DESCRIPTION OF SOME TAXA OF TESTACEA OF HUMID PARAMO VEGETATION TYPES OF THE COLOMBIAN CORDILLERA ORIENTAL

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ABSTRACT

This paper reports on the occurrence of some taxa of Testacea in plant communities of the paramos of the Colombian Cordillera Oriental.

RESUMEN

En esta contribución se reportan los resultados de un estudio sobre la presencia de algunas especies de Testacea en diferentes tipos de la vegetation húmeda en los páramos de la Cordillera Oriental de Colombia.

INTRODUCTION

During pollen analytical research of recent moss samples of the humid vegetation of the paramos of the Colombian Cordillera Oriental we often find remnants of uni-cellular organisms which are rather difficult to identify. Sometimes it is doubtful whether they represent aberrant and unknown pollen, diatoms, spores or protozoans.

Finally we succeded to recognize one group of animals at least: the shells of the Testacea (a group of the Protozoa). The aim of this study is to recognize these "shells" in the pollen analyses and to examine the distribution of the different "shells" in the vegetation types of the páramos.

A SHORT SURVEY OF THE TESTACEA

The ordo Testacea includes protozoans and are classified as Sarcodina. Characteristic is the shell which envelopes the uni-cellular animal. An aperture or mouth in every shell allows the animal to extend their pseudopodia to capture food.

Thought the shells are extremely variable, these as well as the apertures (pseudostomata) exhibit a number of useful morphological characteristics. Sometimes more than one aperture or a number of very small apertures may be present. The material of the shell consists of pseudochitin secreted by the animal. It resembles keratin. Some testacean shells consist of pseudochitin of only one layer, whereas other species have shells of two layers because the animal itself adds building-elements (idiosomes) or foreign particles (xenosomes) to the construction of the shell.

The xenosomes are small sand grains, empty diatomeen scales, detritus, pollen and other material. The idiosomes consist of silicic acid which forms small plates cemented together forming the shell. It is assumed that these plates consist of pseudo-quartz. Pseudochitin is entirely hyaline. Ferro-salts may cause its brownish and manganese-salts its violet colour, which can be clearly observed during pollen analyses. The resistance of the shell is great so that we can find them in peat and lake deposits. In peat testacean shells fossilize very well.

IDENTIFICATION

Up to the present time there is hardly any report on Testacea from Colombia. Because the Testacea from the páramo area appeared to be cosmopolitan or at least wide temperate in distribution, the identification is based on European literature (Deflandre 1928, 1929; Grospietsch 1972; Hoogenraad & De Groot 1940, 1951, 1952; Schönborn 1962/1963, 1966; Wulfert 1969).

MATERIAL

In 1972/1973 A.M. Cleef studied the vegetation in the páramos of the Colombian Cordillera Oriental (Cleef, 1981). Together with the relevés of the vegetation Antoine and Mieke Cleef collected bryophyte samples for analysis of the recent pollen deposition. These samples provided so many testacean shells that our curiosity was roused and it was tried to identify these shells as much as possible. The shells were especially found in different types of humid vegetation, some of which with *Sphagnum*.

The moss samples have been prepared according to the usual acetolyse: method for pollen research purposes. As we did not apply a special method to prepare Testacea, it is possible that some transformation have occurred. In addition, it is not ruled out that also some specimens representing other species might have disappeared.

DESCRIPTION OF THE PRINCIPAL GROUPS

The names of the páramo plant communities are cited according to Cleef (1981).

Amphitema Archer 1869. (subfamily: Amphitreminae; genus: *Amphitema*).

Form of the shell: cylinder-or tonshaped, sideways compressed, at the ends nearly cut straight.
Pseudostoma: two ends opposite each other.
Substance: chitinoys.
Structure: with or withoyt xenosomes.
Identification: according to Hoogenraad & De Groot, 1940.

Amphitrema flavum (Archer 1877). (Plate 1: fig. 1).

The shell is hyaline without xenosomes, yellow to darkbrown.

Found in rel. 316; Páramo de Cocuy: *Carici peucophilae-Wernerietum crassae Wernerietosum (ritrophio-Wernerietalia, Wernerietea).*

Amphitrema wrightianum Archer 1869. (Plate 1: fig. 2).

The shell is hyaline with xenosomes, yellow to brownish. found in rel. 194; Páramo de San Cayetano: Community of *Eleocharis acicularis.*

Amphizonella Greeff 1866 (family: Difflugiidae; genus: *Amphizonella).*

Form of the shell: broad elliptic.

Pseudostoma: near the aperture a pleated membrane.

Substance: plastic mass with a plegmatic membrane.

Structure: not clear, membrane striped finely, radial.

Identification: according to Hoogenraad & De Groot, 1940.

Amphizonella violacea Greeff 1866. (Plate 1: fig. 3).

Violet-colourid on account of grains and vacuoles.

Found in rel. 93; Páramo de Palacio: *Xyris-Sphagnum* bog.

Arcella Ehrenberg 1830. (family: Difflugiidae; genus: *Arcella*).

Form of the shell: circumference round or broad eelliptic.

Pseudostoma: usually round, sometimes elliptic.
Substance: chitinous.
Structure: finely or grossly faceted with as a rule hexagonal facets, grained of dotted.

Identification: according to Deflandre, 1928.

Arcella arenaria Greeff 1866. (Plate 1: fig. 4).

The aperture is round, surrounded by a wreath of very fine pores, yellowish.

Found in rel. 248; Páramo de la Rusia: *Isoetetum cleefii (Ditricho submersi-Isoetion).*

Arcella catinus Pénard 1890. (Plate 1: fig. 5).

The aperture is round or broad elliptic, subrounded by a varied number of rather large pores, sometimes dark-brown

Found in rel. 9; Páramo de Sumapaz: *Geranio confertae-Calamagrostietum ligulatae (Calamagrostion ligulatae, Marchantio-Epilobietalia).*

Arcella discoides Ehrenberg 1871/1872. (Plate 1: fig. 6).

The aperture is round, sometimes surrounded by a wreath of little pores, yellowish.

Found in rel. 9; Páramo de Sumapaz: *Geranio confertae-Calamagrostietum ligulatae (Calamagrostion ligulatae Marchantio-Epilobietalia).*

Arcella mitrata Leidy 1879. (Plate 1: fig. 7).

The aperture is round with a crenated edge, light yellowish.

Found in rel. 199; Páramo de San Cayetano: *Xyris-Sphagnum* bog.

Assulina Ehrenberg 1872. (family: Trinemidae; subfamily: Trineminae; genus: *Assulina*).

Form ot the shell: broad elliptic or oval, strongly compressed, on account of that from above and aside elliptic.

Pseudostoma: the end small elliptic, without plates, lips of the mouth serrated, more or less regular indented.

Substance: silicic plates.

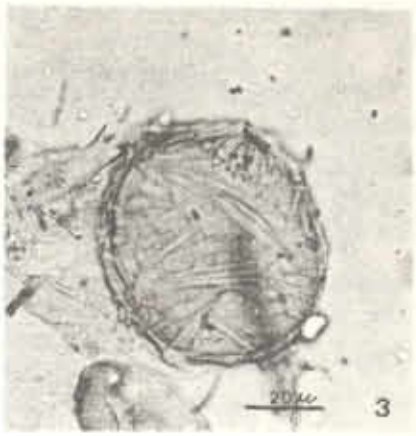
Structure: elliptic silicic plates covering each other imbricately.

Identification: according to Hoogenraad & De Groot, 1940.

PLATE I

1

2



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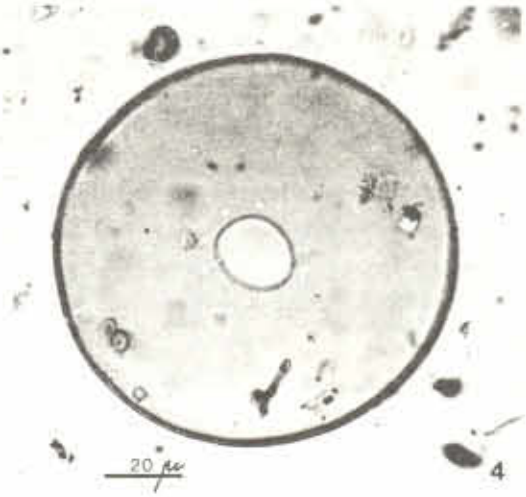

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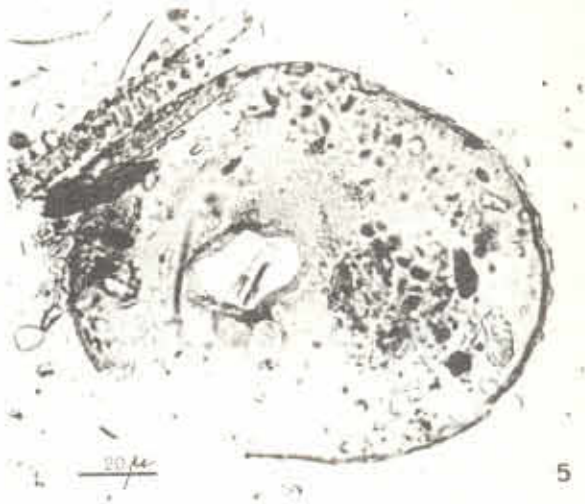

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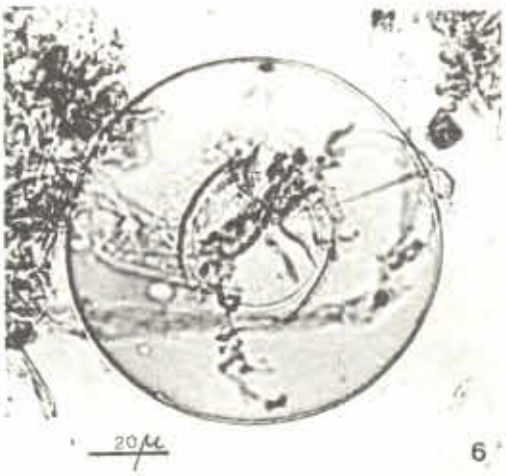

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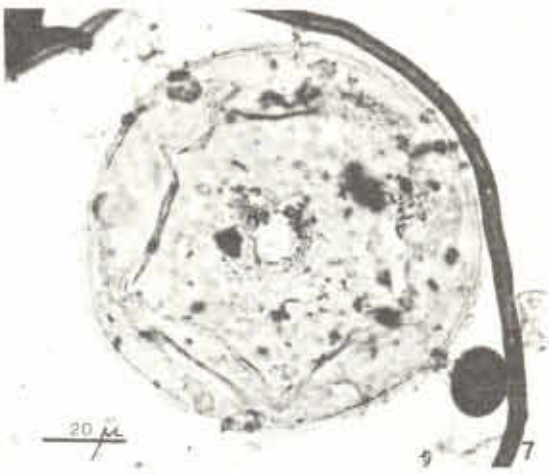

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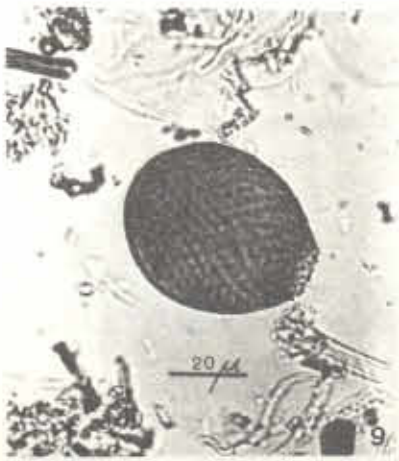


9

Assulina muscorum Greeff 1888. (Plate 1: fig. 9).

The aperture is irregular serrated, without plates, brownish.

Found in rel. 9; Páramo de Sumapaz: *Geranio confertae-Calamagrostietum ligulatae (Calamagrostion ligulatae, Marchantio-Epilobietalia).*

Assulina seminulum (Ehrenberg 1848). (Plate 1: fig. 8).

The shell somewhat larger, relatively broader than

A. muscorum, the aperture is twice so large as that from

A. muscorum and less brown.

Found in rel. 319; Páramo de Cocuy: *Carici peucophilae-Wernerietum crassae Wernerietosum (Oritrophio-Wernerietalia, Wernerietea).*

Centropyxis Stein 1857. (family: Difflugiidae; genus: *Centropyxis).*

Form of the shell: oval broad elliptic or nearly circular in shape.

Pseudostoma: more or less eccentric, round elliptic or somewhat irregular, sometimes with a thickened edge.

Substance: chitinous with alternating numbers of xenosomes.

Structure: finely grained with a number of hollow, crooked thorns.

Identification: according to Deflandre, 1929.

Centropyxis hemisphaerica (Barnard) Wailes 1913. (Plate II: fig. 10).

Pseudostoma eccentric, sometimes lobed, the shell is round, not clearly coloured.

Found in rel. 9; Páramo de Sumapaz: *Geranio confertae-Calamagrostietum ligulatae (Calamagrostion ligulatae, Marchantio-Epilobietalia).*

Centroyxis aculeata Ehrenberg 1838. (Plate II: fig. 11).

The shell circular in shape, at the side of the aperture somewhat flattened, yellowish.

Found in rel. 267; Páramo de Sumapaz: Community of *Calamagrostis ligulata* with *Sphagnum sanctu-josephense, (Calamagrostion ligulatae, Marchantio-Epilobietalia).*

Centropyxis discoides Pénard 1890. (Plate II: fig. 12).

Thorns very variable, rounded, pointed, crooked, short cone shaped, not clearly coloured.

Found in rel. 219; Páramo de San Cayetano: *Geranio confertae-Calamagrostietum ligulatae breutelietosum (Calamagrostion ligulatae. Marchantio-Epilobietalia).*

Centropyxis platystoma Pénard 1890. (Plate II: fig. 13);

The shell has two parts, one part is hemispherical, the other part is flattened with the aperture, not clearly coloured.

Found in rel. 327; Páramo de Cocuy: *Isoetetum palmeri (Ditricho submersi-Isoetion).*

Centropyxis cassis Wallich 1864. (Plate II. fig. 14).

The shell has also two parts, but the part with the aperture is more flattened than *C. platystoma,* brownish coloured.

Found in rel. 200; Páramo de San Cayetano: *Isoetetum palmeri* variant of *Drepanocladus exannulatus (Ditricho submersi-Isoetion).*

Difflugia Leclerc 1815. (family: Diffugiidae; genus: *Diffugia).*

Form of the shell: oval, narrow or broad elliptic, spheroid, pear-shaped or cylindrical.

Pseudostoma: at the end round or more or less irregular, sometimes lobed or incised, with a thickened fringe outside.

Substance: pseudo-quartz, colourless, sometimes reddish.

Structure: xenosomes with quartz grains or diatom scales.

Identification: according to Hoogenraad & De Groot, 1940.

Difflugia gramen Pénard 1902. (Plate III: fig. 19).

The aperture not clearly axial, placed at the side with three lobes, not clearly coloured.

Found in rel. 185; Páramo de Cocuy: *Oritrophio limnophilae-Wernerietum pygmaeae cotuletosum minutae (Oritrophio-Wernerietalia, Wernerietea).*

Difflugia lobostoma Leidy 1879. (Plate III: fig. 20).

The aperture usually with four or three lobes, the lobes in circumference round, not clearly coloured.

Found in rel. 326; Páramo de Cocuy: *Carici peucophilae-Wernerietum crassae caricetosum (Oritrophio-Wernerietalia, Wernerietea)*

Difflugia amphora (?) Leidy 1874. (Plate III: fig. 21).

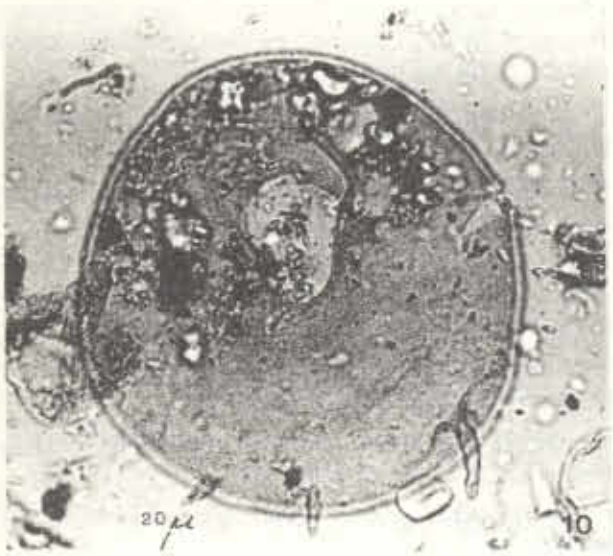
The shell ovoid with translucent jointed quartz plates very regular, not clearly coloured.

Found in rel. 138; Páramo de Chisacá: *Caricetum pichinchensis (Galio-Gratiolion Marchantio-Epilobietalia).*

Heleopera Leidy 1879. (family: Difflugiidae; genus: *Heleopera).*

Form of the shell: oval with lips cut off convexly.

PLATE II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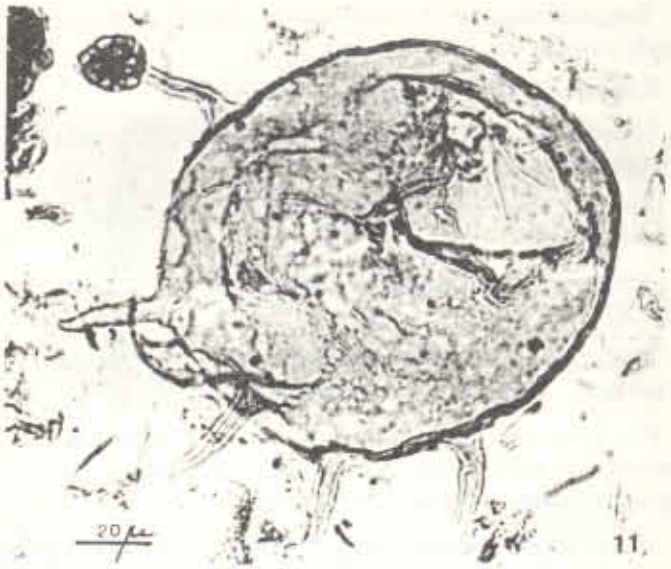
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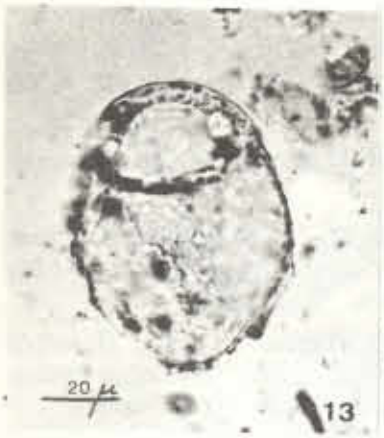
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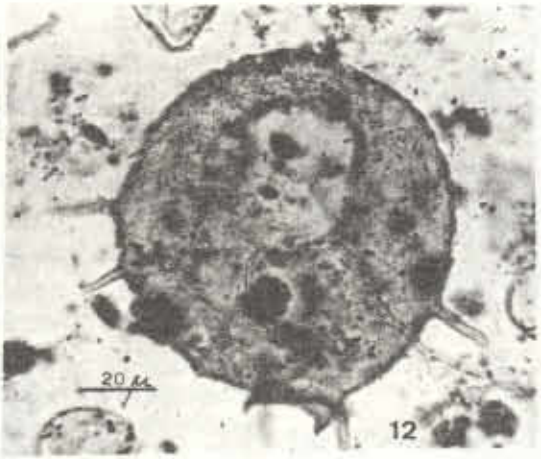
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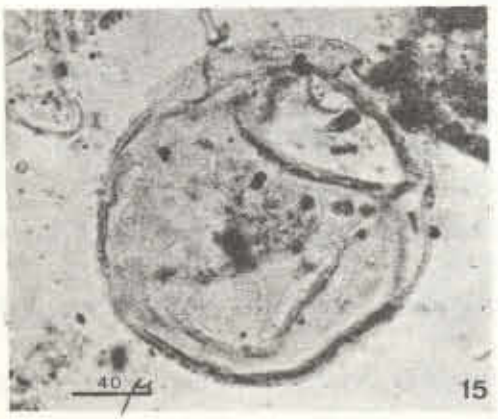
12


20 µ
14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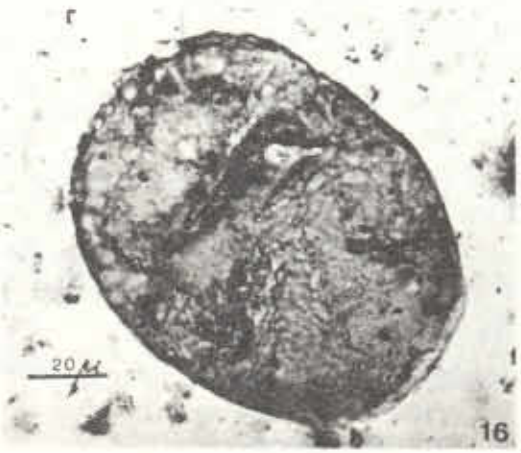
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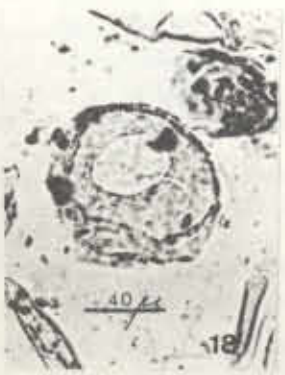
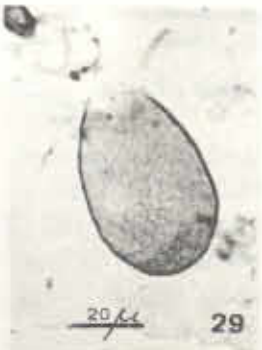
40 µ
17


40 µ
18


20 µ
28


20 µ
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Pseudostoma: at the end narrow elliptic or linear with corners cut off sideways.

Substance: chitninous, a slightly opaque.

Structure: covered with xenosomes chiefly quartz plates and grains.

Identification: according to Hoogenraad & De Groot, 1940.

Heleopera petricola (?) Leidy 1879. (Plate III: fig. 22).

The shell is reticulate and has an edge without structure, sometimes colourless or bluish violet.

Found in rel. 101; Paramo de Pisba: *Lupino alopecuroides-Mimuletum glabratae (Calamagrostion ligulatae, Marchantio-Epilobietalia).*

Hyalosphenia Stein 1857. (family: Difflugiidae; genus: *Hyalosphenia).*

Form of the shell: pear-shaped with contracted neck.

Pseudostoma: with thickened edge, elliptic in circumference.

Substance: chitinous.

Structure: structureless, in the part of the fundus a number of semi-circular dents, slightly yellowish.

Identification: according to Hoogenraad & De Groot, 1940.

Hylaosphenia elegans Leidy 1874. (Plate III: fig. 27).

Usually two shell pores in the part of the neck, aperture with thickened edge, colourless.

Found in rel. 41; Páramo de Guantiva: *Tillaeetum paludosae (Tillaeetalia).*

Nebela Leidy 1874. (family: Difflugiidae; genus: *Nebela).*

Form of the shell: pear-shaped sometimes more bottle-shaped, more or less compressed.

Pseudostoma: at the end, narrow or broad elliptic with fringe sometimes thickened.

Substance: chitinous.

Structure: consisting of round or broad elliptic idiosomes (silicic plates) not covering each other along the edges, sometimes xenosomes in between.

Identification: according to Hoogenraad & De Groot, 1940.

Nebela galeata (?) Pénard 1902. (Plate III: fig. 23).

The shell compressed, opaque, colourless, silicic plates form lacework.

Found in rel. 145; Páramo de Chisacá: Community of *Eleocharis acicularis.*

Nebela collaris (?) Leidy 1879. (Plate III: fig fig. 24).

The aperture very small, elliptic with thickened edge, sideways more or less curved inward, light yellowish.

Found in rel. 200; **Paramo de San Cayetano:** ***Isoetetum palmeri*** **variant of** ***Drepanocladus exannulatus (Ditricho submersi-Isoetion).***

Nebela dentistoma (?) Pénard 1890. (Plate III: fig. 25).

The shell egg-round, cosisting of irregular quartz grains, colourless.

Found in rel. 11; Paramo de Sumapaz: *Eleocharitetum macrostachyae myriophylletosum (Junco ecudoriensis-Eleocharition macrostachyae).*

Pontigulasia Rhumbler 1895. (family: Difflugiidae; genus: *Pontigulasia).*

Form of the shell: pear-shaped, more or less constricted to form a kind of neck.

Pseudostoma: in the "neck" a septum with two apertures.

Substance: quartz grains and diatom scales (xenosomes).

Structure: irregular.

Identification: according to Hoogenraad & De Groot, 1940.

Pontigulasia spectabilis Pénard 1902. (Plate III: fig. 26).

Resembles *P. bigibbosa,* but the shell is less thick set because the back-part is more narrow and the neck longer, colourless.

Found in rel. 108; Páramo de Pisba: *Hyperico lancioides-Plantaginetum rigidae (Gentiano-Oritrophion, Oritrophio-Wernerietalia. Wernerietea).*

Sphenoderia Schlumberger 1845. (subfamily: Trineminae; genus: *Sphenoderia).*

Form of the shell: sideways elliptic or circular, colourless, consisting of elliptic or circular idiosomes.

Pseudostoma: at the end narrow elliptic.

Substance: silicic plates.

Structure: small elliptic plates covering each other imbricately.

Identification: according to Hoogenraad & De Groot, 1940.

Sphenoderia dentata (?) Moniez 1888. (Plate II: fig. 28).

The shell broad elliptic, not compressed, finely serrated aperture, colourless.

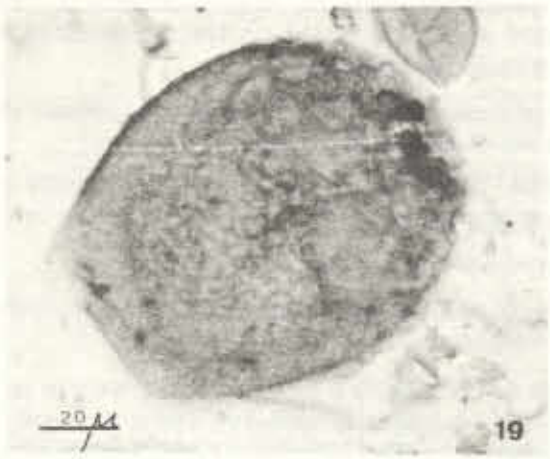
Found in rel. 332; Páramo de Cocuy: Community of *Distichia muscoides* with *Cortaderia sericantha* and *Campylopus cf fulvus (Gentiano-Oritrophion, Oritrophio-Wernerietalia, Wernerietea).*

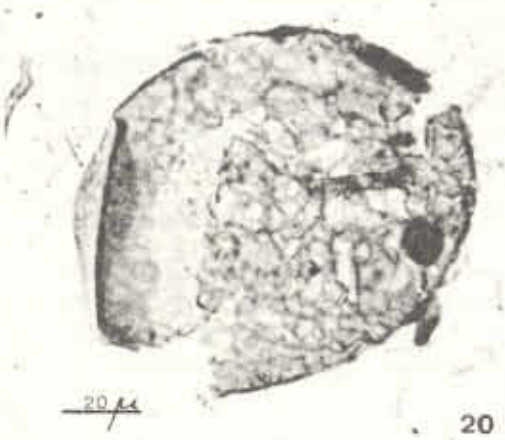
Sphenoderia lenta (?) Schlumberger 1845. (Plate II: fig. 29).

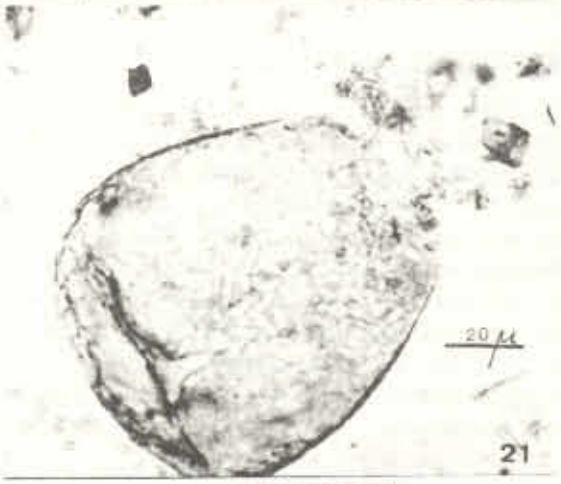
Circumference of the shell spheroidal, slightly compressed, colourless.

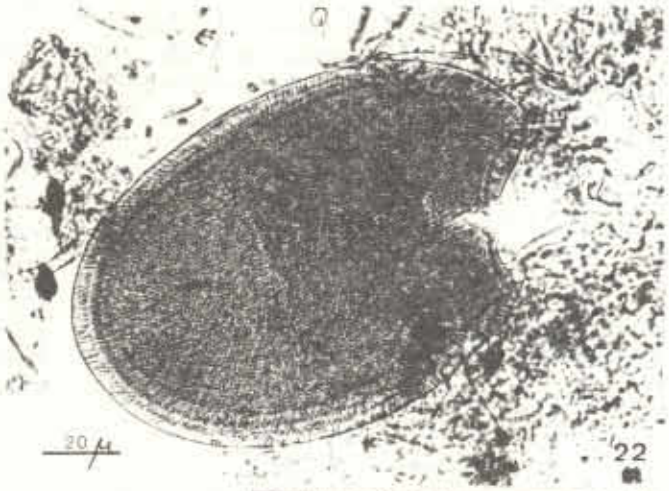
Found in rel. 41: Páramo de Guantiva: *Tillaeetum paludosae (Tillaeetalia).*

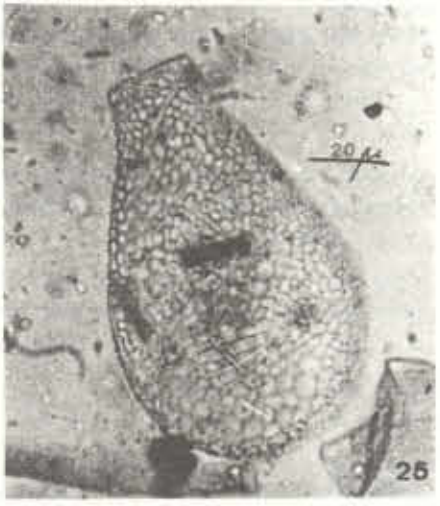
PLATE III

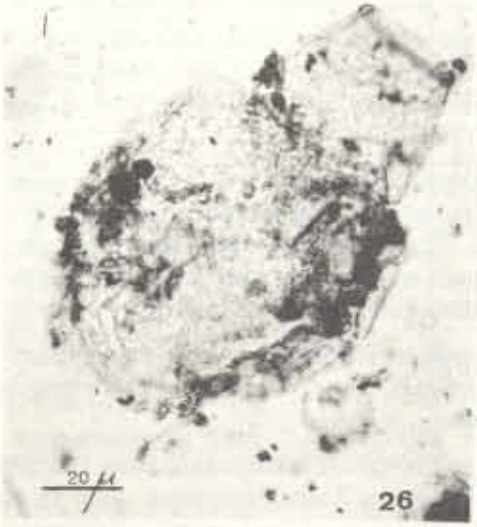


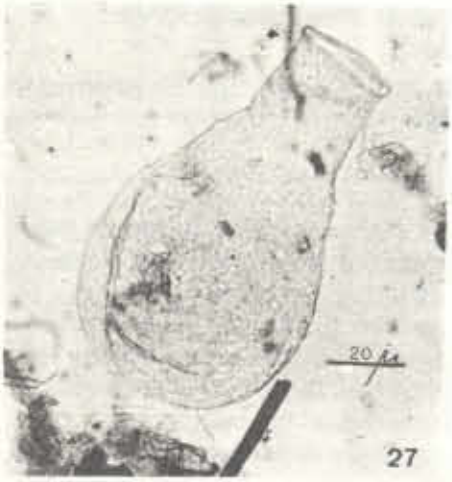












Unidentified types: Plate II: fig. 15. perhaps a species of *Centropyxis.*

Found in rel. 39: Páramo de Guantiva: *Oritrophio limnophilae-Wernerietum pygmaeae typicum* var. of *Sphagnum cyclophyllum (Wernerion crassaepygmaeae, Oritophio-Wernerietalia, Wernerietea).*

Plate II: fig. 16. perhaps a species of *Centropyxis.*

Found in rel. 147; Páramo de Palacio: *Oritrophio peruvianae-Oreoboletum obtusanguli typicum* var. of *Rhacocarpus purpurascens (Gentiano-Oritrophion, Oritrophio-Wernerietalia, Wernerietea).*

Plate II: fig. 17. unknown.

Found in rel. 147; Páramo de Palacio: *Oritrophio peruvianae-Oreoboletum obtusanguli typicum* var. of *Rhacocarpus purpurascens (Gentiano-Oritrophion, Oritrophio-Wernerietalia, Wernerietea).*

Plate II: fig. 18. perhaps a species of *Centropyxis.*

Found in rel. 387; Páramo de Tota: *Cyperetum rivularis (Galio-Gratiolion, Marchantio-Epilobietalia).*

GEOGRAPHICAL DISTRIBUTION

In recent times much research has been done on the distribution of the Testacea. It appears that in comparison with other groups of animals the Testacea include a high percentage of cosmopolitans, but there are also species which are restricted to a limited area. Decloitre (1953) studied the distribution of the Testacea and provided the following division:

1. temperate zones of the northern and southern hemisphere; mainly species of *Heleopera, Arcella* and *Difflugia.*
2. temperate zone of the northern hemisphere: mainly species of *Difflugia* and *Nebela.*
3. temperate zone of the southern hemisphere: mainly species of *Nebela.*
4. temperate zone of the northern hemisphere and the (inter) tropical zone: mainly species of *Arcella, Centropyxis* and *Heleopera.*
5. temperate zone of the southern hemisphere and the (inter) tropical zone: mainly species of *Arcella* and *Nebela.*
6. (inter) tropical zone: mainly species of *Arcella* and *Centropyxis.*

ECOLOGY

Rhizopoda and Heliozoa occur in humid environment. In all places where water is present, Rhizopoda and Heliozoa have the opportunity to develop. Some species need very muddy water. Other species depend on little water. Testacea live under the most varied ecological circumstances and biotopes, from lakes to puddles and from *Sphagnum*-peatbog to dry moss-carpets on trees and stones. Many Testacea have a strong preference for the *Sphagnum*-plants in bogs. Harnisch (1927) provided a division based on the composition of species in *Sphagnum*-peat.

1. forest-moss type with sphanophilous species and species restricted to *Sphagnum.*
2. closed "peat-area" type with the presence of
   a. *Hyalaosphenia*
   b. *Amphitrema flavum.*
3. very good developed peat-moor with *Amphitrema wrightianum.*

This division is used in Europe and we can now make the comparison with the Testacea-fauna in the páramos of the Colombian Cordillera Oriental.

CONCLUSIONS

Testaceans appear to be present in almost all páramo vegetation types (Grabandt, in prep.). Most of the recorded genera exhibit close ecological affinities to vegetation types rich in bryophytes, e.g; zonal bamboo páramos, *Marchantio-Epilobietalia, Sphagnum* bogs and in part also zonal superpáramo *(Arcella)* and *Wernerietea (Arcella, Nebela).* Species of *Assulina* for example seem to be frequently present in zonal as well in azonal páramo plant communities. *Heleopera* apparently is absent in zonal vegetation.

As to the azonal humid and wet páramo vegetation it is evident that most testacean genera present in *Sphagnum* bogs in Europe are now also recorded for *Sphagnum* bogs in the Colombian páramos. *Amphizonella violacea* and *Arcella mitrata* are only known from *Sphagnum* bogs (table 1).

However, a number of testacean genera do not exclusively occur in páramo *Sphagnum* bogs, but are also recorded in other vegetation types (table 1). According to the first results *Arcella* seems most abundant in the *Wernerietea, Amphitrema* in páramo *Sphagnum* bogs, and *Nebela* in both *Wernerietea* and *Sphagnum* bogs.

Aquatic vegetation is in general poor in testacean fauna and bryophitic mire vegetation *(Marchantio-Epilobietalia)* is rich in Testacea.

Amphitrema and *Heleopera* are almost lacking in the *Wernerietea* (which also includes the vascular cushion bogs), while *Centropyxis* is rare in this habitat.

Páramo *Sphagnum* bogs are rich in testacean fauna; especially *Amphitrema* and *Nebela* are abundant. The moss layer of páramo shrub on boggy ground was richest in Testacea, predominantly *Assulina* and *Arcella.*

Meadow vegetation is in general poor in testacean fauna, except for *Muehlenbergia*-dominated stands.

The ecological distribution from Harnisch (1927) for European Testacea applies only in part to the testacean fauna of the Colombian páramos.

TABLE I.

SURVEY OF THE STUDIED TESTACEA AND RELATED VEGETATION TYPES

species of Testacea:	Communities of the vegetation in the páramos of the Colombian Cordillera Oriental.									literature data ').			
	Ditricho submersi-Isoetion	Tillaeion paludosae (*Tillaeetalia*)	Eleocharis acicularis	Junco ecuadoriensis–Eleocharition macrostachyae	Galio-Cratiolion (*Marchantio-Eriobietalia*)	Calamagrostion ligulatae (*Marchantio-Eriobietalia*)	Wernerion crassae-pygmaeae (*Wernerietea*)	Gentiano–Oritrophion (*Wernerietea*)	Xyris-Sphagnum bogs	Sphagnum	bryophytes (*Sphagnum excepted*)	various Sapropelia	geographical distribution ")
Amphitrema	o	o	o	o	o	o			o				
Amphitrema flavum							x			x			we
Amphitrema wrightianum			x							x			we
Amphizonella violacea									x	x			we
Arcella sp.	o	o	o	o	o	o	o	o	o				
Arcella arenaria	x										x		c
Arcella catinus						x				x			c
Arcella discoides						x				x	x	x	c
Arcella mitrata									x	x			c
Assulina sp.	o	o	o	o	o	o	o	o	o				
Assulina muscorum						x				x			we
Assulina seminulum							x			x			we
Centropyxis sp.	o	o	o	o	o	o	o	o	o				
Centropyxis hemisphaerica						x						x	nsa
Centropyxis aculeata						x				x	x	x	e
Centropyxis discoides						x				x		x	c
Centropyxis platystoma	x									x			c
Centropyxis cassis	x										x	x	c
Difflugia gramen							x					x	we
Difflugia lobostoma							x			x		x	we
Difflugia amphora					x					x		x	we
Heleopera sp.	o	o							o				
Heleopera petricola						x				x		x	we
Hyalospnenia elegans		x								x	x		we
Nebela sp.	o	o	o	o	o	o	o	o	o				
Nebela galeata			x							x			we
Nebela collaris	x									x	x		we
Nebela dentistoma				x						x	x		we
Pontigulasia spectabilis							x			x			we
Sphenoderia dentata								x		x	x		we
Sphenoderia lenta		x								x	x		we
unidentified type (fig. 15)							x						
unidentified type (fig. 16)								x					
unidentified type (fig. 17)								x					
unidentified type (fig. 18)					x								

') see: Deflandre, 1928/1929.
Hoogenraad & De Groot, 1940/1951/1952.

") we = West Europe
e = Europe
nsa = N. & S. America
c = cosmopolitan
o = genus present
x = species present

Considering the provisional zoogeographic distribution of Decloitre (1953) it is apparent that the Colombian páramo Testacea are mainly wide temperate in distribution. In a forthcoming study also the distribution of Testacea in the andean forestbelt will be discussed.

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