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VAUCHERIA BIROSTRIS n.sp. AND SOME FURTHER REMARKS ON THE GENUS VAUCHERIA IN THE NETHERLANDS

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SUMMARY

Vaucheria birostris is described as a new species belonging to the section *Anomalae* which so far contained only two species: *V. canalicularis* and *V. cruciata*. *V. birostris* was found in the Dutch Wadden area, on the isle of Schiermonnikoog, growing in a cart-track in a primary dune valley. A revised list of *Vaucheria* species for the Netherlands is presented. Some additional remarks are made on the distribution and morphology of *V. alaskana*, *V. pseudogeminata*, *V. medusa* and on *V. arcassonensis*, *V. coronata*, *V. intermedia*, *V. minuta*.

1. INTRODUCTION

The data presented in this paper form part of an investigation into the distribution, ecology and morphology of the *Vaucheria* species occurring in the Netherlands. This investigation was until now concentrated upon the brackish species of the coastal region.

In the Dutch coastal region *Vaucheria* species make up an important component of the algal vegetation on soft substrata from marine salt marshes, beach plains, estuarine brackish marshes, freshwater tidal areas, and non-tidal inland brackish environments.

Some of the results were published earlier (SIMONS & VROMAN 1968, 1973; NIENHUIS & SIMONS 1971).

2. VAUCHERIA BIROSTRIS N. SP.

2.1. Morphology

This new species belongs to the section *Anomalae* Hansgirg. The section is characterized by the pulvinate-deltoid antheridium with distal prominences usually two in number, each of which opens by a pore. Until now the section contained only two species, namely *V. canalicularis* and *V. cruciata*. Both species are common and widespread.

Most observations on *V. birostris* were done on freshly cultivated material, additional data were gathered from fixed material which happened to contain reproductive structures. The following description can be given:

The sexual organs are borne on lateral bisexual fruiting branches. The fruiting branch (length 140–300 μ) is terminated by a short pulvinate-deltoid antheridium (length of median axis 22–37 μ), which opens by means of two lateral

pores (*fig. 1b, c, d* and *2a*). At a short distance below the top of the fruiting branch usually two oogonia are placed laterally on short pedicels. The tip of each oogonium is inclined towards an antheridial pore. The apex of the oogonium bears a very typical receptive structure with two laterally directed beaks, each with a fertilization pore (*fig. 1c, f, g* and *2b-e*). The two beaks are oriented with respect to one another in such a way, that quite often they are not seen simultaneously (*fig. 1d, e*). In such cases the antheridium is indispensable for the identification of the species. The ovoid-reniform, greyish to reddish brown oospores measure (59–)69–95(–110) × (51–)58–73(–84) μ. They usually contain one dark central pigment spot. The oospore wall is three-layered with a lamellated middle-layer. Total thickness of oospore wall varies from 3.5 to 8 μ. The ripened oospore soon falls off (*fig. 1c*). At one time a fruiting branch was observed showing a series of proliferations with unpaired oogonia (*fig. 2a*). Diameter of vegetative filaments varies from (18–)26–40(–73) μ. The rhizoidal filaments of this species often form proliferations which show resemblance to reproductive structures (*fig. 3*).

Latin diagnosis:

Vaucheria birostris Simons, *sp. nov.* – *Figs. 1,2.*
Filamenta (18–)26–40(–73) μ diam.; Oogonia antheridiaque in ramis fructiferis portata; Ramus fructiferus duo (vel interdum unum) oogonia et unum antheridium ferens, rami fructiferi 140–300 μ altitudine; Antheridium terminale, pulvinatum-deltoideum, aperiens duobus poris lateralibus; Oogonium pedicello brevi, apex oogonii versus porum antheridii, ferens structuram recipientem duobus rostris a se ex adverso flexis; Oosporae ovoideae vel reniformes, cineraceae vel bruneolae-rubellae coloratae, parietibus tristratis, oosporae (59–)69–95(–110) × (51–)58–73(–84) μ.
TYPE: The Netherlands, Schiermonnikoog, primary dune valley in the "Kobbeduinen", in a cart-track, 20-VII-1973.
Leg. J. Simons (herbarium of the Free University, Amsterdam).
The principal distinction between *V. birostris* and the species *V. canalicularis* and *V. cruciata* of the section *Anomalae* lies in the presence of a beaked receptive structure on the oogonium.

V. canalicularis and *V. cruciata* lack any such differentiated receptive structure. *V. canalicularis* has wider and generally longer oospores and longer oogonium pedicels than *V. birostris*. The systematic position of *V. cruciata* is more remote from the other two species of this section due to the upright position of its terminal antheridium instead of this antheridium being inclined.

2.2. Description of the habitat

Vaucheria birostris was found on the 20th of July 1973 on the isle Schiermonnikoog in the Dutch Wadden area. The sample was taken in the western part of the "Kobbeduinen" from a cart-track in a moist primary dune valley, bearing a hygrophytic calcicole vegetation. The most striking phanerogamic species

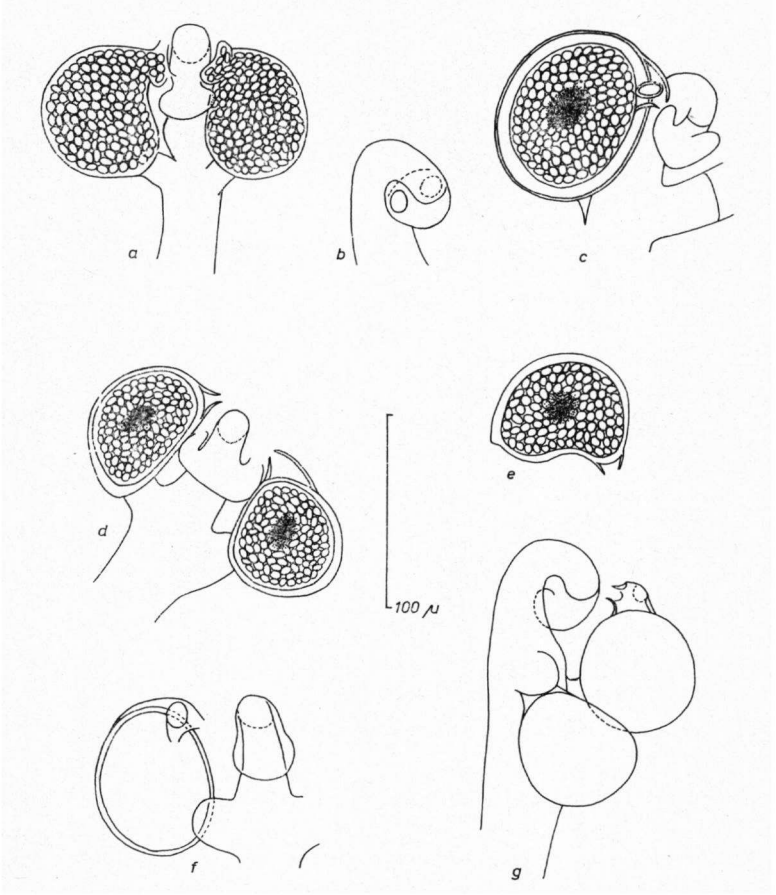

Fig. 1. *V. birostris*. a: reproductive stage before rounding off of oospores, b: view of antheridium, c: one of the two oospores has fallen off, d and e: oospores with only one visible beak, f: orientation of the two beaks upon each other, g: side view of fruiting branch.

(nomenclature after HEUKELS & VAN OOSTSTROOM 1970) in this valley are: *Salix repens*, *Schoenus nigricans*, *Juncus alpino-articulatus* ssp. *atricapillus*, *Epipactis palustris*, *Orchis incarnata*, *Liparis loeselii*, *Parnassia palustris*, *Mentha aquatica*, *Linum catharticum*, *Gentianella amarella*.

In the above mentioned cart-track were growing: *Juncus bufonius*, *J. articulatus*, *Glaux maritima*, *Centunculus minimus*, *Centaurium pulchellum*, *C. littorale*, *Potentilla anserina*, *Hydrocotyle vulgaris*, *Carex serotina*, *Agrostis stolonifera*, and (only sparse) *Samolus valerandi*. Such a vegetation may be related to the *Centaurio-Saginetum moniliformis*, subass. *samoletosum* (WESTHOFF & DEN HELD 1969), belonging to a group of ephemeral, instable communities with many small summer-therophytes on bare, moist soils with a strongly fluctuating moisture content. At the edges of the cart-track the liverworts *Pellia endiviifolia* (Dicks.) Dum. and *Riccardia pinguis* (L.) Dum. and the moss *Callier-*

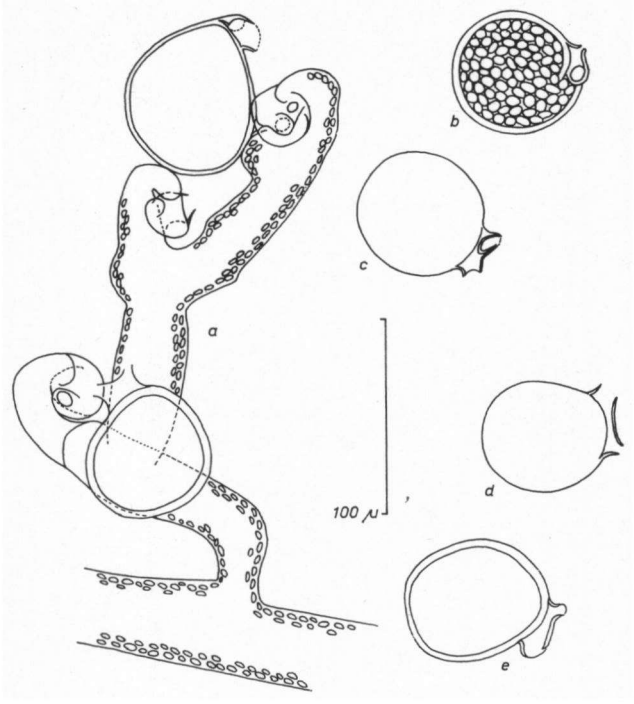

Fig. 2. *V. birostris*, a: proliferation of a fruiting branch, b. c, d, e,: ripe oospores.

gonella cuspidata (Hedw.) Loeske were found. In the track the moss *Bryum marratii* Wils. occurred.

The cart-track appeared to constitute a rather rich algal habitat. In the algal crusts many small spherical *Nostoc* colonies were visible to the naked eye.

Algal samples, measuring 4–6 × 2 × 1 cm, were cut out from the upper soil layer. One part from each sample was fixed in formaldehyde 4%, the other part was cultivated in petri-dishes containing an Erdschreiber medium. Culture conditions involved a temperature of c. 12 °C., a photoperiod L/D 12/12, and light intensities between 1000 and 2000 Lux. Under these conditions the *Vaucheria* species develop reproductive structures in most cases.

In the sample from the 20th of July 1973 *Vaucheria birostris* bore reproductive structures at the moment of collecting. *V. birostris* formed part of a mixture of *Vaucheria* species, namely *V. medusa*, *V. alaskana* and *V. canalicularis*, these three species showing reproductive structures as well. After culturing also *V. bursata* appeared to occur in the sample.

V. medusa and *V. canalicularis* are rather common on Schiermonnikoog, especially on a beach plain which is situated N. E. of the dune valley in question. Both species generally occur in freshwater as well as in slightly brackish environments. *V. alaskana* however, was never observed in the Netherlands before (see under 3.).

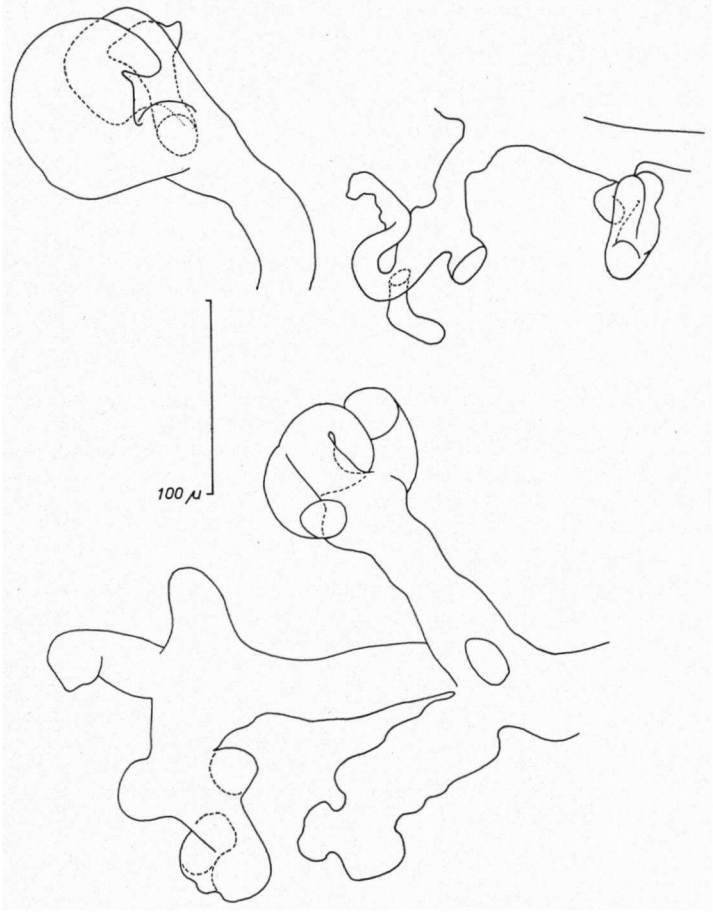

Fig. 3. *V. birostris*: rhizoidal filaments.

The other accompanying algae were predominantly *Cyanophyceae* (see *table 1*). Quantitatively the most important species were coccoid *Cyanophyceae* (especially *Anacystis montana f. montana*), *Microcoleus chthonoplastes*, *Hydrocoleum lyngbyaceum*, *Nostoc* sp., *Lyngbya semiplena*. The occurrence of species like *Pediastrum integrum*, *Scenedesmus quadricauda*, *Tetraëdron caudatum* and *Coelastrum scabrum* which are supposed to be planctonic freshwater forms, is presumably due to the often stagnating water at this place. Most of the other algae, except the desmids, generally are found under brackish conditions.

On the 8th of October 1973 a series of eight samples from the same cart-track was taken in order to obtain more material of *V. birostris*. These samples contained most of the species already found, but unfortunately not any *V. birostris*! *V. bursata* was not seen again either. Species like *V. birostris*, *V. alaskana*, *V. medusa* and *V. canalicularis* apparently show an ephemeral growth

Table 1. List of algal species found in the cart-track accompanying *V. birostris*. Nomenclature of coccoid *Cyanophyceae* is in accordance with DROUET & DAILY (1956), the nomenclature of non-coccoid *Cyanophyceae* follows GEITLER (1932).

Vaucheria spp.:
V. alaskana Blum
V. bursata (O. F. Müll.) C. Ag.
V. canalicularis (L.) Christensen
V. medusa Christensen

Chlorophyceae:
Coelastrum scabrum Reinsch
Cosmarium spp. (5)
Cylindrocystis brebissonii Menegh.
Pediastrum integrum Naegeli
Percursaria percursa (C. Ag.) Rosenv.
Rhizoclonium riparium (Roth) Harv.
Scenedesmus quadricauda (Turp.) de Bréb.
Tetraëdron caudatum (Corda) Hansgirg

Cyanophyceae (coccoid forms):
Agmenellum quadruplicatum Brébisson
Anacystis aeruginosa Dr. & Daily
A. dimidiata Dr. & Daily
A. montana (Lightf.) Dr. & Daily
f. *minor*
f. *montana*
Anacystis thermalis (Menegh.) Dr. & Daily. f. *thermalis*
Coccochloris stagnina Sprengel

Cyanophyceae (non-coccoid forms):
Anabaena oscillatorioides Bory
Cylindrospermum stagnale (Kütz.) Born. & Flah.
Hydrocoleum lyngbyaceum Kütz
Lyngbya aestuarii (Mert.) Liebm.
L. perelegans Lemm.
L. semiplena (C. Ag.) J. G. Ag.
Microcoleus chthonoplastes (Mert.) Thur.
M. tenerrimus Gom.
Nodularia harveyana Born. & Flah.
Nostoc sp.
Oscillatoria amphibia Ag.
O. brevis (Kütz.) Gom.
O. splendida Grev.
O. tenuis Ag.
O. sp.
Phormidium corium Kütz.
P. fragile (Menegh.) Gom.
Schizothrix calcicola (Ag.) Gom.
Spirulina subsalsa Oersted
Symploca muscorum (Ag.) Gom.

Chrysophyceae:
Apistonema sp.
Ruttnera sp.

pattern in this type of habitat. For example before the 20th of July, during dry weather, not a single *Vaucheria* could be observed in the cart-track. They did not appear until a few days later, after the onset of rainy weather. Besides showing ephemeral growth, *V. birostris* may be a species of seldom occurrence!

3. FURTHER REMARKS ON VAUCHERIA

3.1. Revised list of Vaucheria species from the Netherlands

A preliminary list of *Vaucheria* species occurring in the Netherlands was published in 1968 (SIMONS & VROMAN). A new list is given here to meet changes in nomenclature and to include new records. The names are brought in accordance with CHRISTENSEN (1969, 1973). Between brackets the names used in the 1968 list are given.

V. alaskana Blum
V. arcassonensis Dangeard
V. aversa Hass.
V. birostris sp.n.
V. bursata (O. F. Müll.) C. Ag. (*V. sessilis*)
V. canalicularis (L.) Christensen (*V. woroniniana*)
V. compacta (Collins) Coll. ex Taylor
V. coronata Nordtst.
V. dichotoma (L.) Martius
V. dillwynii (Web. et Mohr) C. Ag. (*V. pachyderma*)
V. erythrospora Christensen
V. fontinalis (L.) Christensen[1]
V. frigida (Roth) C. Ag. (*V. terrestris*)
V. geminata (Vauch.) DC.
V. intermedia Nordtst.
V. litorea Hofm. ex C. Ag.
V. longata Blum[2]
V. medusa Christensen
V. minuta Blum & Conover
V. prona Christensen (*V. hamata*)
V. pseudogeminata Dangeard
V. racemosa (Vauch.) DC. (*V. walzii*)
V. sescuplicaria Christensen
V. subsimplex Crouan frat. (*V. sphaerospora*)
V. synandra Wor.
V. terrestris (Vauch.) DC. (*V. hamata*)
V. velutina C. Ag. (*V. thuretii*)
V. vipera Blum

[1] as yet only one record in the Netherlands (Grathem, Molenbeek)
[2] only known to the author from herbarium material (Goes, ditch, Van den Bosch, 1847).

3.2. Additional data on the distribution and morphology of some species

3.2.1. V. alaskana, V. pseudogeminata, V. medusa

V. alaskana (*fig. 4a, b*)

This species has been described by BLUM (1953) from a forest in Alaska, growing on soil. Furhter records are from N. America, S. America (BLUM 1972) and from China (RIETH 1963). Thus the record of *V. alaskana* on Schiermonnikoog is the first European one. As already mentioned (see 2.2.) this species was found in the same habitat as *V. birostris* on July 20, 1973. Besides this observation,

there is another one from the same data: from a ditch along a foot-pathway in a marshy dune valley, at a little distance S. of the cart-track find. There it occurred together with *V. dichotoma*, *V. frigida*, *V. geminata*, *V. bursata* and *V. pseudogeminata*.

From samples taken on Oct. 8 and 9, 1973 from the cart-track and the western part of the beach plain, it appeared that *V. alaskana* not only occurred in the cart-track and the ditch, but also in the western part of the beach plain, material from both places showing reproductive organs. On the beach plain this species was growing together with *V. canalicularis* and *V. medusa* especially in small depressions of the sandy soil. The composition of the algal vegetation shows close resemblance to that mentioned for the cart-track (*table 1*).

The phanerogamic vegetation in that part of the beach plain has a summer aspect dominated by *Parnassia palustris*, *Centaurium pulchellum*, *C. littorale* and *Sagina nodosa*. Other species of general occurrence are: *Glaux maritima*, *Agrostis stolonifera*, *Parapholis strigosa*, *Odontites verna*, *Potentilla anserina*, *Plantago coronopus*, *Juncus articulatus*, *J. bufonius*, *J. gerardii*, *Carex serotina*, *C. extensa*, *C. distans*, *C. flacca*. Less frequent are *Herminium monorchis*, *Epipactis palustris*, and *Samolus valerandi*.

The characteristics of our material of *V. alaskana* agree quite well with the data of BLUM (1953) and RIETH (1963) except for the reddish-brown colour of the oospores not mentioned by these authors. The typical oogonial beak does not always show the prominent downward curvature (BLUM 1953), as stated also by Rieth. Proliferations of the fruiting branch were frequently observed (*fig. 4b*). Dimensions agree a little better with those given by Rieth, than with those of Blum. The dimensions were: diam. of filaments 25–55 μ, oospores: 80–131 × 59–107 μ, length of antheridia 54–62 μ.

V. pseudogeminata (*fig. 4c*)

The above mentioned find of this species from a ditch in a marshy dune valley, is the only record of *V. pseudogeminata* for the Netherlands until now. From the few records in literature it may be concluded that this species is not a very common one. Existing records are from France (DANGEARD 1939), N. Africa (GAUTHIER-LIÈVRE 1955), Denmark, England, Switzerland (CHRISTENSEN 1952, 1969) and N. America (BLUM 1972).

V. medusa (*fig. 5*)

Since the description of *V. medusa* by CHRISTENSEN (1952) from the Swedish Eastern coast, there are only a few more records, all from the Baltic Sea region. There are only two records from outside that region namely from the freshwater tidal part of the river Weser near Bremen (BEHRE 1961), and from the Dutch freshwater tidal area named Biesbosch (ZONNEVELD 1960). RIETH (1956) has refined the description given by Christensen, using material from Hiddensee (Baltic Sea).

In the Netherlands it seems to be a rather rare species. So far the following records are available: Kampereiland, Ramspol, *Phragmites* marsh (freshwater);

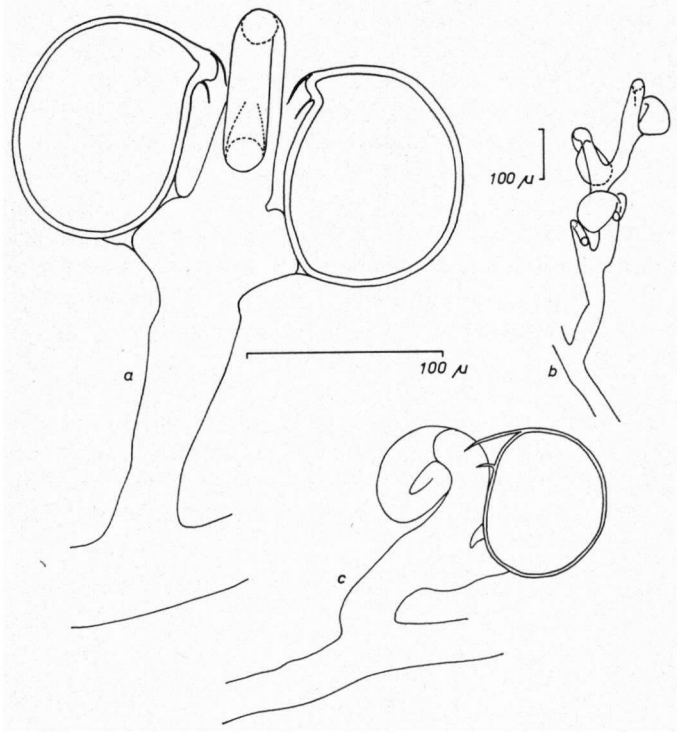

Fig. 4. *V. alaskana.* a: fruiting branch with ripe oospores, b: proliferation of a fruiting branch. *V. pseudogeminata,* c: fruiting branch.

Biesbosch (tidal freshwater); Hellevoetsluis (β mesohalinic tidal water); Ouden Doel, Belgic Westerschelde (β mesohalinic tidal water); Schiermonnikoog (fresh and slightly brackish water). At all these localities, except at Schiermonnikoog, *V. medusa* was found in small quantities amidst other *Vaucheria* species (often *V. compacta*).

In the most western part of the beach plain habitat, *V. medusa* was accompanied by *V. alaskana*, *V. canalicularis* and sometimes *V. sescuplicaria.* For the description of the phanerogamic vegetation on this part of the beach plain, see habitat data of *V. alaskana.* From West to East in the beach plain, the vegetation on the lower parts changes in composition towards vegetation types related to the alliance *Puccinellio-Spergularion salinae* (WESTHOFF & DEN HELD 1969). This means that species like *Parnassia palustris*, *Carex flacca* a.o. gradually disappear from West to East, and that halophytic plants like *Puccinellia capillaris*, *Salicornia europaea*, *Spergularia marina* a.o. appear as elements of a pioneering vegetation type on the lower parts of the beach plain, surrounding small dunes.

As to the *Vaucheria* species, which constitute a rather small component of the algal vegetation in the lower parts of the beach plain, going from West to

East *V. medusa* becomes mixed up with *V. intermedia*, *V. compacta*, *V. sescuplicaria*, *V. canalicularis*, *V. synandra* and (not frequent) *V. erythrospora*. The *Vaucheria* aspect is present not only in soil depressions on open scarcely grown places, but also in relatively low lying *Agrostis* clumps. Among the accompanying other algae, *Rhizoclonium riparium* often dominates the algal aspect on the open plains. It should be noted that also *Vaucheria compacta* can form extensive algal mats in small pools with *Scirpus maritimus*, on blackish FeS containing sandy mud. The above mentioned combination of *Vaucheria* species (except *V. alaskana*) indicates a brackish influence in this environment, coming from the ground water and the sporadic influx of sea water in autumn and winter.

Morphology and dimensions of *V. medusa* agree well with the existing data in literature.

3.2.2. V. arcassonensis, V. coronata, V. intermedia, V. minuta

V. arcassonensis, *V. coronata* and *V. intermedia* are of common occurrence in salt marshes of the atlantic coasts of Europe and N. America. In the Netherlands they grow especially in salt marshes bordering euhalinic-polyhalinic

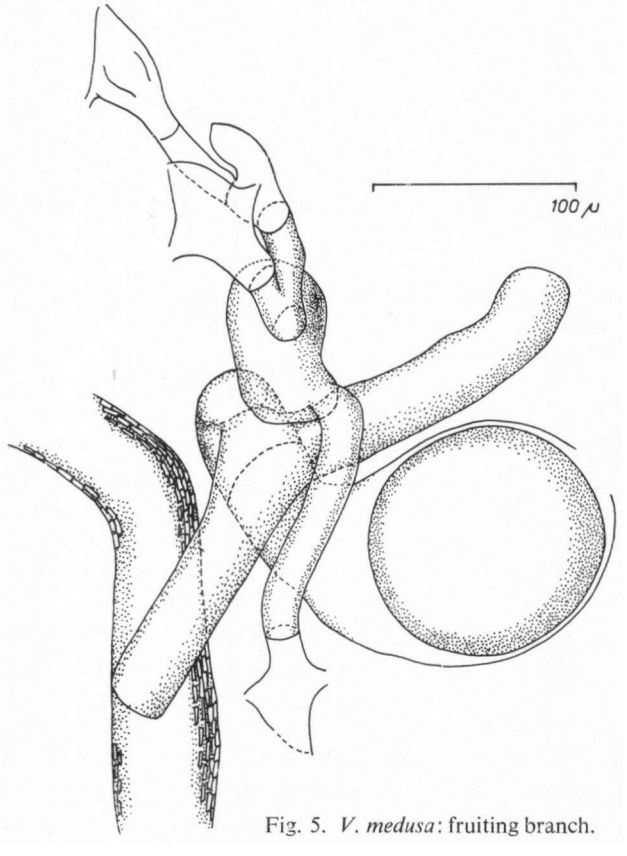

Fig. 5. *V. medusa*: fruiting branch.

waters, in vegetations belonging to the *Puccinellietum maritimae* or *Halimionetum portulacoidis* (NIENHUIS & SIMONS 1971). They penetrate into the mesohalinic parts of estuarine areas as well. In non-tidal inland brackish localities they are also frequently met with (SIMONS & VROMAN 1973).

V. minuta seems to have the same distributional pattern be it of far less common occurrence. Since the first European record in the Dutch S.W. estuarine region (SIMONS & VROMAN 1968) it was found at several other localities in the Netherlands (Westerschelde and Wadden region). Recently it was also found in Denmark (POLDERMAN 1973) and England (Polderman, personal communication).

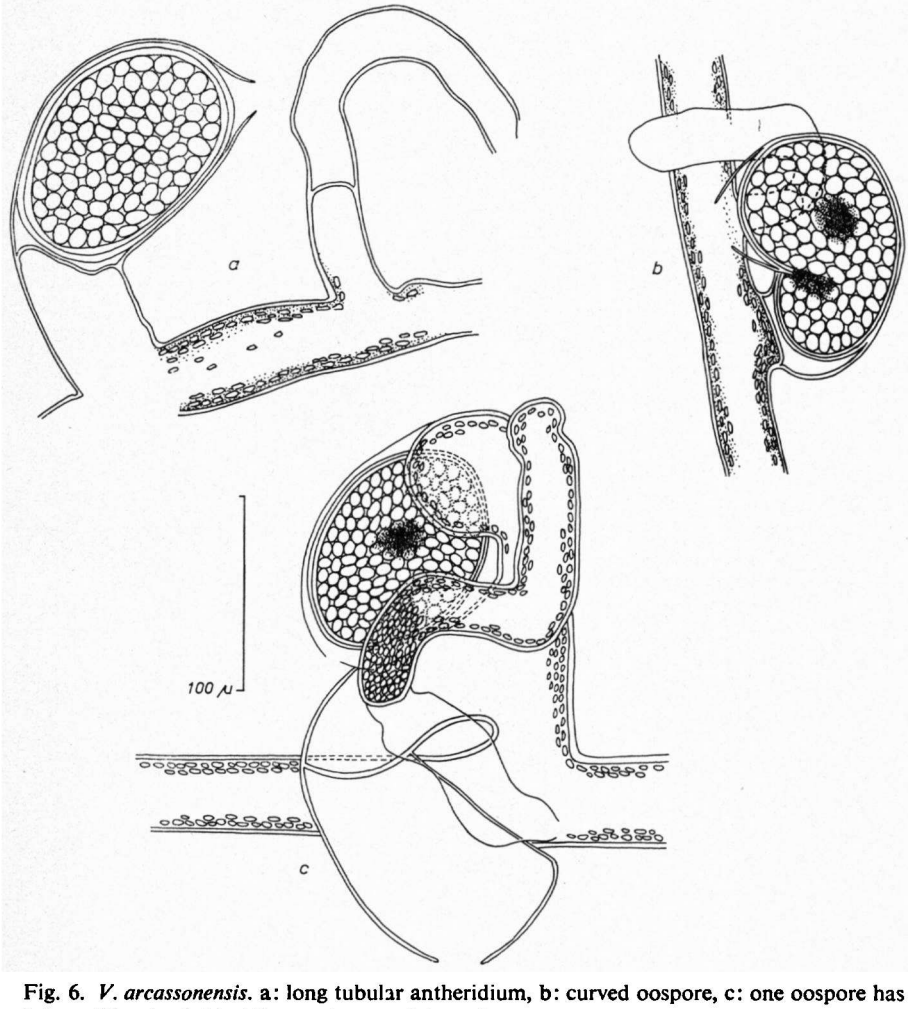

Fig. 6. *V. arcassonensis*. a: long tubular antheridium, b: curved oospore, c: one oospore has fallen off leaving behind the empty oogonial envelope.

V. arcassonensis

Of this species only a few poorly detailed illustrations exist in literature (DANGEARD 1939; BLUM 1972). Antheridia are long, tubular and contorted. Oospores often have a curved axis (*fig. 6b*), they soon fall off leaving behind the empty oogonial envelope (*fig. 6c*).

V. coronata

Characteristic for this well-known and wide-spread species is the receptive structure at the tip of the oogonium with a "crown" of fertilization pores (*fig. 7a*). The number of pores amount from 3–6 according to published data (BLUM 1972). However numbers of 2 (*fig. 7b*) and even 10 can occasionally be found. Oospores are not always rounded, sometimes they have a lengthened elliptical form (*fig. 7c*). As to the antheridia, they are normally placed at the end of sympodial ramified lateral branches (*fig. 7a*). However, at some occasions a series of antheridia within a main filament was seen (*fig. 8*). They may be called inter-

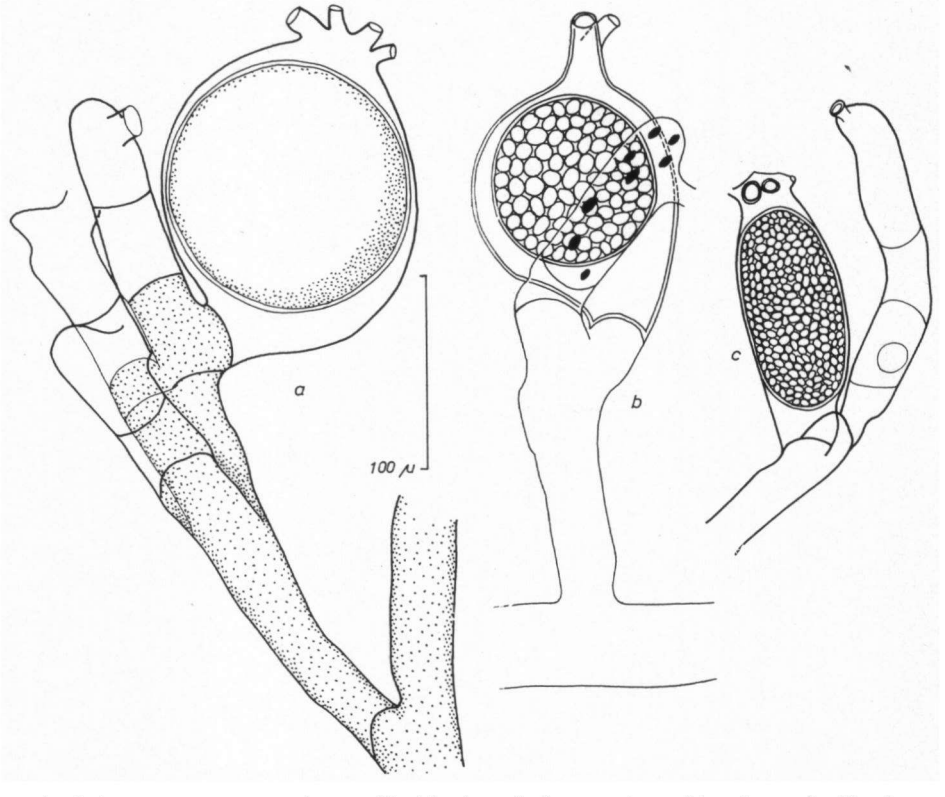

Fig. 7. *V. coronata*. a: normal type of fruiting branch, b: oogonium with only two fertilization pores, c: aberrant oospore form.

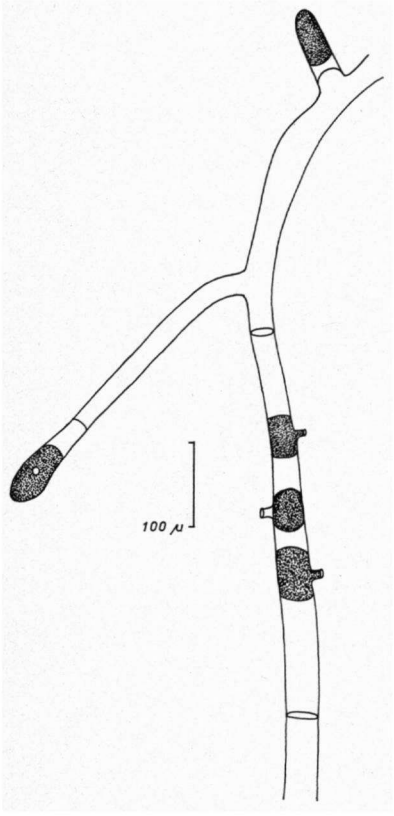

Fig. 8. *V. coronata*: "intercalary" antheridia.

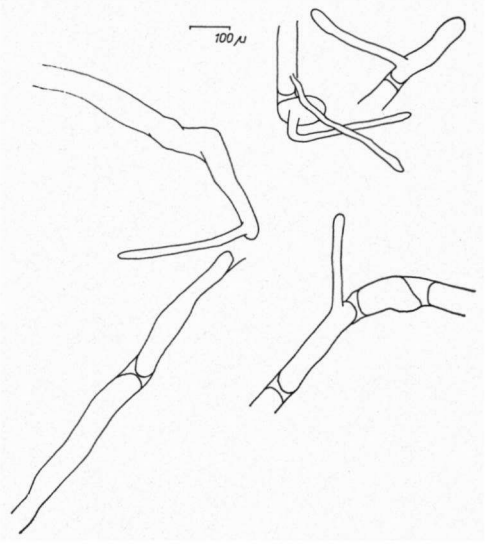

Fig. 9. *V. coronata*: akinete formation.

calary antheridia. Another matter to be pointed at is a vegetative mode of propagation: filaments can be fragmented by segmentation of the protoplast by the formation of additional wall material. The segments are of variable length. Each segment can grow out into one or more new filaments (*fig. 9*). This mode of akinete formation was observed with certainty on *V. coronata*, at the end of the winter season. Probably this way of propagation is of general occurrence within the genus *Vaucheria*.

V. intermedia

The morphology of this species has been treated extensively by RIETH (1956). Only one additional remark can be made concerning the number of pores of the antheridium. This number amounts from 2–4 according to published data (BLUM 1972). However on many occasions antheridia were found with more than 4 pores; the number of pores can amount to at least 9 (*fig. 10*).

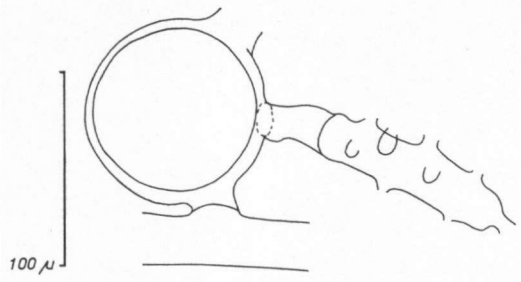

Fig. 10. *V. intermedia*: antheridium with at least nine pores.

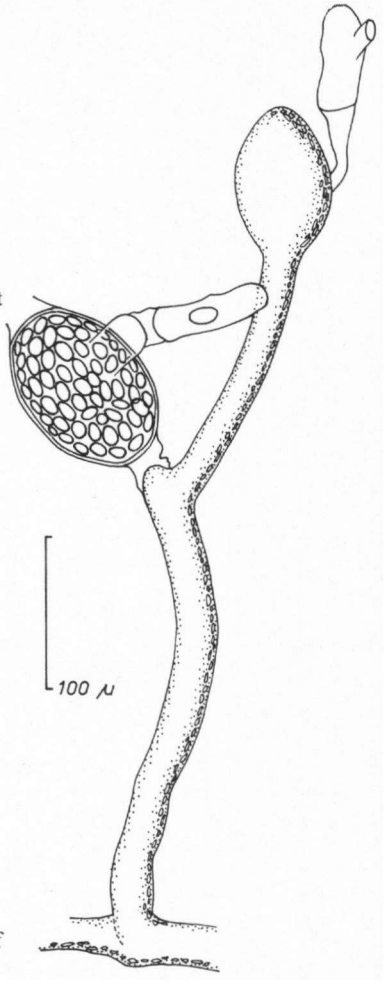

Fig. 11. *V. minuta*: proliferation of fruiting branch.

V. minuta

Lateral fruiting branches of *V. minuta* normally bear one terminal antheridium and one intercalary oogonium. However, on one occasion a proliferation of the fruiting branch was seen with another antheridium and oogonium, showing that a lateral fruiting branch is in fact a part of a sympodial branching system (*fig. 11*).

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