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Tylotus (Gigartinales, Rhodophyceae), a genus known in Australia and Japan, newly recorded in South Africa

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Recent studies on *Tylotus* have shown that all species except the type and one from Japan have been transferred to *Gracilaria*, Plants found in Natal, which are gametophytic, have characters similar to the type species, *T. obtusatus*. Distribution of this species was restricted to southern Australia but the discovery of it in Natal has extended its distribution across the Indian Ocean. This is the first record for any species of the Dicranemaceae in Africa.

Key Index Words: *Dicranemaceae*; *Gigartinales*; *red algae*; *Rhodophyceae*; *South African algae*; Tylotus.

Coriaceous blade-like thalli characterize the genus *Tylotus* J. AGARDH (1876), the irregularly divided blades, usually repent, arising from a basal prostrate section that is attached by peg-like outgrowths from the lower surface. These outgrowths give the thallus an essentially dorsi-ventral habit that is also reflected in the reproductive structures on the monoecious gametophytes that have male structures only on the upper surface and female reproductive structures on the lower side (KRAFT 1977a). The thallus medulla is comprised of large thick-walled, angular cells and the cortex of smaller cells growing in short filaments perpendicular to the thallus surface. Characteristics of the female reproductive system have been studied by KRAFT (1977a) for the type species, *T. obtusatus*, revealing that its structure is different from the Gracilariaceae, where it had been placed by KYLIN (1932, 1956), and that it has characteristics similar to the Dicranemaceae of the Gigartinales. The production of zonate tetrasporangia in *Tylotus obtusatus* also reinforces the removal of *Tylotus* from the Gracilariaceae, a family in which cruciately divided tetrasporangia are always produced. KRAFT (1977b) reviewed the present status of *Tylotus*' systematics revealing that besides the type species only one other species, *T. lichenoides* OKAMURA (1921), from Japan, remains in the genus.

Tylotus obtusatus is found on Australia's southern coast but has not been previously discovered outside that region. A few specimens of this species have been found amongst Dr. M. A. POCOCK's Natal collections of marine algae, thereby extending the range of the species across the Indian Ocean to the shores of Africa. Furthermore, the family, Dicranemaceae, has not been previously recorded on the African shores.

Materials and Methods

Three specimens of *Tylotus obtusatus* are in Dr. POCOCK's herbarium at the Albany Museum in Grahamstown (GRA). One specimen (Pocock no. 9675) was collected in the drift at Richard's Bay (17 Oct. 1951) and the other two are from an intertidal collection at Crayfish Point, St. Lucia Rocks (20 Oct. 1951, Pocock nos 9800 & 9860).

Dr. POCOCK made a drawing of one specimen before it was mounted on the herbarium sheet, clearly depicting the prostrate proximal part of the thallus and the peg-like outgrowths that attach the plant. Because only herbarium specimens are available of this species all side preparations were prepared by sectioning fragments of dried thalli, soaking the sections in water and then staining in a 1% aniline blue, 20% Karo mounting medium.

Results and Discussion

The thalli of the Natalian *Tylotus* are subdichotomously branched, up to eight centimeters long and the branches are up to approximately one centimeter broad except in distal regions where some of them expand to two centimeters (Fig. 1). The thallus margins are irregularly crentate and thickened in distal regions but are entire and unthickened in proximal parts (Fig. 1).

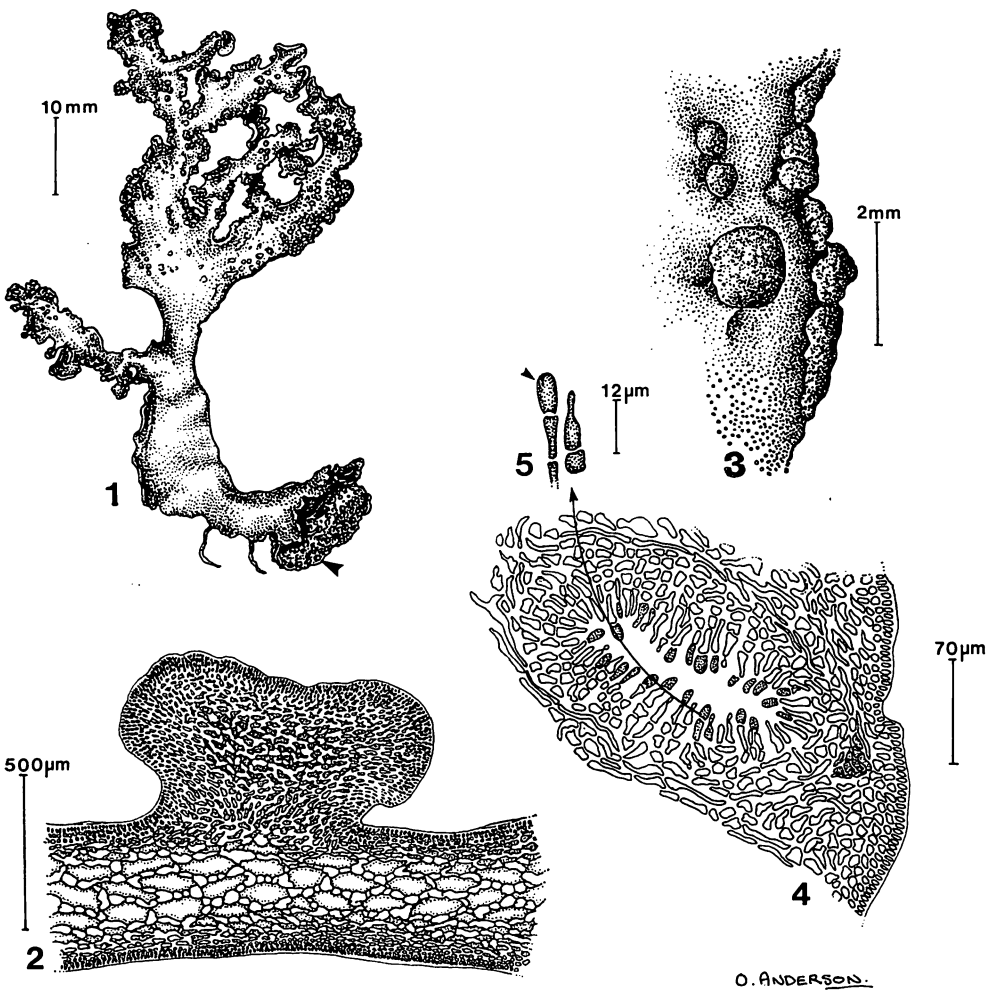

Fig. 1. Habit of *Tylotus obtusatus* from Natal (GRA, Pocock No. 9800). Note rhizomatous and peg-like outgrowths (large arrow-head) from the lower side of the thallus. Fig. 2. Section of thallus showing a surface protuberance on which are borne carpogonial branches (not shown). Fig. 3. Surface view of thallus showing surface protuberances, the largest contains a cystocarp. Fig. 4. Cellular details of a single locule in a cystocarp in which short gonimoblast filaments terminate in single carposporangia. Fig. 5. Detail of the terminal part of two adjacent gonimoblast filaments from Fig. 4 (arrow) showing a young carposporangium (small arrow-head).

In section the thalli are up to 500 μm thick and comprised of large pseudoparenchymatous medullary cells that measure up to 50×125 μm and smaller cortical pseudoparenchyma cells that are covered by an outer cortex of small cells, 5 μm in diameter (Figs. 1 and 2). Cell walls of medullary and inner cortical cells in mature parts of thalli are very broad in section, measuring up to 15 μm thick (Fig. 2).

The vegetative structure and form of the South African plants is similar to the type species of *Tylotus*, *T. obtusatus* (SONDER) J. AGARDH (1876). The only other species of *Tylotus*, *T. lichenoides* OKAMURA (1921) has not been studied from the point of view of KRAFT's recent analysis of *Tylotus*, but if the Japanese plant is a *Tylotus*, its shorter, somewhat broader branches indicate that it may be a species separate from *T. obtusatus*. KRAFT (1977a), however, noted that some Australian plants sometimes are similar to the form described for *T. lichenoides*.

All of the plants in the Natal collection are gametophytes, two of them producing cystocarps. KRAFT (1977a) noticed a dorsoventral arrangement of male and female reproductive cells in the Australian thalli, the males being produced on the 'upper' surface and female reproductive structures on the 'lower' side of the thallus. Natalian plants produce carpogonial branches in protuberances (Figs. 2 and 3) on the thallus upper surface and clusters of male reproductive organs, as illustrated by KRAFT (1977a), have not been found. Instead, in the Natalian thalli, what appear to be male reproductive cells are borne singly on outer cortical cells in scattered irregular positions on either surface of the thalli. Many carpogonial branches are formed in the large protuberances each having three cells that are laterally attached to a subcortical cell, the supporting cell. All of these cells have a denser protoplasmic material than the surrounding cells of the cortex giving a slightly darker stain in the sections. KRAFT (1977a) gave convincing evidence that the reproductive system is procarpic, the supporting cells functioning as auxiliary cells, and my observations support his conclusion. Sometimes several fusion cells in a protuberance were found in the Natal plants indicating, presumably, that multiple fertilizations or possibly diploidizations have taken place. A section through cystocarps shows a highly convoluted gonimoblast causing an eruption above the protuberance surface but in some cases it seems that adjacent cystocarps have fused into one on the protuberance. Gonimoblast filaments form a thin layer of tissue lining the cavities of the cystocarp (Fig. 4), producing upright short filaments that terminate in single carposporangia (Fig. 5). The cavities in the cystocarps are narrow and it could not be determined whether or not they form a continuous system. A definite ostiole has not been observed on cystocarps of the Natal plants although they were observed in those from Australia. Cystocarps often become eroded thereby releasing the carpospores.

Tetrasporophytes have not been found in South Africa.

KRAFT (1977a, b) characterized *Tylotus* as the only pseudoparenchymatous and procarpial member of the Dicranemaceae. KRAFT placed the genus in this family, removing it from the Gracilariaceae where KYLIN (1956) had placed it, because of early stages in growth of the gonimoblast as well as tetrasporangial and male reproductive characteristics. He also noted that the single terminal carposporangia and the hemispherical-shaped cystocarps are characteristic of Dicranemaceae. Cystocarps on Natal specimens have the hemispherical-shaped structure with a continuous narrow lumen above the gonimoblast in early stages of development. Older cystocarps become more protuberant, sometimes being almost spheroidal, and the gonimoblast becomes highly convoluted forming narrow cavities that probably are continuous throughout the cystocarp but this could not be determined with certainty. KRAFT showed a convoluted gonimoblast in his figures of *Tylotus obtu-*

satus but the configuration is far more extensive and complex in the South African specimens. The presence of carpogonial branches on protuberances in the Natal specimens is different from KRAFT's description of *Tylotus obtusus* from Australia. In addition, there may be a difference in male reproductive structures but this needs to be confirmed with more extensive collections in Natal. Neither of these differences seems to be reason, at the present time, to establish a new species for the South African plants, especially because the general structure of the thalli is similar to the Australian type species.

Comparison of *Tylotus obtusatus* with species in the genus *Curdiea* are of interest because of the strong similarity between the two genera in vegetative structure and in form of cystocarps. Both genera have thickly coriaceous subdichotomously branched thalli. I have compared the Natalian specimens of *Tylotus* with the numerous specimens of several species belonging to *Curdiea* that I collected in Australia, specimens that are now in the Herbarium of the University of Natal. *Curdiea* is not a well-known genus but seems to belong in the Gracilariaceae, probably quite closely related to *Gracilaria* (*sensu* FREDERICQ and NORRIS 1985). My examination of specimens has shown that the two genera can be separated on the following characters: 1) thalli of *Tylotus* attach by specialized peg-like outgrowths whereas *Curdiea* attaches by a tightly adherant discoid holdfast; 2) the large medullary cells of *Curdiea* have moderately thick walls, not clearly discrete for each cell, that often have calcite granules between them as well as many secondary pit connections with adjacent cells, but these large cells in *Tylotus* have fewer pit connections and thicker discrete walls that never seem to have calcite granules between them; 3) the cortex of *Curdiea* has many small cells in rows perpendicular to the thallus surface but in *Tylotus* the cortex is relatively thin, consisting of only a few (1-4) cells in a series; 4) cystocarps of *Curdiea* are spheroidal, the gonimoblast radiating from a basal mass of pseudoparenchyma and carposporangia occurring in long chains; in *Tylotus* cystocarps are hemispherical to spheroidal the gonimoblast forming an invasive core of pseudoparenchyma (branched in older cystocarps and perhaps with vegetative tissue) into the center of the cystocarp, the tissue becoming convoluted and the cavities lined with short gonimoblast filaments that terminate in single carposporangia. In addition, tetrasporophytes of the two genera can be distinguished by the zonately divided sporangia in *Tylotus* contrasted with the cruciately divided sporangia in *Curdiea*.

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ノリス, R. E.: ナミイワタケ属（紅藻スギノリ目）藻類　南アフリカに産す

ナミイワタケ属 *Tylotus* に関する近年の研究により，本属のタイプと日本産の１種を除き，本属にいれられていた種は全てオゴノリ属 *Gracilaria* に移された。南アフリカのナタル産の標本（配偶体）を調べたところ，この藻体はタイプ標本（*T. obtusatus*）と同じ特徴を備えていることが明らかになった。本種の分布は南部オーストラリアに限られるとされていたが，本研究の結果，その分布域はインド洋を越えて南アフリカにまで及ぶことになる。これは，また，アフリカにおける Dicranemaceae 藻類の最初の記録である。（南アフリカ　ナタル大学植物学教室）