1985; 28.12. 1985. Sandspit (Leg. M. Nizamuddin, 1.1. 1963). Hawkes Bay (Leg. M. Begum & N. Khatoon, 31.3. 1982; M. Begum & N. Khatoon, 9.4. 1982; 21.3. 1985; M. Begum, 21.11. 1986; Buleji (Leg. M. Begum & N. Khatoon, 31.3. 1982; 26.1. 1983. Paradise point (Leg. M. Nizamuddin, 7.1. 1962; M. Begum & N. Khatoon, 9.4. 1982.)

**Geographical distribution:** Endemic to eastern and northern coast of Arabian Sea (Pakistan and India).

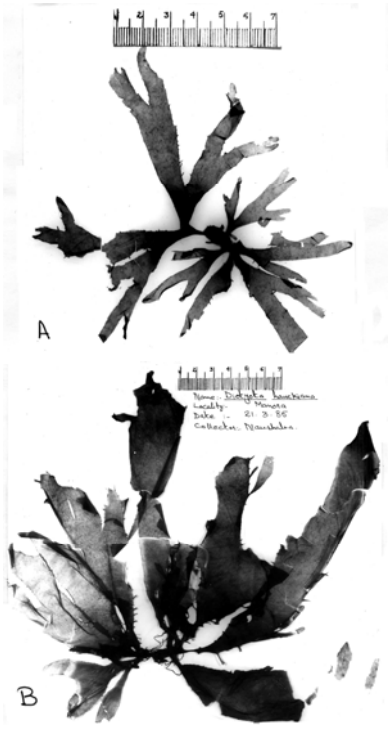


Fig. 3. *Dictyota hauckiana* Nizamuddin.
A. Small plant with dentate margin; B. Large plant with dentate and proliferated margin.

Pakistani specimens resemble Indian specimens described by Boergesen (1935, 1937) and Misra (1966) and Ceylon specimens by Durairatnam (1961). The small or young plant differs from the specimens described by Durairatnam due to the presence of dentations. This specimen also resemble to the briefly described specimen by Shaikh & Shameel (1995) but differs in having stipe, lower part of the thallus narrow gradually increasing in width with greater number of dichotomous branching, younger plants denticulate and older ones with proliferations instead of uniform width and dichotomous branching, margin dentate and proliferation arises from upper portion of the thallus.

***Dictoyota dichotoma* (Huds) Lamour (Figs. 6-7)**

**Syn:** *Zonaria dichotoma* C. Ag. 1817:20; 1823: 133; 1824: 266. *D. attenuata* Kütz 1859: 6, pl. 11, f.1. *D. elongata* Kütz 1859: 6, pl. 11, f.2. *D. latifolia* Kütz 1859, pl. 12, f.1. *D. pardalis* Kütz 1859, pl. 39, f.2.1960: *D. volubilis* Kütz 1859, pl. 13, f.1. *D. vulgaris* Kütz 1859, pl. 10, f.2. J. Ag. 1848: 42; Trevisan, 1849; 451. Kütz, 1859: 5, pt. 10, f.1. Hoyt, 1920; 46. Yamada, 1925: 253; Grev 1930: 57. Newton 1931: 212. Boergesen 1937: 72. Taylor 1942: 58, 1960: 40; 1962: 50; 1964: 4; 1969: 158. Nasr 1947: 79. Dawson 1954: 401. Almodovar & Blomquist 1961: 87. Durairatnam 1961: 38. Chapman 1963: 31. Misra 1966: 132. Womersley 1967: 208. Jaasund 1970: 78. Richardson 1975: 100. Nizamuddin *et al*., 1978: 468. Price & John 1979: 329. Lee 1980: 265. Nizamuddin 1981: 41. Silva *et al*., 1987: 76. Womersley 1987: 194. Begum & Khatoom 1988: 295. Shameel 1989: 179. Nizamuddin, 1981: 41. Shaikh and Shameel, 1995: 38.

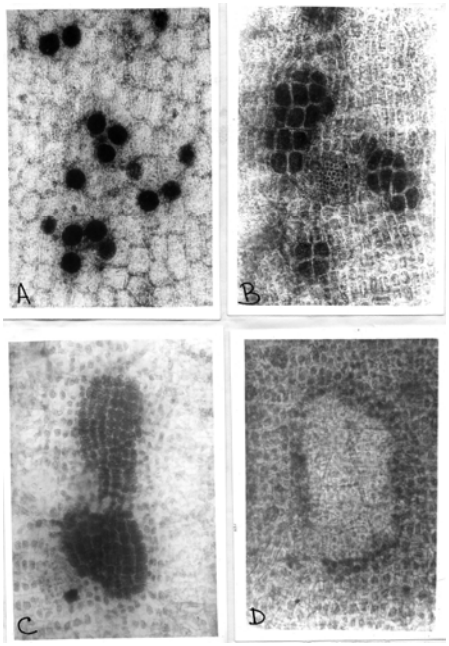


Fig. 4. *Dictyota hauckiana* Nizamuddin. Surface view showing.
A. Tetrasporangia, 230x; B. Oogonial sori; C. Antheridial soril; D. Empty antheridial sori with involucres, 550x.

Plants upto 14 cm erect, thin, flat, ribbon-like, greenish to yellowish brown in colour; attached by rhizoidal holdfast. Thallus regularly dichotomously branched; sinuses narrowly obtuse or broadly acute; segments become broad 4-8 (-10mm) before bifurcation. Lower segments thick, dark to blackish brown, 3-5mm broad, internodal segments 1-2 cm long; upper segments thin, yellowish to greenish brown, 2-3mm broad, internodal segments 5mm-10mm long. Apices broadly and narrowly round, obtuse or blunt.

In C.S. upper part of the thallus 95 µm thick; medullary cells squarish 70 µm assimilatory cells squrarish µm. Lower part 200 µm thick; medullary cells 160 µm high, 120-130 µm broad; assimilatory cells squarish 18 µm.

Hairs 14 µm broad, irregularly scattered or associated with reproductive organs.

Tetrasporangia ovate or round in shape in surface view. In C.S. 120 µm high and 75 µm broad. Oogonial sori blackish brown, round, elongate or oval, in surface view. In C.S. oogonia broadly elongate with narrow base and broad apex, 65 µm high, 30 µm broad. Antheridial sori yellowish brown, oval to elongate. In C.S. antheridia narrowly elongate, 75 µm high, 21 µm broad, 2-4 celled in width; involucres 80 µm high, 20 µm broad.

**Ecology:** *D. dichotoma* is common in occurrence and found growing on send covered rocks and in rock pools from mid-to lowr-water mark at Manora and Buleji but rare at Paradiase Point (collected as drift). Salim (1965) also reported it as drift from Karachi coast. Nizamuddin (1981) collected from muddy, rocky flat of littoral region from a depth of 75-90 m on Syrte Bay, Libya. Peterson (1918) collected at 35 m from Tripoli and recently Kajimura (1987) from 20-25 m from Japan. It appears that *D. dichotoma* grows in lower tide level in different geographical locations.

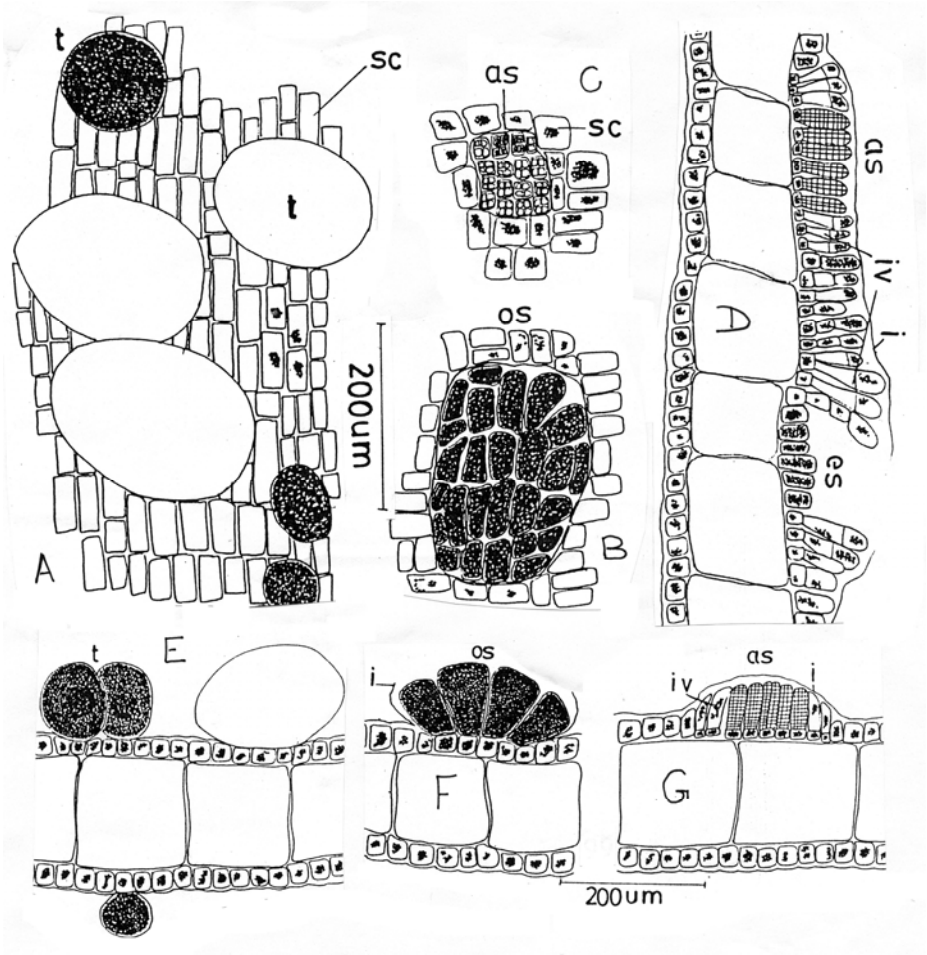


Fig. 5. *Dictyota hauckiana* Nizamuddin: Surfae view.
A. Tetrasporangia; B. Oogonia; C. Antheridia; D-F. T.S. of the thallus through reproductive organs; D. Mature and empty antheridial sori; E. Tetrasporangia; F. Oogonia; G. Antheridia.

**Local distribution:** Manora (Leg. *Bilgrami*, 28.12. 1961; M. Nizamuddin, 30.10. 1963; 29.11. 1963; 8.12. 1963; which Khan, 23.3. 1966; Arshad, 66.11.1973; M. Begum & Khatoon, 31.3. 1982; i. 5. 1982; 16.10. 1982; 1.11. 1982; 12.12. 1982; 19.2. 1983; 5.3. 1983; 27.5. 1983; 22.10. 1983; 29.11.1983; 19.12. 1983; 11.2.1984; 19.12.1984. Hawkes Bay (Leg. M. Begum & N. Khatoon, 9.4. 1982. Buleji (Lig. M. Begum & N. Khatoon, 26.1. 1983; 22.10. 1983; 19.12. 1984. Paradise point (Leg. M. Nizaduddin, 7.1. 1962; M. Begum & N. Khatoon, 31.3. 1982. Cape Monze (Leg. M. Nizamuddin, 30.12 1964).

**Geographical distribution:** Arabian Sea: Ceylon, Tuticorin, west coast of India and Pakistan. Pacific ocean: Philippines, Japan, Australia. Atlantic Ocean: West Indies, Florida, England, Helogland. Mediterranean Sea: Spain, France, Italy, Sicily, Yugoslavia, Greece, Libya, Tunisia, Morocco.

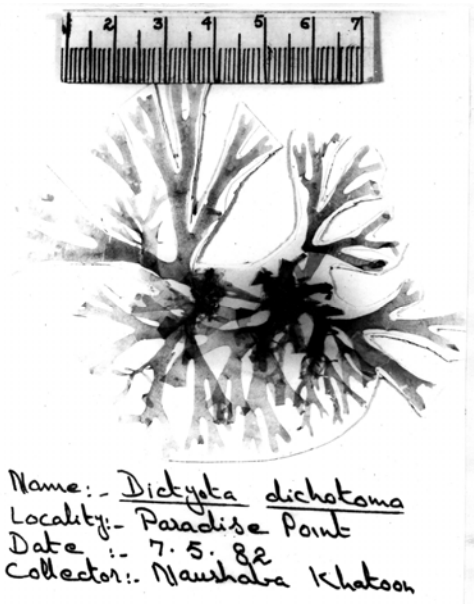


Fig. 6. *Dictyota dichotoma* (Hudson) Lamouroux. Plant with regular dichotomous branching.

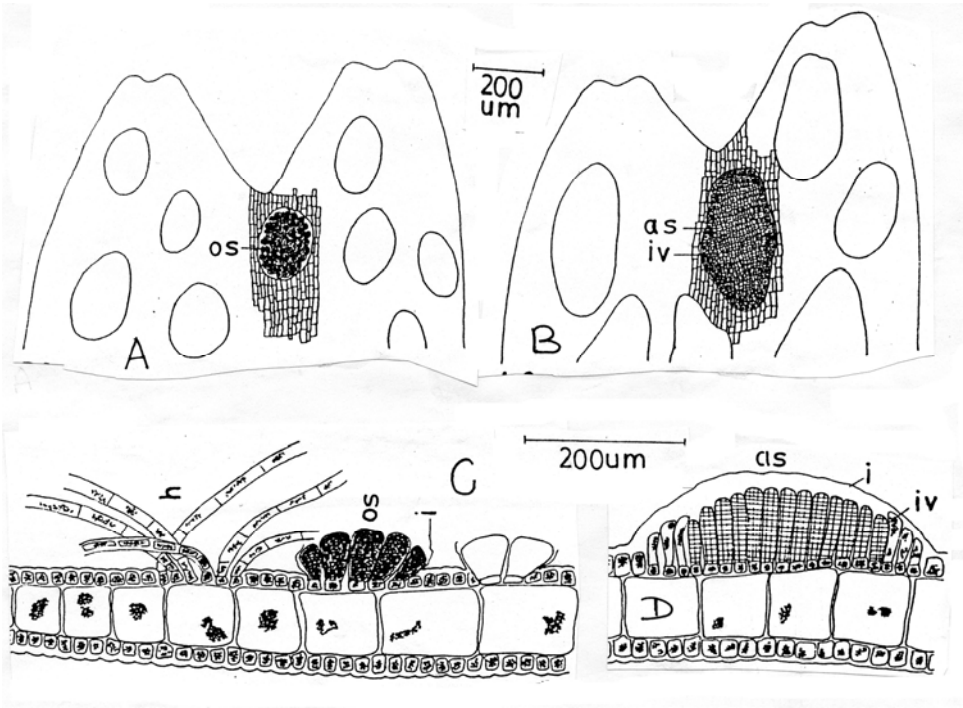


Fig. 7. *Dictyota dichotoma* (Hudson) Lamouroux. Surface view showing.
A. Oogonial sori; B. Antheridial sori; C. T.S. of the thallus through oogonial sori and hair; D. T.S. of the thallus through antheridial sori and involucres.

Pakistani specimens of *Dichotoma resemble* specimens from Britain (Newton, 1931), Ceylon (Durairatnam, 1961), Jamaica (Chapman, 1963), India (Misra, 1966), West Indies (Richardson, 1975), Libya (Nizamuddin, 1981), Southern Australia (Womersley, 1987), Pakistan (Shaikh & Shameel, 1995) but differs from the British specimens in broader segment at the base, from Jamica in the absence of proliferations at the margin, South Australian specimens in the absence of spirally twisted branches, from Ceylon in the absence of rhizome-like holdfast. It also differs from briefly described specimen from Pakistan by Shaikh & Shameel (1995) in the presence of broad segments before bifurcation, lower segments dark brown, upper segments yellowish to greenish brown broad with short inter nodal segments.

***Dictyota dichotoma* (Hud) Lamour var. *intricata* (C. Ag Grev (Figs. 8-9)**

**Basn:** *Zonaria dichotoma* var. *intricate* C. Ag 1823: 134; 1824: 266.

**Syn:** *Zonaria implexa* (Lamour.) C. Ag 1817: 21. *Dictyota dichotoma* var. *implexa* (Lamour.). J.Ag. 1848: 92. Newton 1931: 212.

Misra, 1966: 133. Papenfuss, 1968: 33. Nizamuddin, 1981: 45. Begum & Khatoon, 1988: 296.

Plants thin, erect, upto 22 cm high yellowish or blackish brown, twisted; branches much entangled and forming ball of thallus. Lower segments thick, 3-5mm broad, flat, blackish brown, distantly dichotomously branched, upper part dichotomously much branched, segments linear, narrow, 0.5-1mm broad, divaricated. Apices acute; sinuses broadly acute.

In C.S. upper part of the thallus 130 µm thick; medullary cells 100 µm high, 110 µm broad; assimilatory cells 15 µm high and broad. Lower part 245 µm thick at the center but become narrow at the margin, 170 µm thick; medullary cells 160-210 µm high, 65-115 µm broad at the center, 60 µm high, 50 µm broad at the margin; assimilatory cells squarish 20µm. Segments of the lower part of the thallus attached with each other.

Tetrasporangia ovate to spherical in surface view, 135 µm high, 100 µm broad. Hairs rarely seen, uniseriate, unbranched, 18 µm broad.

**Ecology:** *D. dichotoma* var. *intricata* found rare in occurrence and grows in sandy bottom pools from mid to lower water mark at Manora and Buleji, but it was very rare and collected as drift from Hawkes Bay and Paradise point.

**Local distribution:** Manora (Leg. M. Nizamuddin, 6.11. 1964; 23.3. 1966. Hawkes Bay (Leg. M. Nizamuddin, 21.11. 1964; 13.3. 1964; M. Begum & N. Khatoon, 31. 3. 1982. Buleji (Leg. M. Begum & N. Khatoon, 31.3. 1982; 21.1. 1983. Paradise point (Leg. M. Begum & N. Khatoon, 31.3. 1982.

**Geographical distribution:** Arabian Sea: India, Karachi (Pakistan). Mediterranean Sea: France, Italy, Sicily, Yugoslavia, Greece, Libya. Atlantic Ocean: England.

The Karachi specimens of *D. dichotoma* Lamour. var. *intricata* (C. Ag) Grev. resemble the specimens from Libya (Nizamuddin, 1981), but differs being rhizoids arising from the lower part of the thallus, narrow segments and thick thallus. *D. dichotoma* var. *intricata* also resemble with *D. dichotoma* but is distinguished by narrow, linear segments, acute divaricate apices and medullary cells mostly narrower than breadth at the lower part of the thallus.


Fig. 8. *Dictyota dichotoma* (Hudson) Lamouroux var. *Intricata* (C. Agardh) Greville.
A. Habit of the plant; B. plant showing much intermingled narrow segments.

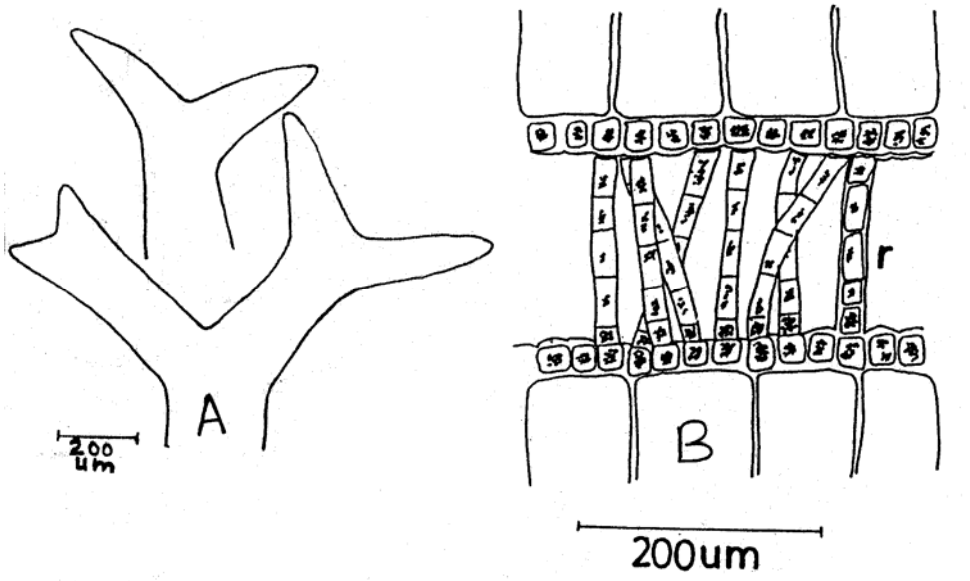


Fig. 9. *Dictyota dichotoma* (Hudson) Lamouroux var. *Intricata* (C. Agardh) Greville.
A. Apices of the segment; B. T.S. of the thallus showing attachment of segments by means of rhizoids.
Legend: as, anteridial sori; es, empty sori; h, hairs; I, inducim; iv, involucres; os, oogonial sori; r, rhizoids; sc, surface cells; t, tetrasporangia.

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