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## On the Identity of *Vaucheria submarina* auct. (Tribophyceae)

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The name *Vaucheria submarina* (Lyngbye) Berkeley was first used for a plant from Weymouth, and has later been applied to algal finds from other parts of the world. Some of these algae have also been referred to *V. pilus* Mertens in von Martens or to *V. dichotoma* (L.) Martius.

After a survey of the finds and the naming of them it is concluded that all three specific names must be rejected for the algae in question. As recent observations on *V. velutina* C. Ag. suggest a close relationship between this species and all or most of the finds, the name *V. velutina* var. *separata* is introduced, typified by de Wildeman's description of the reputed *V. submarina*.

In preparing the text on Tribophyceae for *Seaweeds of the British Isles* (Christensen, 1986), efforts have been made to clear up the identity of the plants referred to *Vaucheria submarina* (Lyngbye) Berkeley. The study has led to the conclusion that these plants—or at least the best known of them—should be referred to *V. velutina* C. Ag. under a new varietal name. This transfer is undertaken here after presentation of the background.

### OBSERVATIONS AND DISCUSSION

In 1833 Berkeley reported on the finding of an alga which he regarded as identical with *V. dichotoma*  $\beta$  *submarina* Lyngbye. He gave an illustration of the plant and, in applying Lyngbye's epithet, elevated the former variety to the rank of species. The illustration, which is reproduced as Fig. 1 in the present paper, shows few details. One part of his material, first kept in his private herbarium, is now in the Kew collection transferred to the British Museum (Natural History); another part is in the Greville herbarium at the Royal Botanic Garden in Edinburgh. A drawing has previously been published (Christensen, 1952) showing oogonia from the very small portion at the

British Museum then regarded as type material of Berkeley's species. The larger Edinburgh sample has not only sexual organs (Figs 2–4) but also some oospores (Fig. 5).

Berkeley found his material "at Weymouth, immediately under Sandown Castle", "in muddy spots covered by the sea every tide". Since then, much of the sediment has probably been washed away right up to the foot of the cliff at Sandsfoot Castle. (Berkeley may have confused Sandsfoot with Sandown Castle on the Isle of Wight.) The vegetation today is dominated by larger epilithic algae with *Zostera* between the rocks. Once in 1880 and twice in 1884, however, Holmes collected a similar alga in the same area, only closer to the Island of Portland. In his *exsiccata Algae Britannicae rariores* he issued dried material of this plant collected in September 1884, and in a subsequent paper (1886) he described it in detail, redrawing for it two illustrations of material from the Adriatic published by Hauck (1878) and later used by the same author in his section of Rabenhorst's *Kryptogamen-Flora* (1885). The two illustrations by Hauck are reproduced here as Figs 9 and 10. Holmes placed his plant under *V. dichotoma* as f. or var. *submarina*.

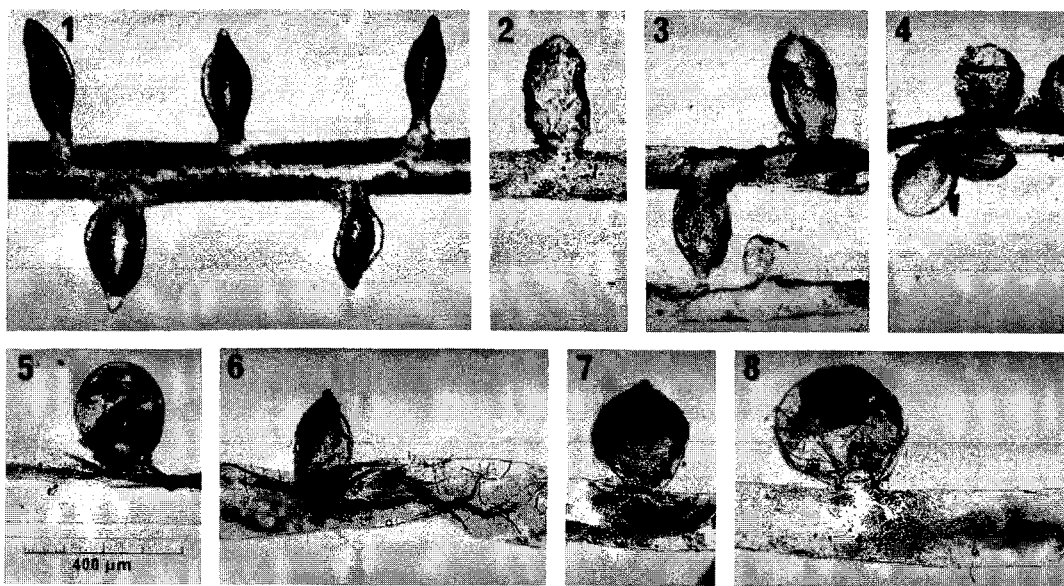


FIG. 1. Illustration from Berkeley (1833), showing his *Vaucheria* from Weymouth. Figs 2–5. Part of Berkeley's material kept in Edinburgh. Figs 2–4. Larger and smaller oogonia, probably all abortive, in Fig. 3 probably also an antheridium. Fig. 5. Oogonium with oospore. Figs 6–8. Part of material collected by Holmes nearby but closer to the Isle of Portland and kept in the British Museum. The fully flattened parts of the tubes in Figs 6 and 8 show that the diameter has been far greater than the width of those in Figs 18–22.

Hauck had previously (1876) recorded his find as *V. submarina*, but in his 1878 paper he referred it to *V. pilus* Mertens in von Martens (1824), and in the *Kryptogamen-Flora* he called it *V. dichotoma* f. *marina*. Both authors declared the plant to be dioecious. Drawings of unfertilized oogonia from the exsiccata of Holmes have been published previously (Christensen, 1952). These drawings should be compared with Figs 6–8, which show sexual organs from material collected by Holmes east of Ferry Bridge in October 1884 and placed in the British Museum from his personal herbarium.

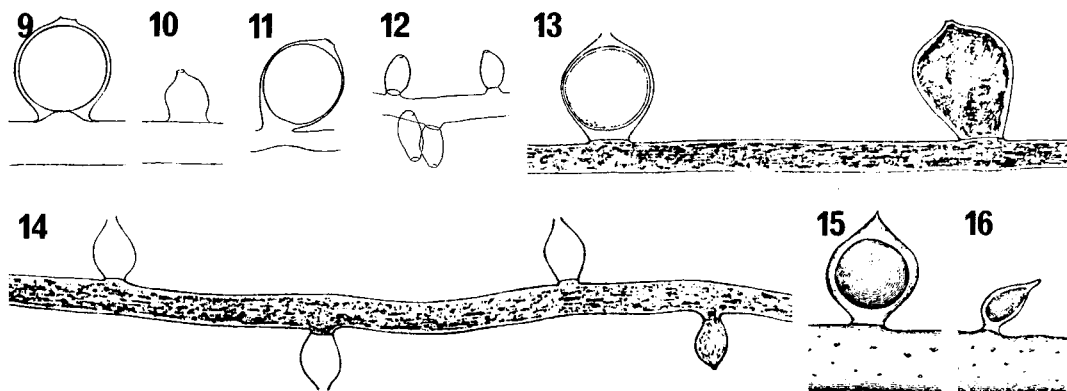
In 1888 Dupray published the drawings rendered here as Figs 15 and 16, showing a fertilized oogonium and an antheridium of similar material collected in Calvados, Northern France. Dupray, too, regarded the plant as a variety of *V. dichotoma*.

De Wildeman (1897) described a *Vaucheria* from Java and provisionally referred it to *V. submarina* (Lyngbye) Berkeley. He gave good illustrations of it,

two of them rendered here as Figs 13 and 14.

Blum & Wilce (1958) reported and illustrated a similar alga from the east coast of Canada as *Vaucheria submarina* Berk. *sensu de Wildeman*, expressing their doubt with regard to the identity of Berkeley's plant and also with regard to the relationship between their own plant and *V. dichotoma*. Two of their illustrations are given here as Figs 11 and 12.

Since the code of botanical nomenclature has been clarified by what is now Paragraph 10 of Art. 7, Berkeley's material can no longer be considered as type of *V. submarina* (Lyngbye) Berkeley. Instead, this species is typified by the description by Lyngbye, as no authentic Lyngbye material seems to exist. Lyngbye's text gives little information, and neither Berkeley's plant nor any other known *Vaucheria* comes very close to his illustrations. So *V. submarina* can only be regarded as a *species dubia*. The same applies to *V. pilus*, the name used by Hauck (1878), since this species was only characterized by



FIGS 9, 10. Illustrations from Hauck (1878), showing an oogonium and an antheridium from a *Vaucheria* collected on the Adriatic coast. FIGS 11, 12. Illustrations from Blum & Wilce (1958), showing an oogonium and a group of antheridia from a *Vaucheria* collected in a Québec salt marsh. FIGS 13, 14. Illustrations from de Wildeman (1897), showing oogonia and antheridia of *Vaucheria velutina* var. *separata* var. nov. FIGS 15, 16. Illustrations from Dupray (1888), showing an oogonium and an antheridium from a *Vaucheria* collected in Normandy.—The magnifications of the various illustrations have been adjusted to that in Figs 2–8 on the basis of the dimensions indicated by the respective authors, the disproportionate filament width given by Dupray (800  $\mu$ m) being disregarded.

vegetative features by its author. The third name applied to some of the algae in Figs 6–16, is that of *V. dichotoma* (L.) Martius, a well-defined species, which is known to vary considerably. With some caution, I have previously supported the idea that the plants of Berkeley and Holmes might be referred to this species (Christensen, 1952). Having seen oospores in the Edinburgh material of Berkeley's plant and having visited the localities at Weymouth, I must now agree on morphological as well as ecological grounds that these plants cannot belong in *V. dichotoma*. The loose oospore not coalescing with the oogonium wall, and the relatively wide connexion between the sexual organs and the filament are features not shown by this species, and conditions at the stations are not suitable for it. On the other hand both features are present in *V. velutina* C. Ag., and this is also the species found on sheltered intertidal flats at Weymouth today.

The idea of referring the plants in Figs 1–16 to *V. velutina* may seem unnatural. *V. velutina* is monoecious. Typically it has a small group of antheridia at each oogonium, and the oogonium is more or less bent in the direction of the filament

tip, all or most antheridia being situated in the same direction (Figs 17, 18). This is not only true in the geographic area of the type but also applies to material from the Pacific coast of North America and material from the south coast of Australia. However, a recent collection of *V. velutina* shows that the grouping of the sexual organs is not a fully constant feature of this species. The plant in question was found in August 1983, forming rather extensive somewhat tufted growths on part of the intertidal sand flat just south of Ferry Bridge between Weymouth and the Isle of Portland, close to where Holmes collected his material a century earlier. The alga had some sexual organs at the time of collecting, and these looked normal. When grown in crude cultures at salinities about 20‰ (the plants in Figs 18, 19, 22) or about 30‰ (those in Figs 20, 21), a temperature of 15° and an irradiance of approximately 6 W m<sup>-2</sup>, however, it showed an unusual variation. Some filaments had the normal configuration of male and female organs (Fig. 18), some had only oogonia (Fig. 19), some had only antheridia (Fig. 20), and in some the sexual organs were more or less consistently upright, rather irregularly scattered over the

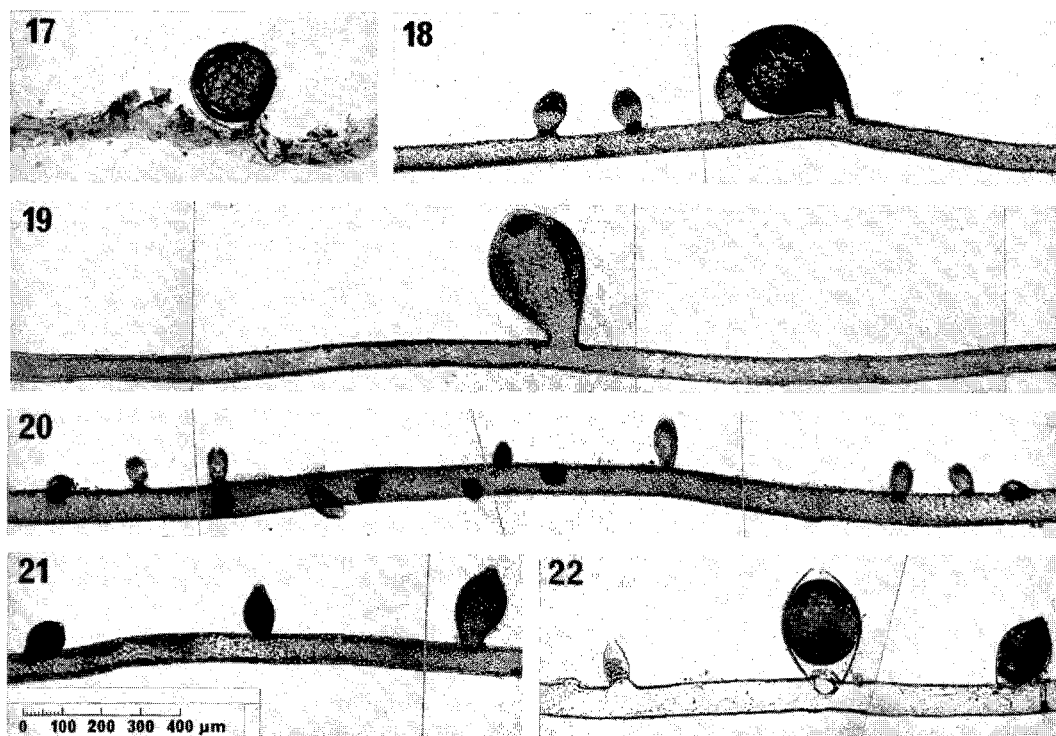


FIG. 17. *Vaucheria velutina*, part of type material. FIGS 18–22. *Vaucheria velutina*, from crude cultures of material collected south of Ferry Bridge, Weymouth. Fig. 18. Normal configuration. Fig. 19. Oogonium without antheridia. Fig. 20. Group of antheridia without oogonium. (Not shown: parts of filament without sexual organs on either side, as in the preceding figure.) Fig. 21. Probably abortive oogonia. Fig. 22. Antheridium, base of another antheridium, fertilized oogonium and aborted oogonium.

filament, and often probably abortive, oogonia showing dimensions intermediate between those of antheridia and those of normal oogonia (Figs 21, 22).

The plants collected by Berkeley and Holmes can hardly be separated from some of these variants of *V. velutina* except by the width of their filaments. Those described by de Wildeman and by Blum & Wilce have thinner filaments, and thus come still closer. Exactly how close they are must be settled by future studies of living material, but it must be assumed on the basis of present knowledge that they belong either under *V. velutina* or in close vicinity to it. To replace the rejected specific names as a means of reference pending further studies, a new varietal name is hereby introduced under this species, the epithet “*separata*” referring to the separate occurrence of antheridia and

oogonia. As the description by de Wildeman is relatively precise, and is also referred to by Blum & Wilce, this has been chosen as type. The material on which the description was based has been searched for in vain, but may perhaps be found later, and then will constitute the holotype.

*Vaucheria velutina* C. Agardh var. *separata* var. nov.

*Vaucheria submarina* sensu de Wildeman (1897), p. 74–76, vix *V. dichotoma*  $\beta$  *submarina* Lyngbye (1819).

A var. *velutina* differt oogoniis et antheridiis non in eodem filamento formatis, plerumque paene vel omnino erectis.

Mense Augusto anni 1894 prope oppidum javanicum Probolinggo a J. Massart e fossa aquae subsalsae lecta. Nomen descriptione a de Wildeman facta typificatum, nisi materie typifica posthac oblata.

Differs from var. *velutina* by forming oogonia and antheridia on different fila-

ments and by carrying both kinds of sexual organs in an almost or entirely upright position.

Collected in August 1894 in a brackish water ditch at Probolinggo, Java, by J. Massart. Name typified by de Wildeman's description, unless Massart's sample is found.

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