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THE DIATOM FLORA of SOUTHERN AFRICA

by
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PREFACE (1)

With the distribution of this issue, the first three parts of *The Diatom Flora of Southern Africa* have been published. A stage has, therefore, been reached when reassessment of the project should be made, bringing to light any problems and considering any criticisms. We have been particularly gratified at the very favourable reaction received so far, but this will not lead to any complacency in achieving our goals. Nevertheless, some of the features of the *Flora* attracting the greatest commendation, have been the cause of not attaining certain objectives. For instance, we aimed to describe twenty species in each number, but have only been able to deal with ten taxa per issue. Failure to achieve this aim is due, partly to the short intervals between publication dates, but more especially to all the work involved in ensuring the correct identity of the species presented, and in illustrating them through the medium of the light, transmission and scanning electron microscopes. The latter is probably the most valuable contribution the *Flora* makes to diatomists.

We are almost entirely dependent on the good will of many scientists and institutions in sending us type or properly authenticated material for comparative purposes, as well as for the confirmation of the accuracy of our identifications. To those previously acknowledged, we reiterate our sincere gratitude for their assistance and sacrifice of time. Since publication of the first issue of this work, a further number of persons are owed a word of thanks for assistance rendered in many ways. We would therefore like to thank the following:

- Dr M. Coste of the Ministry of Agriculture, Paris, for diatom material and electron micrographs of various taxa.
- Dr D. Mollenhauer of the Forschungsinstitut Senckenberg at Biebergemuend (Federal Republic of Germany), for rediscovering various sets of diatom slides made by Dr B.J. Cholnoky, which are not in our collection, and for his permission to borrow them.
- Dr H. van Dam of the Rijksinstituut voor Natuurbeheer at Leersum in the Netherlands, for sending diatom material.
- Mr H.J. van Tonder at the Rietondale Research Station of the Department of Agricultural Technical Services, Pretoria, for his invaluable assistance in our studies using the scanning electron microscope.
- Ms D.E. Waldron of the British Museum (Natural History), for preparing material for light and electron microscope examination, and for electron micrographs of certain species.

One of our goals in the production of this *Flora* is to ensure to the best of our ability the correct identification of our southern African taxa. In this respect our dependence on obtaining type specimens or well authenticated material has already been mentioned above. There is, however, another aspect in which we need the help of other diatomists, particularly those well acquainted with the older collections of diatoms. On many occasions it has been a source of surprise

to us that, while examining old material from the British Museum (Natural History) or the Naturhistorisches Museum Wien, we have observed taxa which, to the best of our knowledge, have only recently been described from southern Africa. Some of these taxa occur in sufficient numbers on the slide, so that it is highly unlikely that they have been overlooked by the investigator. As many of these early slides do not have an accompanying inventory of the species occurring on them, we cannot relate these taxa to any particular species described in earlier times. Such instances suggest that some of the species recently described from southern Africa may, in fact, have been described previously, or have been placed with some other taxa. We have, however, no means of establishing this, as we do not know what type material to request for comparison. We therefore appeal strongly to any diatomist who recognises such a case amongst the diatom taxa described in this *Flora*, to point out our error and the correct identification.

Our descriptions of species treated in this *Flora* are based on our own observations, in addition to information drawn from literature surveys. Although our diatom library is extensive as far as taxonomic publications are concerned, it is far from complete. Furthermore, the information contained by this library is not all completely catalogued or in a readily retrievable form. We are therefore conscious that errors in our descriptions may arise through overlooking publications containing vital information, as well as through incorrect interpretation of the data at our disposal. Consequently, with the aim of trying to be as accurate as possible in what we write, we again invite not only the criticism of our fellow diatom taxonomists, but also any references which may lead to a reassessment of our ideas and greater accuracy. We also welcome suggestions which may help to make the format or content of the *Flora* as helpful as possible to those using it.

As more numbers of the *Flora* are produced, certain modifications of techniques will become necessary from time to time as we learn from experience. In addition, we may wish to comment briefly on certain flaws or weaknesses in our present methods of examination of samples, or methods of description or illustration of the species. Such notes or comments will be written, when necessary, in the prefaces to various numbers. In this Preface, three points are discussed: the first concerning a part of the information given in the text; the second, a comment on the illustrations; and the third involving an alteration of technique.

We wish to make it clear that the information on the range of distribution of any species in the text of the *Flora* is valid at the time of publication of the relevant number. It should be pointed out, however, that there are still large regions of southern Africa which have not yet been surveyed for their diatom flora, or about which little is known apart from a few random collections of diatom samples. The range of distri-

bution of many species may therefore be much greater than indicated in the text.

Since we work mainly through the medium of phase contrast illumination, the majority of the light microscope photographs are taken under this type of illumination. Consequently the LM photographs in the plates are, unless stated otherwise, of specimens in phase contrast illumination.

For some time we have endeavoured to improve the quality of the scanning electron micrographs. Through a change in technique and instrument this goal has been partially achieved. The new method for examining diatom material under the scanning electron microscope is outlined below.

- i) Cleaned diatoms are suspended in deionized water to which several drops of 50% ethanol have been added to reduce static.
- ii) Brass viewing stubs (10 mm diameter) are coated with a monolayer of 2% collodion in amyl acetate and allowed to dry at room temperature.
- iii) Several drops of the diatom suspension are placed on the collodion covered brass stub, and allowed to air dry.
- iv) The diatom material on the stub is then coated with gold/palladium for 2 to 3 mins. in a Hummer Technics DC Sputter Coater.
- v) A Jeol JSM-35 scanning electron microscope, operating at 15 or 25 kV and having a rotatable stage tilting variously through 60°, was used for viewing. Micrographs were taken on Kodak Verichrome Pan (VP 120) film having an ASA of 125 (22 DIN).

Finally, we should like to appeal for diatom material to study under the electron microscope. We kindly ask anyone who makes a gathering of diatom material in which a particular species occurs in great abundance and is relatively free of silt to send us some of this material. The importance of the electron microscope in diatom taxonomy is increasing rapidly, and good micrographs are therefore essential. Good micrographs are best obtained from clean, rich material, but so much of our material is contaminated to a large degree with silt and contains a few specimens that a great deal of time is spent in finding suitable examples. For this reason, anyone sending us rich, clean material may help us in this aspect of our studies, and their assistance would be greatly appreciated. Samples should be addressed to Dr F.R. Schoeman & Mr R.E.M. Archibald, National Institute for Water Research, P.O. Box 395, Pretoria 0001, South Africa.

EXPLANATORY NOTES (2)

Units of linear measurement

In scanning the early diatom literature for dimensions of diatom valves and the density of the transapical striae or fibulae, one frequently encounters antiquated units of linear measurement. These units were peculiar to each nation or region in which they had developed. The metric system was therefore proposed in Paris in June 1799 to facilitate scientific communication by eradicating national and regional variants in measurement units. However, acceptance of the metric system was very slow, and it was not until late in the nineteenth century that most diatomists adopted it. Similarly today, in order to overcome the proliferation of subsystems of the metric system designed for different disciplines, a universal system of units, *Le Système International d'Unités* (SI), was introduced in 1960. In South Africa, as in most other countries, SI is the only officially recognised system of units. Fortunately for diatomists the metric unit of linear measurement, the micron (μ), has suffered little change, being merely a change in name to micrometre with the symbol μm . To conform to SI units in our descriptions, as well as for comparative purposes, the antiquated units must therefore be converted.

The problem encountered by present day diatomists in converting the old units into SI units is to determine which of the old units were used by various individuals. In a number of cases the early authors state precisely which units were employed in their contributions, but others do not.

For instance Kützing (1849 :VI) made it plain that in his *Species Algarum* he used Paris lignes ($1'' = \text{linea parisiensis}$) for the dimensions of the diatoms, and it is reasonable to assume that in his other works the same unit was used. Likewise Rabenhorst (1864 : VI) wrote in the introduction to his *Flora Europaea - "Mensura usi sumus Gallica (lineis Parisinis) et Anglica (digitis Anglicis)"* - thus clearly indicating his use of both Paris lignes and English inches. It is also reasonable to assume that the early British diatomists such as Gregory, Greville and Smith gave their dimensions of diatom valves in English inches. We have only two publications of Ehrenberg (1845; 1854) but deduce from these that his measurements were given in Paris lignes. On Plate I of the *Mikrogeologie* (Ehrenberg 1854) a bar scale showing the appropriate divisions as fractions of a Paris ligne clearly indicates this.

The Paris ligne and English inch appear to be the units most commonly used by early diatomists. According to *The New Encyclopaedia Britannica* (1974 :734) the Paris ligne ($1''$) in terms of SI units is equal to 2,26 mm (or more accurately 2,256 mm). We have therefore accepted this value for our conversions of Paris lignes to micrometres (μm). The SI equivalent of an English inch is 25,4 mm. Dimensions of a diatom valve given in English inches are, however, usually expressed as decimal fractions of an inch, while striae counts are given as a certain number in 0,001" (= 25,4 μm).

Problems arise, however, when dealing with the units used by Grunow. In his earliest papers Grunow expressed all the dimensions of diatom valves in decimal fractions of a Zoll or inch ($1''$). The difficulty is to decide which of the many variants of the inch or Zoll, all bearing the same symbol ($1''$), was used by Grunow. As far as we know Grunow made no positive reference to his units, and therefore the problem must be solved by inference. After about 1878 Grunow did in fact switch to the metric system, but we have unfortunately been unable to find two sets of dimensions from which a direct comparison between his dimensions in metric units and those expressed as fractions of an inch or Zoll can be made.

Lange-Bertalot (personal communication) believes that Grunow used a Paris inch ($1'' = 27,07 \text{ mm}$) as his unit, but he was unable to provide any concrete evidence for this. Nevertheless, in his work on the Austrian Diatoms, Grunow (1862 : 553) directly quoted W. Smith (1853 : 36) as giving 31 transapical striae in 0,001" for *Tryblionella punctata* (= *Nitzschia punctata*). Smith would undoubtedly have given this information in English inches ($1'' = 25,4 \text{ mm}$). However, at a later stage, Grunow (in Cleve and Grunow 1880 : 68), having adopted the metric system, again quoted W. Smith with reference to the same point, but on this occasion gave 11,5 striae in 0,01 mm (= 10 μm). Grunow could only have derived this measurement of 11,5 striae from Smith's count of 31 transapical striae in 0,001" if $1''$ equals 27,07 mm. This value is the SI equivalent of a Paris inch ($1'' = 27,07 \text{ mm}$), one twelfth of which is a Paris ligne ($1''' = 2,256 \text{ mm}$). This evidence cannot be construed as conclusive, but it lends some support to Lange-Bertalot's contention.

Apart from this shred of evidence, we have no other indication that Grunow used the Paris inch as his unit of linear measurement. In fact it is obvious that many of Grunow's contemporary diatomists made no distinction between the English unit they employed and the inch variant applied by Grunow. For instance Rabenhorst (1864), although implicitly stating his use of English inches, quoted without alteration Grunow's dimensions for certain species, thereby implying Grunow's use of the English inch. Similarly in Kitton's English translation of Grunow's paper on the "Novara" diatoms (cf. Grunow 1870; 1872) no alterations were made to Grunow's original dimensions. Here also the inference may be drawn that Kitton regarded Grunow's variant of an inch to be the English inch. Furthermore, with the exception of the single example mentioned above, Grunow correctly converted other measurements given in English inches into metric units.

As significant differences can arise when converting a dimension expressed in inches to SI units, depending on whether it is a Paris inch ($1'' = 27,07 \text{ mm}$) or an English inch ($1'' = 25,4 \text{ mm}$), it is important to decide which of the two variants should be applied to the dimensions in Grunow's

Explanatory notes (2) (ii)

earlier diatom descriptions. Accordingly we have selected the English inch and its SI equivalent of 25,4 mm as Grunow's unit of linear measurement. This unit is selected in preference since, as indicated above, Grunow's contemporaries appeared to recognise the English inch as Grunow's unit. Furthermore, its selection eliminates one of the possible variants of the inch or Zoll used by the early diatomists. In accepting the English inch we are not precluding the possibility that Grunow's unit was indeed the Paris inch. We are merely indicating to our readers what factor we used in converting Grunow's earlier dimensions into SI units. Should anybody be able to supply any reference providing clear evidence favouring the Paris inch, we would gladly accept it. In this connection attention is drawn to the taxonomic comments on the species, *Navicula seminulum* Grunow (cf. Schoeman and Archibald 1976-). In this note we assumed that Grunow used the Paris inch (1" = 27,07 mm) and therefore derived the value of 15,5 striae in 10 μm from Grunow's original description of this species (cf. Grunow 1860 : 552). However, on subsequent research into the question of which inch variant should be applied to Grunow's dimensions, our earlier assumption has been reviewed, and we now accept the English inch for Grunow's measurements. Unfortunately this change came too late to make the necessary alterations to the text as these pages had already been printed. The change to English inches (1" = 25,4 mm) makes no difference, however, to the substance of the comments except that the number of striae in 10 μm so derived becomes 16,5 in place of 15,5.

In his early works on the diatom flora of Prussia, Schumann (1862; 1864; 1867a) employed the Paris ligne (1''' = 2,256 mm) as his unit of linear measurement. However, in his paper on *Die Diatomeen der hohen Tatra* (Schumann 1867b) and in the last part of the diatom flora of Prussia (Schumann 1869) he developed his own units, represented by the symbols T and R. The units T and R are based on the Paris ligne, and were explained by Schumann (1869 : 84) thus:-

- T = the length of the frustule in Thousandths of a paris ligne, i.e. 0,001'''
 R = the number of striae (Riefen) in a hundredth of a Paris ligne, i.e. 0,01'''.

It is therefore a simple matter to convert Schumann's units T and R into SI units - T = 2,256 μm , and R = number of striae in 22,56 μm .

Finally one other unit worth mentioning is the centièmes de millimètre (1 c.d.m. = $\frac{1}{100}$ mm), which is equivalent to 10 μm . The c.d.m. is the unit favoured by Van Heurck (1880-83; 1885; 1896) and Peragallo & Peragallo (1897-1908).

Information concerning some of the antiquated units used by the early diatomists and their equivalent SI values is summarized in the table below.

ANTIQUATED UNIT		S.I. EQUIVALENT
English inch (1")	=	25,4 mm
0,001"	=	25,4 μm
Paris inch or Zoll (1'')	=	27,07 mm
Paris ligne (1''')	=	2,256 mm
0,01'''	=	22,56 μm
Schumann's T ($\frac{1}{1000}$ ''')	=	2,256 μm
Schumann's R ($\frac{1}{100}$ ''')	=	22,56 μm
1 c.d.m. ($\frac{1}{100}$ mm)	=	10,0 μm .

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Achnanthes exigua Grunow

Grunow in Cleve and Grunow 1880 : 21.
Grunow in Van Heurck 1880-83 : Pl. 27, Figs 29, 30.
Cleve 1895 : 190.
Hustedt 1931-59 : 386, Fig. 832.
Hustedt in A. Schmidt Atlas 1874-1959 : Pl. 413, Figs 3-12, 15-23.

Synonyms:

Stauroneis exilis Kützing 1844 : 105, Pl. 30, Fig. 21.
Achnanthes exigua var. *constricta* (Grunow) Hustedt 1921 : 145, Figs 7, 8.
Achnanthes exigua var. *heterovalva* Krasske 1923 : 193, Figs 9a, b.

Description:

Valves with almost elliptical, linear-elliptical to nearly quadratic central portion, sometimes with one or both margins of the larger forms constricted in the centre; poles greatly variable from slightly protracted, broadly subrostrate apices to abruptly narrowing rostrate to capitate poles; length 5,6-18,0 μm , breadth 3,4-7,0 μm . **Raphe valve:** raphe straight and filiform, central pores usually conspicuous, but terminal fissures indistinct. Axial area narrow, linear, usually with an abrupt funnel-shaped widening near the central pores; central area a transverse fascia reaching the margins of the valve where it is usually broader than at the centre. Transapical striae radial throughout, (22) 24-36 in 10 μm near the centre, becoming denser at the poles. **Rapheless valve:** axial area narrow, linear to lanceolate; central area either lacking or variable in shape due to shortening, widening or complete absence of central striae, thereby producing a single or double sided asymmetrical central area. Transapical striae usually more robust and less radial than on the raphe valve, those in the middle being sometimes parallel to slightly convergent, (19) 20-26 in 10 μm near the centre, increasing in density towards the poles.

SEM micrographs of the raphe valve (Figs 66-68) show that the raphe branches consist externally of a narrow fissure with a proximal expansion somewhat depressed in the central nodule (the conspicuous central pores seen under LM), while the terminal fissures are curved towards and reach the opposite margin of the valve (also shown clearly in TEM Figs 50, 61, 63) where they become quite strongly recurved. Internally the raphe fissure is a narrow slit within an internally raised axial rib (Figs 70, 71), without a prominent expansion at the central nodule and ending abruptly at the terminal nodule (Figs 69-73). The TEM view of the terminal nodule of one specimen (Fig. 59) shows an outer terminal fissure (TF) and inner infundibulum (IM) typical of a naviculoid raphe system. SEM observations of the internal structure of the valves show that the central nodule of the raphe valve is expanded transapically to the margin of the valve, thus forming a stauros (Figs 70, 71, 73). A similar "stauros-like" thickening or widening of the costae is observed in those rapheless valves having a central area

reaching the valve margin (Figs 78-80). In both valves the costae appear to be slightly raised internal ridges, between which are the striae. Under TEM the striae are seen to consist normally of a single row of puncta, which are coarser (51-62 in 10 μm) and oblong in the rapheless valves, while finer (57-74 in 10 μm) and nearly circular in the raphe valve. In a number of specimens (e.g. Figs 54, 57, 61, 64; see also Helmcke and Krieger 1953 : Pl. 50) irregularities in the structure of the striae were observed in the form of the splitting of some puncta into two, thus forming a double row of alternately or adjacently arranged puncta. Finally, SEM micrographs of the rapheless valve have elucidated that the dark patch, observed in LM under phase contrast, near the centre of the axial area (Figs 32, 35, 38) is a pitted depression in the outer surface of the valve (Figs 74-76).

S.A. Ref. Slide Nos. : 59, 73, 74, 76.

Comments:

Achnanthes exigua is an extremely variable taxon resulting in the description of a large number of varieties and forms (cf. VanLandingham 1967 : 24-25). Only three of these varieties have been recorded from Southern Africa, and these are individually discussed below. Guerneur (1954 : 31, Pl. 2, Figs 3a-m) on the other hand recorded nine different varieties and forms from Senegal. We have not attempted to unravel the complexities involved here, but it should be clear from the discussions below that most of Guerneur's forms can be regarded as synonymous with the nominate variety.

The main diagnostic character distinguishing Krasske's (1923 : 193, Figs 9a, b) variety, var. *heterovalva* (not spelt *heterovalvata* as is generally accepted following Hustedt 1931-59 : 387) from the type is the finer striation of the raphe valve, which according to Hustedt (l.c.) is more than 30 striae in 10 μm (Krasske gave 34 in 10 μm). Considering this parameter, examination of a large number of specimens from Southern Africa and Indonesia clearly showed the raphe valve to have an unbroken series giving a range of 24-35 striae in 10 μm (cf. also van der Werff and Huls 1957-74, viz. 28-32 striae in 10 μm). The number of striae, therefore, cannot be used to separate the var. *heterovalva* from the nominate variety. Similarly when valve shape is considered, raphe valves with supposedly "*heterovalva*" type striation were observed representing the range of variation in shape referred to in the description. Since we cannot distinguish the var. *heterovalva* on either of these two characters we have elected to treat it as part of the normal range of variation of *A. exigua*. A similar conclusion appears to be implied by Hustedt (1949 : 75) with regard to material from the Belgian Congo.

The same Southern African and Indonesian material mentioned above shows furthermore that var. *constricta* (Grunow) Hustedt (1931-59 : 386, Fig. 832g) is no longer

tenable, since a morphological range from valves with a convex central portion, through parallel-sided examples, to valves with one side constricted or both margins constricted can be found. In this regard it is interesting that Krasske's (1923 : Fig. 9a) illustration of var. *heterovalva* has constricted margins at the centre, thus closely resembling Hustedt's figure of the var. *constricta* in A. Schmidt's Atlas (1874-1959 : Pl. 413, Fig. 21). Patrick and Reimer's (1966 : 258) comment that the variability of var. *constricta* may form the bridge between the nominate variety and var. *heterovalva* can therefore be accepted. Notwithstanding the remarks above, Cholnoky (1966 : 7; 1970a : 11) recorded forms as var. *constricta* which he described as being very robust. Having examined a few examples of these forms, we are not entirely satisfied that they can be properly assigned to this variety. Further study of these robust forms will be undertaken to determine their true affinity.

The history of the combination *A. exigua* var. *constricta* is somewhat complicated with various authors credited with the combination. The first mention of a var. *constricta* is found in relation to *Stauroneis exilis* Kützing (1844), when Grunow (1870 : 20) described *Stauroneis exilis* var. ? *constricta*, a form with a slight constriction in the centre of the valve. Grunow (in Cleve and Grunow 1880 : 21; in Van Heurck 1880-83 : Pl. 27, Figs 29, 30) subsequently transferred *S. exilis* Kützing to the genus *Achnanthes*, renaming it *A. exigua* on account of the preoccupation of the epithet *exilis* in this genus (cf. *A. exilis* Kützing 1833), but made no mention of *S. exilis* var. *constricta* as a variety of *A. exigua*. According to VanLandingham (1968 : 784), Torka apparently independently described a *Cocconeis exigua* var. *constricta* in 1909, which has been synonymised with *A. exigua* var. *constricta*. Hustedt (1921 : 145, Figs 7, 8) also described a new variety, *A. exigua* var. *constricta*, without apparently being aware of Grunow's var. *constricta* or that of Torka. Later Hustedt (1931-59 : 386, Fig. 832g) attributed the variety solely to Torka. Without examining the type material of Grunow, Torka or Hustedt but from their descriptions, we assume that they are all identical. If this is the case then the combination *A. exigua* var. *constricta* must be attributed to Grunow, the author of the basionym, and Hustedt who first proposed the correct combination.

Although Cholnoky (1970a : 10; 1970b : 7) has united var. *elliptica* Hustedt (1937-38 : 197, Pl. 9, Figs 8, 9) with the nominate variety, we have not examined sufficient material to support this hypothesis at present.

We have examined Kützing type material from Lake Tacarigua, Trinidad (*Stauroneis exilis* - Kützing No. 379) loaned by the British Museum of Natural History (slide BM 18918) and the same material (i.e. Kützing No. 397) from Grunow's collection in Vienna (slide No. 2469 - Vienna), as well as material collected in Abyssinia from the Grunow collection (slide No. 3079 - Vienna). There were no essential

differences between the specimens on these slides and the Southern African material. However, in our specimens the rapheless valves usually had more robust transapical striae and the axial area was generally wider and lanceolate in shape. Forms with similar structure are illustrated by Hustedt in A. Schmidt's Atlas (1874-1959 : Pl. 413, Figs 18-20, 22, 23). We were also fortunate in obtaining a small quantity of dried material from the British Museum for TEM study. Despite their scarcity and poor preservation a few examples were examined electron microscopically (Figs 41-45) and were also shown to be essentially the same as the Southern African material. The only drawback is that we are uncertain of the origin of this material, since it was merely labelled *Achnanthes exigua*. Two samples collected in Indonesia (supplied by Prof. O. Jaag of Switzerland) provided us with forms having a much wider range of variation in valve shape (Figs 40A, 58-65).

In our description of this taxon we have given 22 striae in 10 μ m as the lowest count for the raphe valve. This value is derived from Meister (1912 : 98) and Hustedt's illustration in A. Schmidt's Atlas (i.c. Pl. 413, Fig. 3). The lowest density recorded by ourselves and all other authors consulted was, however, 24 striae in 10 μ m.

In passing it should be noted that in the description of this taxon and its variety var. *heterovalva* by van der Werff and Huls (1957 - 74) the figures have been transposed. The small elliptical forms with rostrate poles should be *A. exigua*, while the larger valves with capitate poles illustrate the var. *heterovalva*.

Distribution:

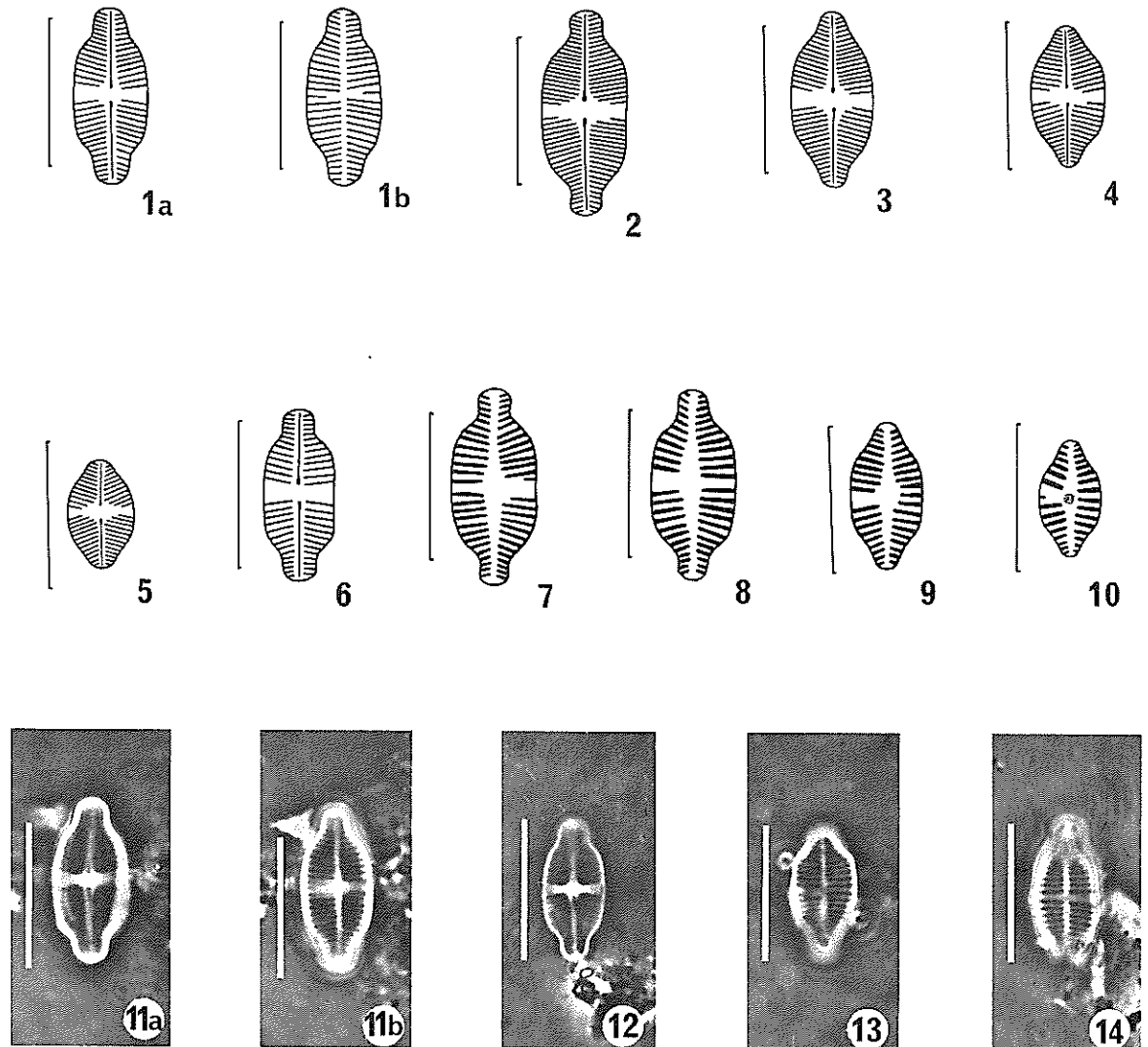
A. exigua is widespread in Natal, the Transvaal, Lesotho and South West Africa. Isolated records of this species have also been made from the Western Cape Province (Cholnoky 1955; 1962a) and in the Eastern Cape Province (Giffen 1966; Archibald: unpublished data). Schoeman (1969; 1970) reported it from the Eastern Orange Free State, while Cholnoky observed it in Rhodesia (1954a; 1954b) and Swaziland (1962b).

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Achnanthes exigua (4)



Achnanthes exigua Grunow

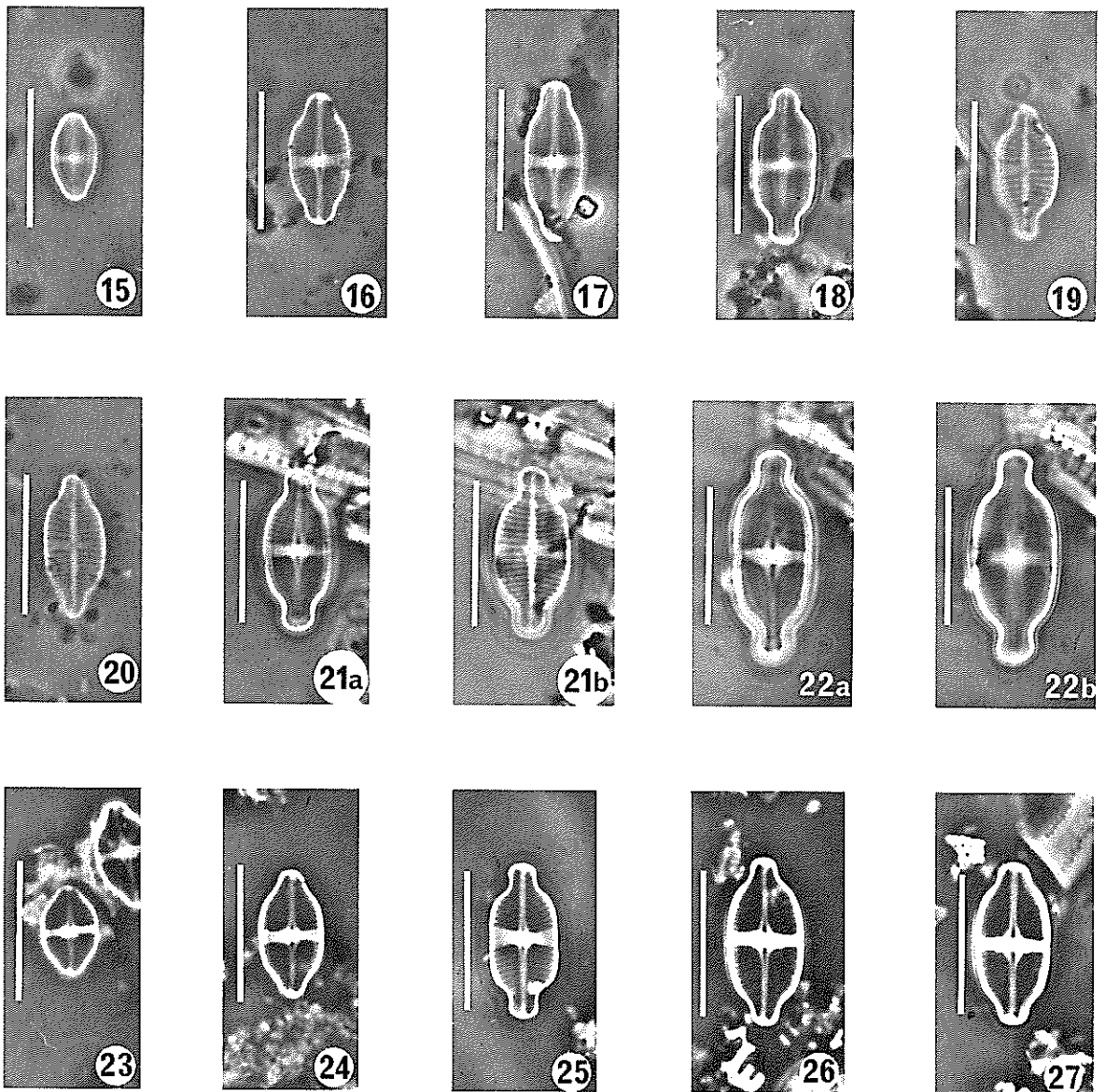
Fig. 1 : Drawing. Lake Tacarigua, Trinidad. Type Slide No. BM 18918.

Figs 2-5, 7-10 : Drawings. Drakensberg, Natal.

Fig. 6 : Drawing. Ladybrand, Orange Free State.

Figs 11-14 : LM. Lake Tacarigua, Trinidad. Type Slide No. BM 18918.

Figs 1-14 : Scale = 10 μ m.



Achnanthes exigua Grunow

Figs 15-20 : LM. Lake Tacarigua, Trinidad. Grunow Slide No. 2469 (Vienna).

Figs 21, 22 : LM. Abyssinia, Leg. Beccari (13.d 15). Grunow Slide No. 3079 (Vienna).

Fig. 21 : Two valves of a frustule.

21a - Raphe valve.

21b - Rapheless valve.

Fig. 22 : A specimen in different planes of focus.

22a - Raphe valve with raphe in focus.

22b - Raphe valve with outline in focus.

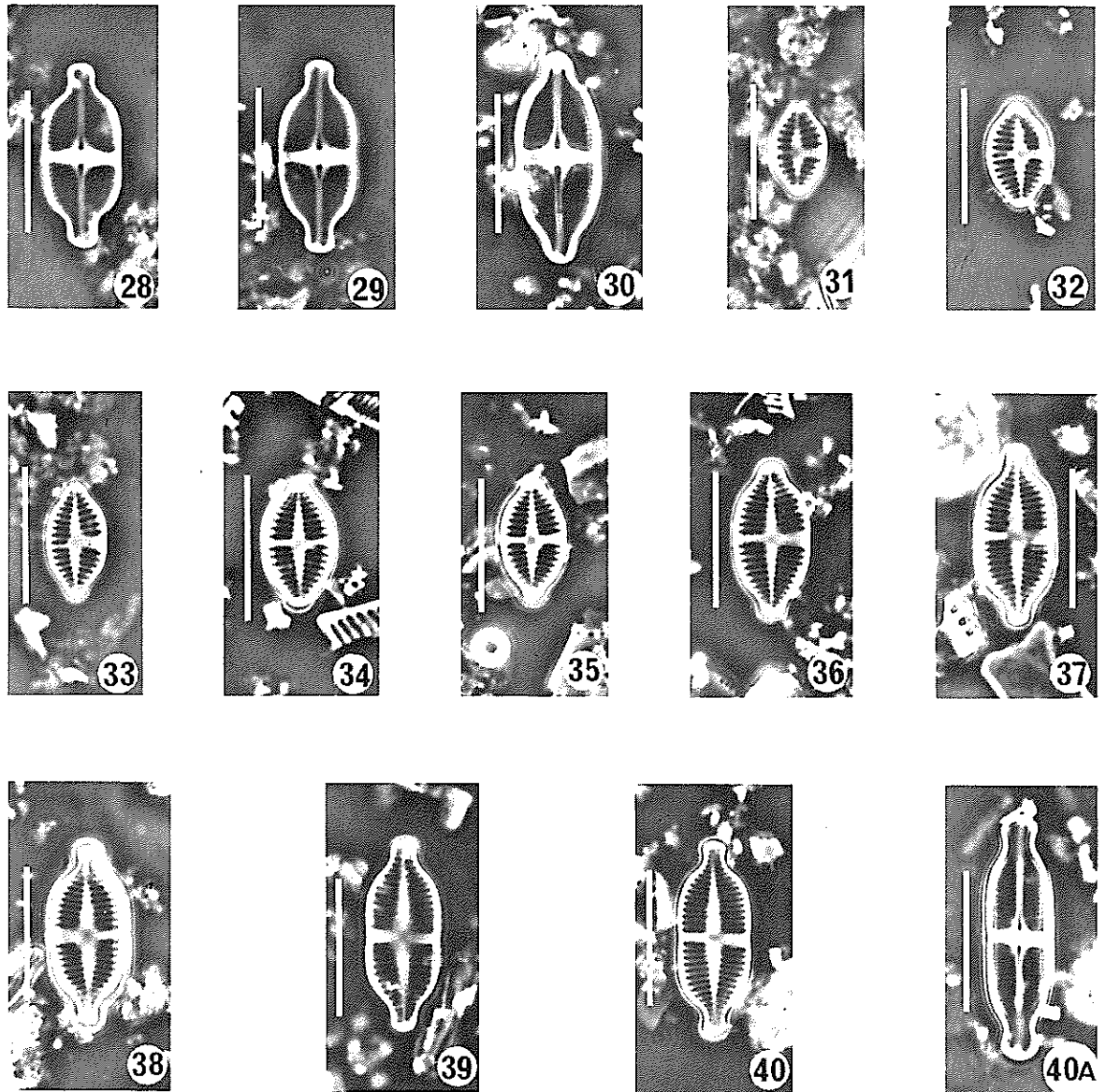
Figs 23, 24 : LM. Drakensberg, Natal.

Fig. 25 : LM. Ladybrand, Orange Free State.

Figs 26, 27 : LM. Khukhune District, Lesotho.

Figs 15-27 : Scale = 10 μ m.

Achnanthes exigua (6)



Achnanthes exigua Grunow

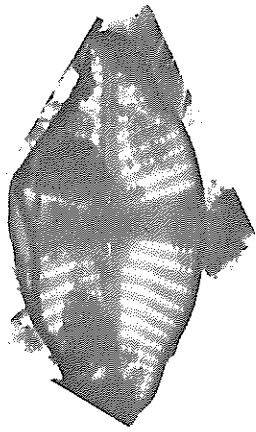
Figs 28, 29, 31, 33 : LM. Drakensberg, Natal.

Figs 30, 32, 34-36, 39 : LM. Khukhune District, Lesotho.

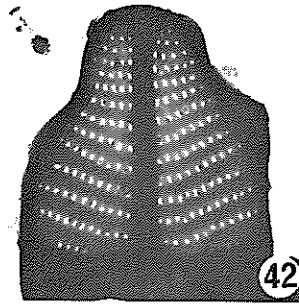
Figs 37, 38, 40 : LM. Ladybrand, Orange Free State.

Fig. 40A : Tjipanas above Tjibodas, Java. Leg. O. Jaag.

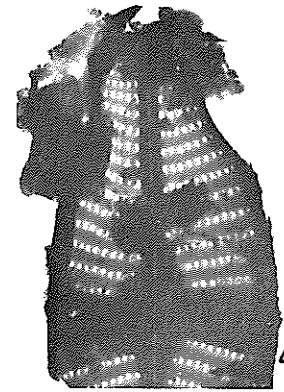
Figs 28-40A : Scale = 10 μ m.



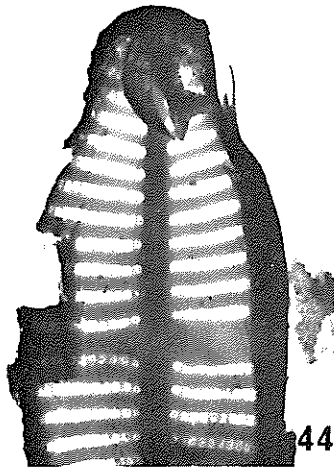
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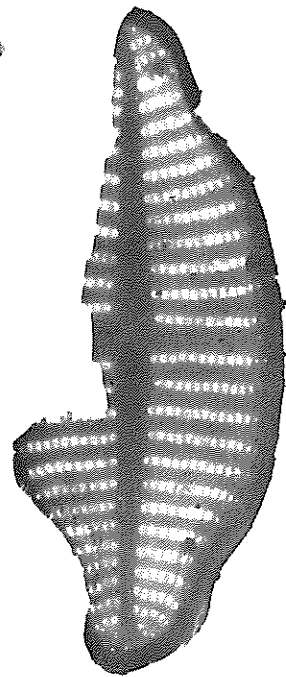
42



43



44



45

Achnanthes exigua Grunow

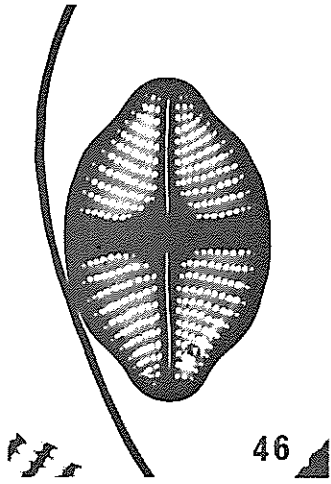
Figs 41-45 : TEM. Exsiccati material obtained from the British Museum (Natural History). Probably Kützing material.

Fig. 41: X 5 800.

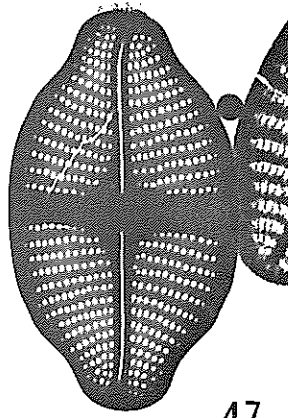
Figs 42-45 : X 8 200.



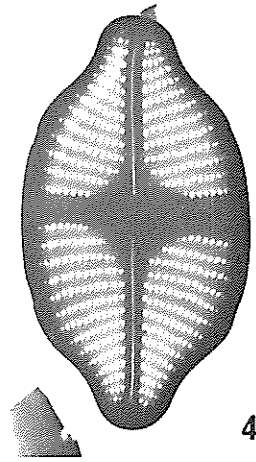
Achnanthes exigua (8)



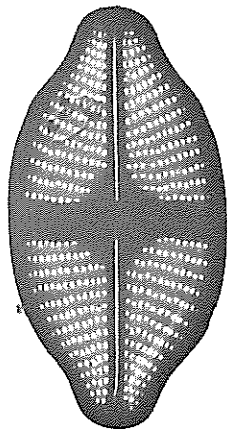
46



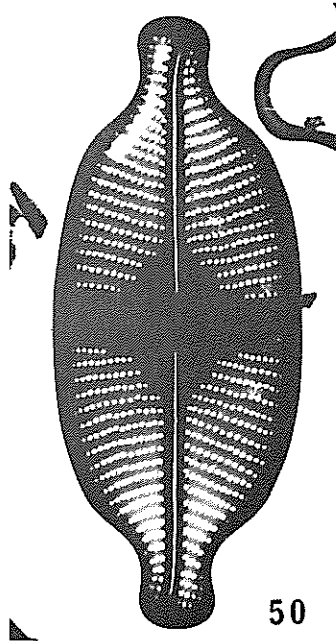
47



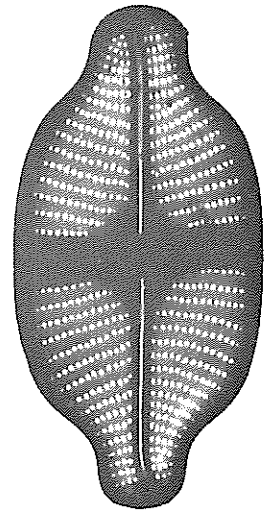
48



49



50

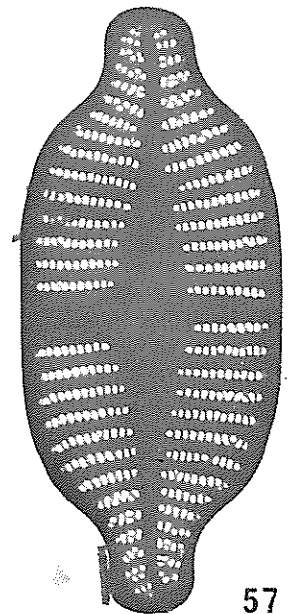
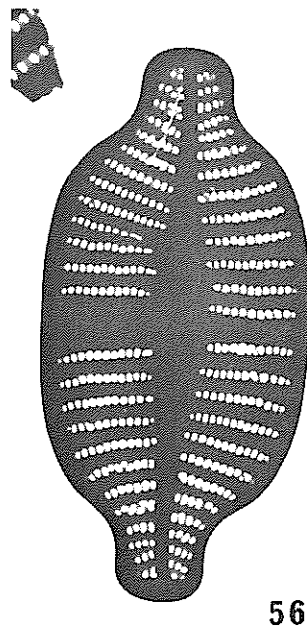
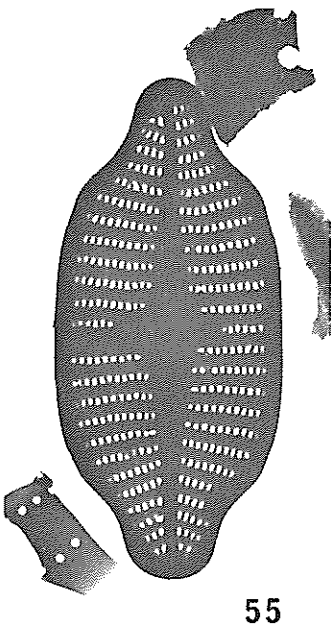
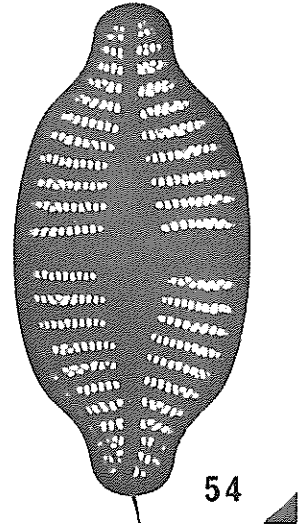
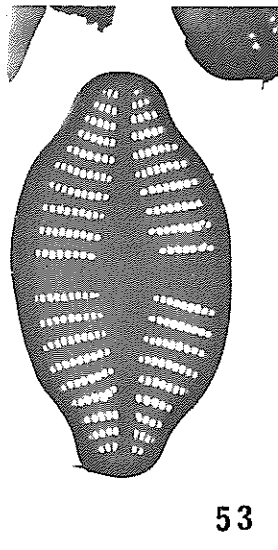
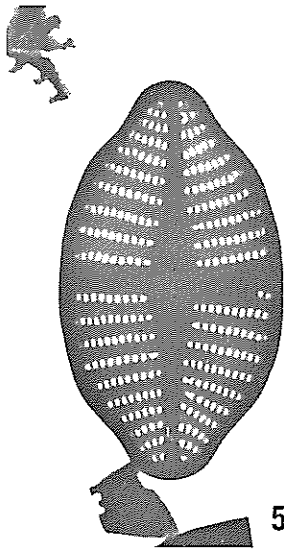


51

Achnanthes exigua Grunow

Figs 46-51 : TEM. Khukhune District, Lesotho.

Figs 46-51 : X 6 000.

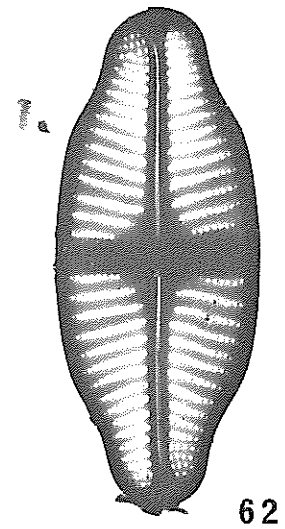
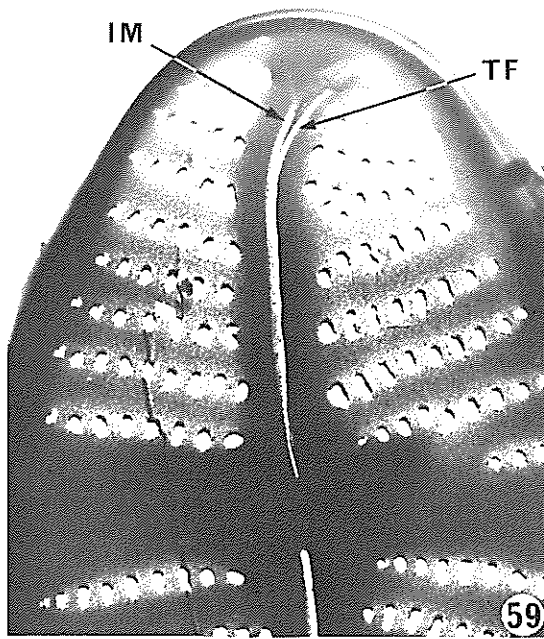
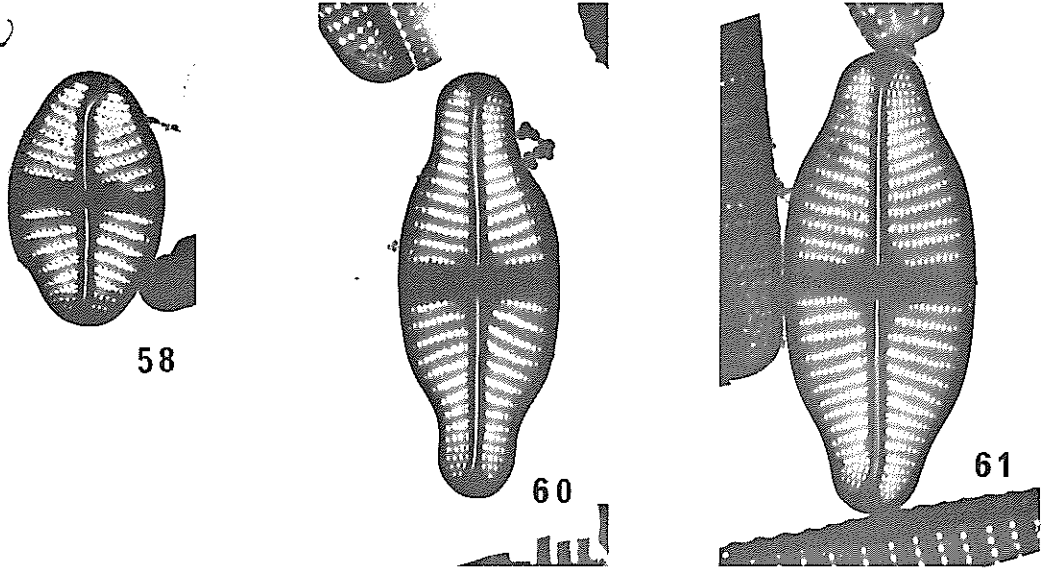


Achnanthes exigua Grunow

Figs 52-57 : TEM. Khukhune District, Lesotho.

Figs 52-57 : X 6 000.

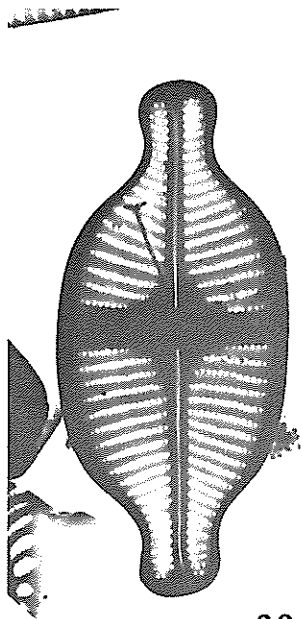
Achnanthes exigua (10)



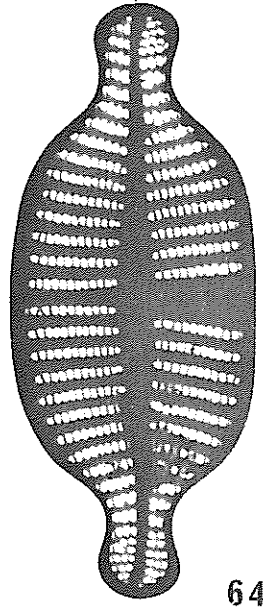
Achnanthes exigua Grunow

Figs 58-62 : TEM. Tjipanas above Tjibodas, Java. Leg. O. Jaag.
Fig. 59 - Part of Fig. 58 enlarged.

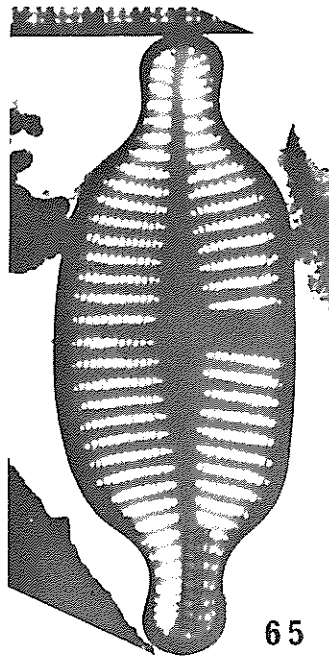
IM = infundibulum; TF = terminal fissure.
Figs 58, 60-62 : X 6 000. Fig. 59 : X24 000.



63



64

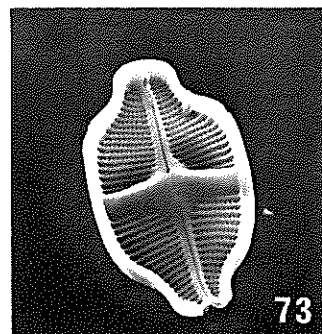
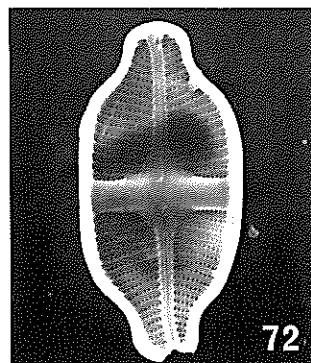
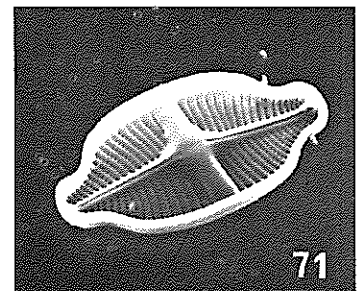
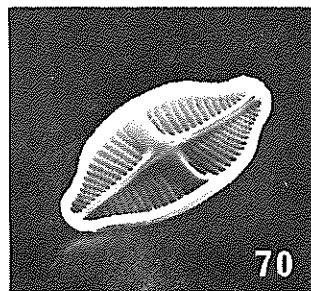
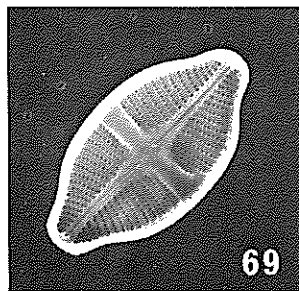
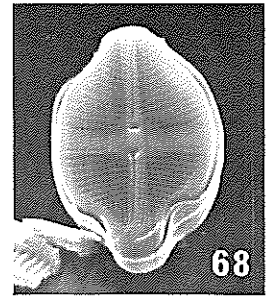
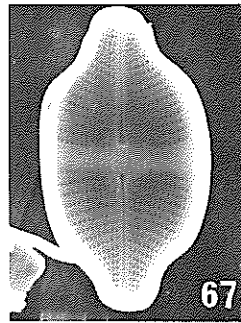
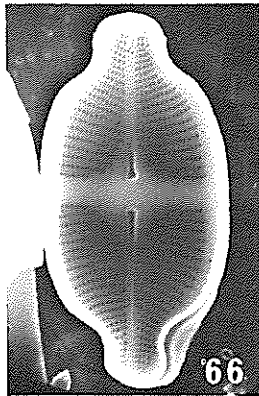


65

Achnanthes exigua Grunow

Figs 63-65 : TEM, Tjipanas above Tjibodas, Java. Leg. O. Jaag.
Figs 63-65 : X 6 000.

Achnanthes exigua (12)



Achnanthes exigua Grunow

Figs 66-73 : SEM, raphe valves. Khukhune District, Lesotho.

Fig. 66 : External view.

Figs 67,68 : External views of another specimen. Fig. 68 : same specimen tilted 55°.

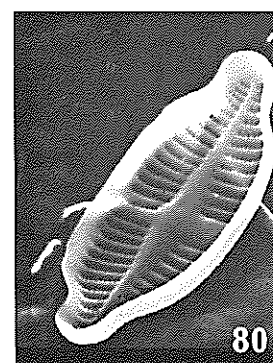
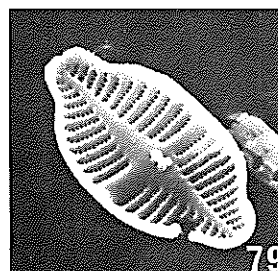
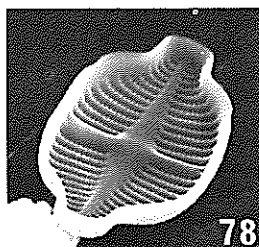
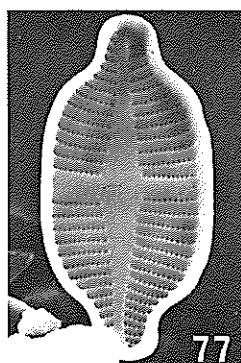
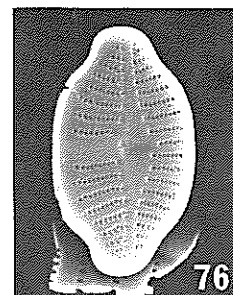
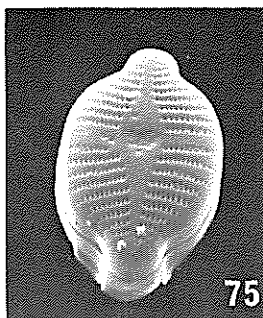
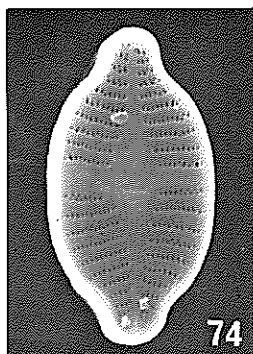
Figs 69, 70 : Internal views. Fig. 70 : same specimen tilted 55°.

Fig. 71 : Internal view.

Figs 72, 73 : Internal views. Fig. 73 : same specimen tilted 55°.

Figs 66-73 : X 4 300.

Achnanthes exigua (13)



Achnanthes exigua Grunow

- Figs 74-80 : SEM, rapheless valves. Khukhune District, Lesotho.
Figs 74, 75 : External views. Fig. 75 : same specimen tilted 55°.
Fig. 76 : External view of another specimen.
Figs 77, 78 : Internal views. Fig. 78 : same specimen tilted 55°.
Figs 79, 80 : Internal views of two other specimens.

Figs 74-80 : X 4 300.

Navicula clarensiana Schoeman

Schoeman 1970a : 341, Figs 28, 29.

Schoeman 1970b : 56, Figs 48-52.

Schoeman 1973a : 118.

Synonym:

Navicula montana Schoeman 1970a : 343, Figs 45-48.

Description:

Valves elliptical (small forms), lanceolate to linear-lanceolate, poles broadly rounded or slightly protracted into subrostrate to rostrate apices; length 6,5-30,5 μm , breadth 3,5-7,6 μm . Raphe straight and filiform; central pores not distinct from the fissure; terminal fissures occasionally visible, directed to the same side of the valve. Axial area usually lanceolate, sometimes more linear towards the poles in larger specimens, about $\frac{1}{4}$ - $\frac{1}{2}$ the valve width at the central pores; central area irregular in shape but often rectangular; in many cases the raphe branches accompanied by parallel longitudinal lines on either side of the raphe, these longitudinal lines not necessarily demarcating the edge of the axial area and not passing through the central nodule; in the central area one or more diffuse dots often present, usually one on either side of the central nodule, otherwise irregularly scattered. Transapical striae radial, (20)22-28 in 10 μm near the centre, to strongly radial at the poles, (24)26-32 in 10 μm .

Under the TEM the transapical striae are shown to consist of single rows of small more or less circular puncta, 53-64 in 10 μm . The external surface of the valve as observed under the SEM is illustrated in Figs 29-33. Figures 32 and 33a show that the valve has a relatively high mantle. The terminal fissures (TF - Figs 30, 33a) are deflected to the same side of the valve and extend some distance down the mantle. The longitudinal lines, visible under the light microscope and running parallel to the raphe, are seen to be a series of shallow depressions (D - Fig. 32b) at the ends of the striae. The depressions sometimes coalesce forming grooves (G - Fig. 33b) parallel to the raphe. The diffuse dots in the central area are likewise shallow depressions (e.g. D - Fig. 33b) in the outer surface of the valve. Internally the valve surface has no peculiarities apart from a hollow cavity (Ca - Figs 34, 35) at the apex of each pole. The cavity does not appear to have an external aperture, but evidently reduces the thickness of the valve wall at this point, since the cavity can be seen under the TEM (Ca - Figs 23, 25).

S.A. Ref. Slide Nos : 56-60.

Comments:

As pointed out by Schoeman (1973a : 118) *Navicula montana* Schoeman (1970a : 343, Figs 45-48) is synonymous with *N. clarensiana* and represents the smaller examples in the size range of this taxon. We have been unable to relate

this taxon to any previously described species known to us. The function of the apical cavities is also unknown at present.

Distribution:

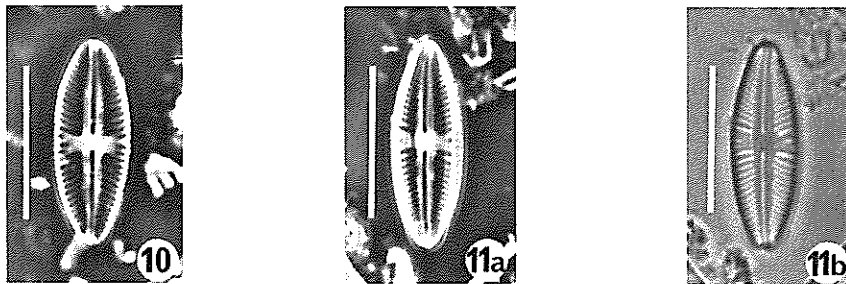
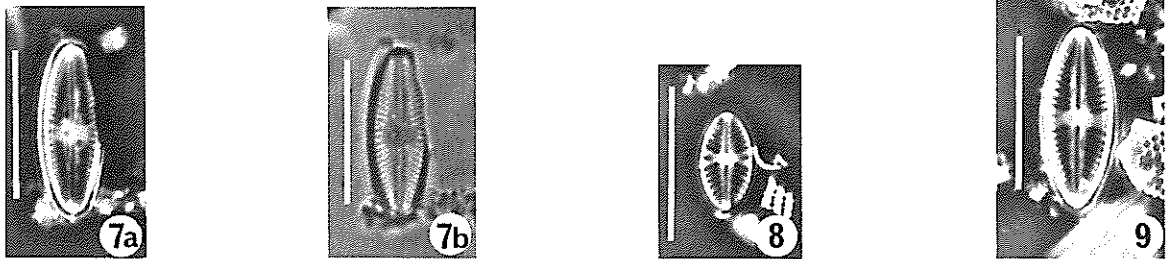
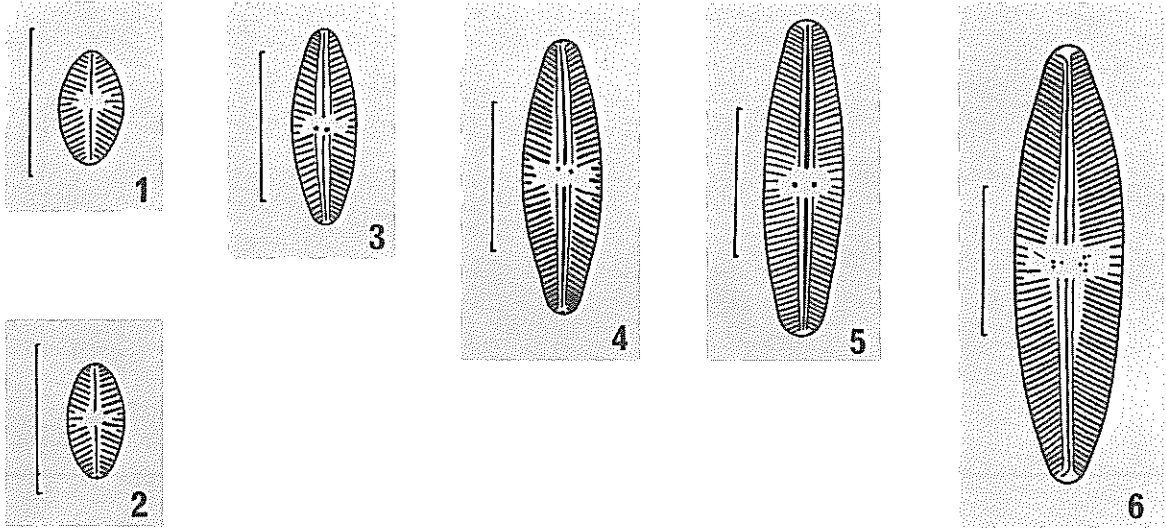
The distribution of this species is interesting since, with the exception of two instances, Schoeman (1973a) has recorded it only from the walls of caves or cave-like habitats in Lesotho and the Eastern Orange Free State, in the region along the border from Ladybrand to Golden Gate. Specimens were also observed from a swamp near Mokhotlong in Lesotho. One other record of this taxon has been made from a diatomaceous earth deposit on the farm Palmietfontein in the Louis Trichardt district of the Northern Transvaal (Schoeman 1973b).

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- Schoeman, F.R. (1970a) Diatoms from the Orange Free State, South Africa, and Lesotho 1. *Nova Hedwigia* Suppl. 31 : 331-353.
- Schoeman, F.R. (1970b) Diatoms from the Orange Free State (South Africa) and Lesotho. No. 3. *Botanica mar.* Suppl. 13 : 49-72.
- Schoeman, F.R. (1973a) *A systematical and ecological study of the diatom flora of Lesotho with special reference to the water quality.* 355p. and 10 pls. Pretoria, V & R Printers.
- Schoeman, F.R. (1973b) Diatoms (Diatomeae) from a diatomaceous deposit in the northern Transvaal (South Africa). *Revta Biol.* 9 : 115-125.



Navicula clarensiana (2)



Navicula clarensiana Schoeman

Fig. 1: Drawing. Golden Gate National Park, Orange Free State.

Figs 2-4: Drawings. Clarens, Orange Free State.

Fig. 5 : Drawing. Golden Gate National Park, Orange Free State. Holotype Slide No. OFS 31 = S.A. Ref. Slide No. 56.

Fig. 6 : Drawing. Khukhune District, Lesotho.

Fig. 7: LM. Golden Gate National Park, Orange Free State. Holotype Slide No. OFS 31 = S.A. Ref. Slide No. 56.

7a - Phase contrast illumination.

7b - Oblique light illumination.

Fig. 8 : LM. Clarens, Orange Free State.

Figs 9-11 : LM. Khukhune District, Lesotho.

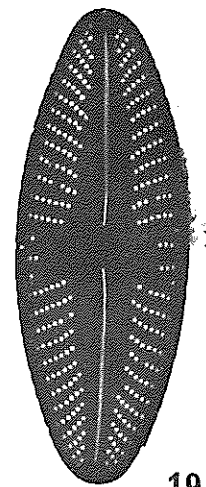
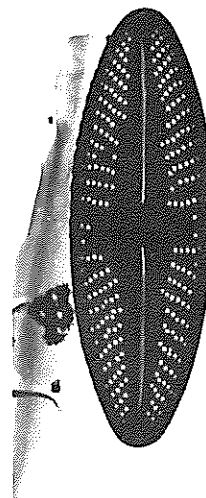
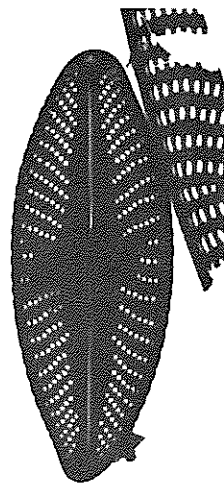
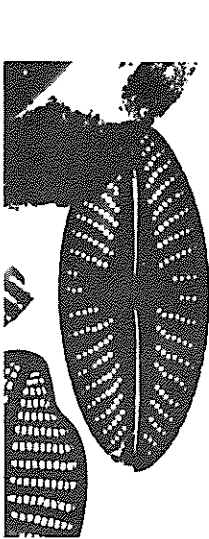
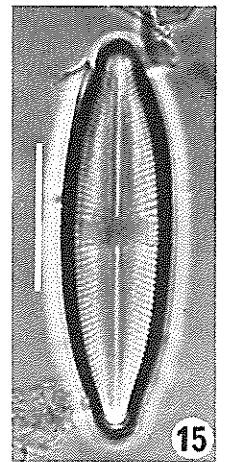
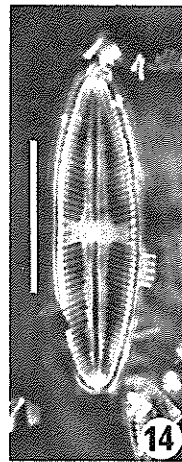
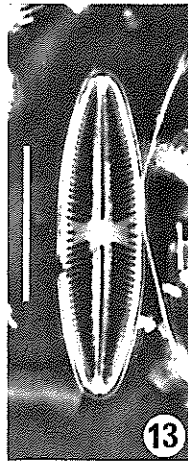
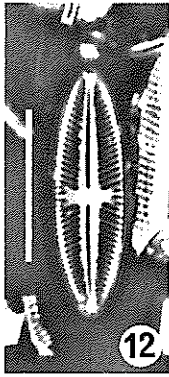
11a - Phase contrast illumination.

11b - Oblique light illumination.

Figs 1-11 : Scale = 10 μ m.

15

Navicula clarensiana (3)



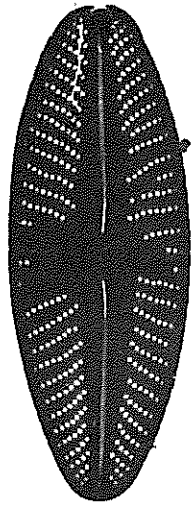
Navicula clarensiana Schoeman

Figs 12-14 : LM. Clarens, Orange Free State.

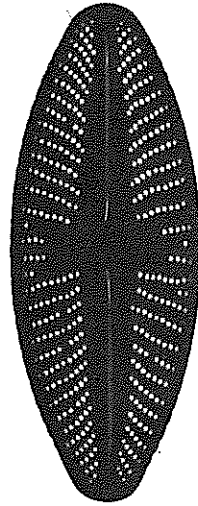
Fig. 15 : LM, oblique light illumination. Khukhune District, Lesotho.

Figs 16-19 : TEM. Khukhune District, Lesotho.

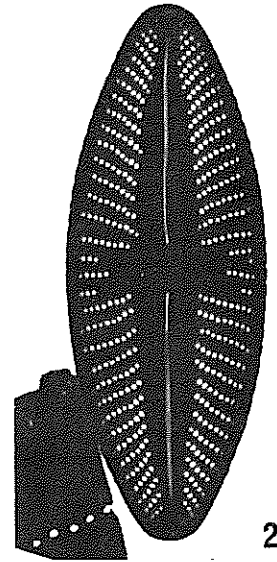
Figs 12-15 : Scale = 10 μ m. Figs 16 - 19 : X 5 100.



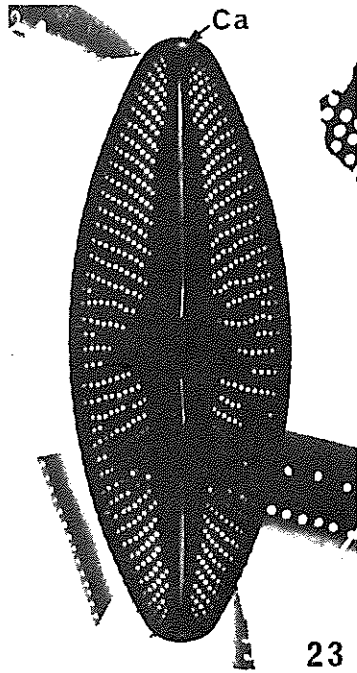
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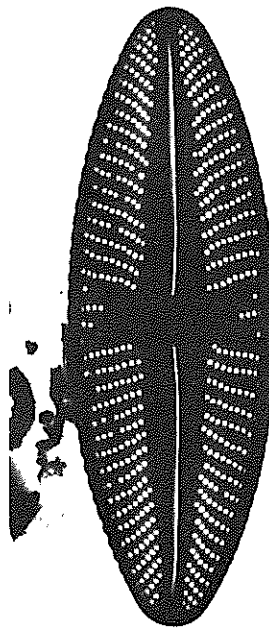
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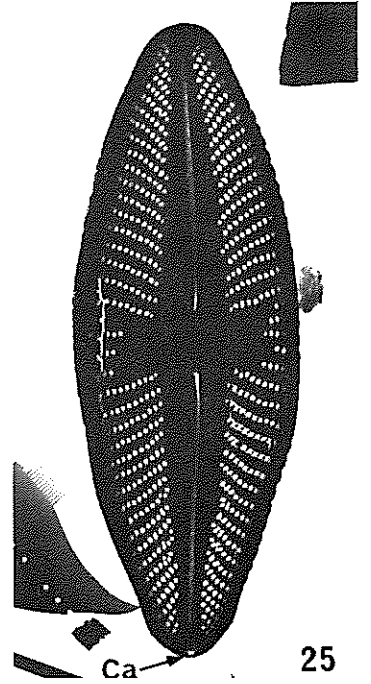
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23



24



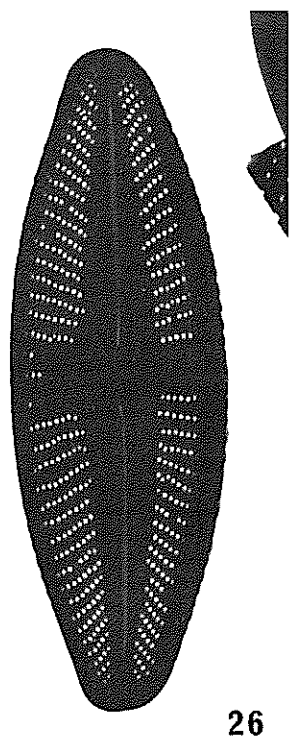
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Navicula clarensiana Schoeman

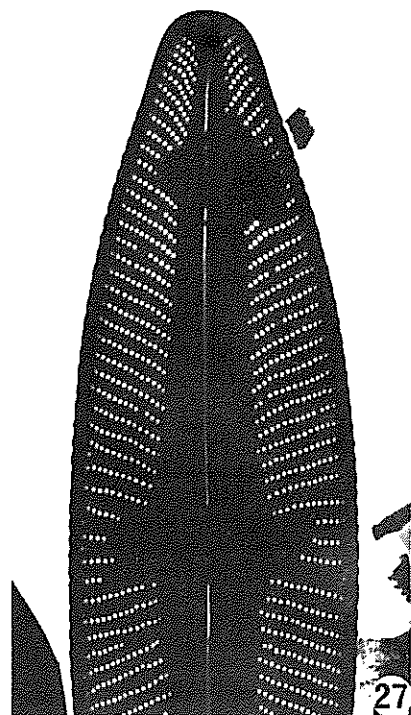
Figs 20-25 : TEM. Khukhune District, Lesotho.

Ca = cavity.

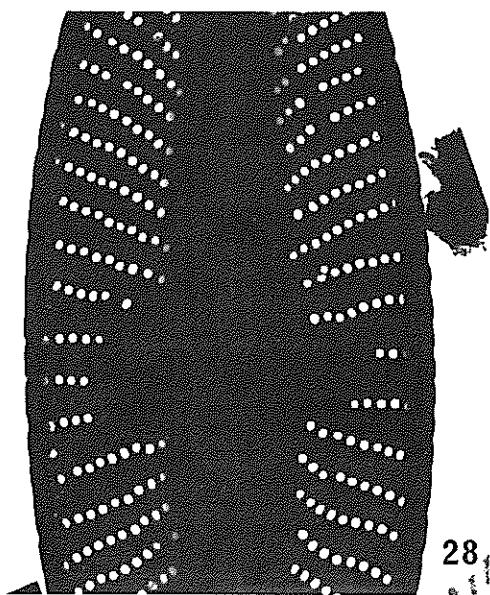
Figs 20-25 : X 5 100.



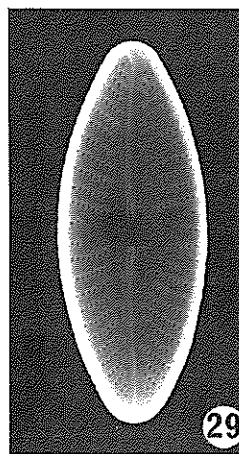
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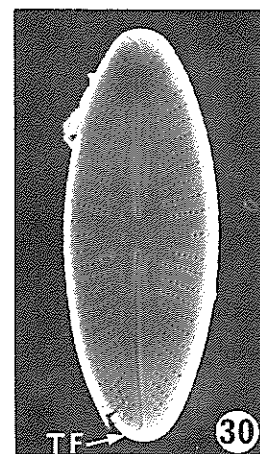
27



28



29



30

Navicula clarensiana Schoeman

Figs 26-28 : TEM. Khukhune District, Lesotho.

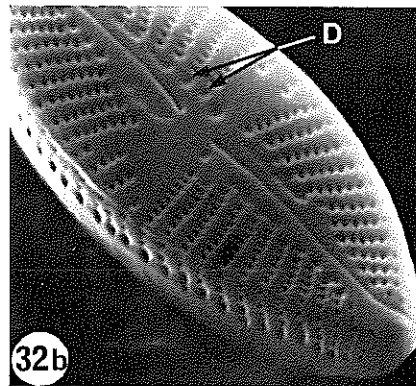
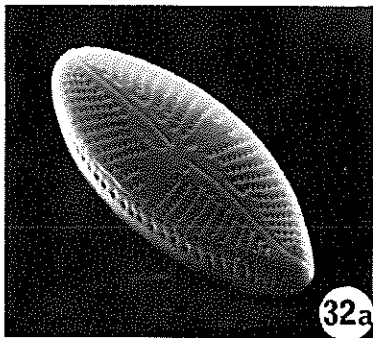
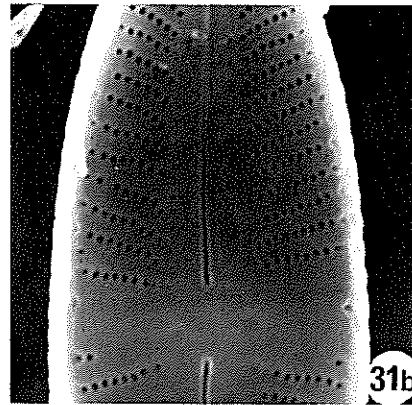
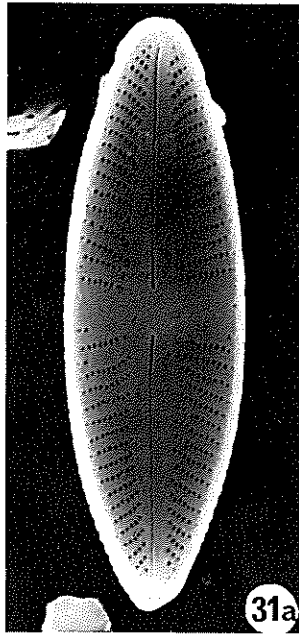
Figs 29, 30 : SEM, external views. Khukhune District, Lesotho.

TF = terminal fissure.

Figs 26, 27 : X 5 100. Fig. 28 : X 10 500. Figs 29, 30 : X 5 050.



Navicula clarensiana (6)



Navicula clarensiana Schoeman

Figs 31, 32 : SEM, external views, Khukhune District, Lesotho.

Fig. 31 : A valve viewed from directly above.

31a - Whole valve.

31b - Central part of valve enlarged.

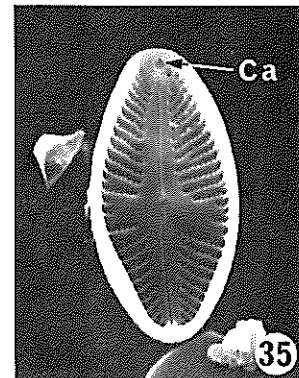
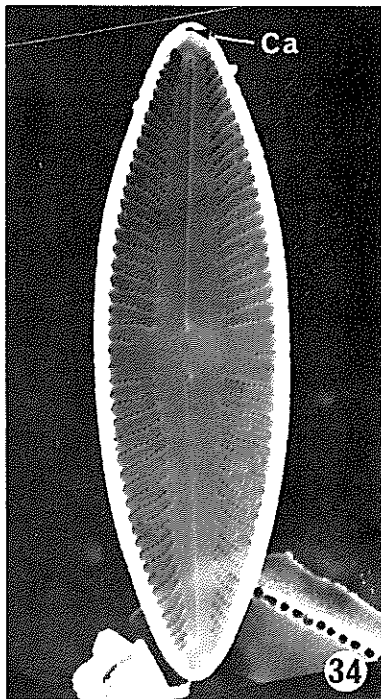
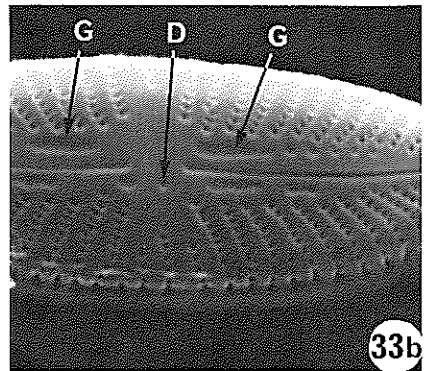
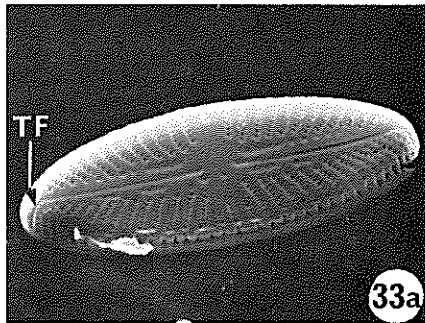
Fig. 32 : Another valve viewed from an angle.

32a - Whole valve.

32b - Part of valve enlarged.

D = depression

Figs 31a, 32a : X 5 050. Fig. 31b : X 8 700. Fig. 32b : X 8 900.



Navicula clarensiana Schoeman

Figs 33-35 : SEM. Khukhune District, Lesotho.

Fig. 33 : External views.

33a - The whole valve.

33b - Part of the valve enlarged.

Figs 34, 35 : Internal views of two valves.

Ca = cavity; D = depression; G = groove; TF = terminal fissure.

Fig. 33a : X 5 050. Fig. 33b : X 9 100. Figs 34, 35 : X 5 200.

Navicula microrhombus (Cholnoky) nov. comb.

Synonyms:

Fragilaria microrhombus Cholnoky 1970 : 14, Figs 2-4.

Achnanthes cogitata Archibald 1971 : 22, Figs 6, 7.

Achnanthes adamantiformis (Archibald) Archibald e.p., 1971 : Figs 4, 5.

Description:

Valves broadly rhombic with relatively broadly to acutely rounded apices, sometimes slightly protracted; length 6-7 μm , breadth 4.4-5 μm . Raphe branches filiform, short but variable in length, 1.3-2.6 μm long from valve apex to central pore, sometimes indistinct so that they are apparently lacking; central pores widely to very widely separated; terminal fissures not resolved under the light microscope. Axial area narrow, linear to linear-lanceolate; central area absent. Transapical striae radial throughout, 22-30 in 10 μm , occasionally a shortened intercalated stria at the centre; striae in phase contrast or oblique illumination indistinctly punctate.

In TEM the raphe branches are slightly arcuate with slightly curved terminal fissures turning to the same side of the valve (Figs 16, 18, 20, 25). Each stria is composed of a single row of roundish puncta, (27) 29-46 (50) in 10 μm .

S.A. Ref. Slide Nos : 36, 38, 40, 47.

Comments:

The indistinct nature of the short raphe branches of this species, so that in some specimens the raphe appeared lacking when viewed under the light microscope, has caused great confusion in the taxonomy of this species. As a result the taxon has been placed variously in the genera *Achnanthes* and *Fragilaria*. Archibald (1971 : 22, Figs 6, 7) described the taxon as an *Achnanthes*, *A. cogitata* Archibald, on the grounds that some valves had raphe branches visible, while in others they appeared to be absent. A revised description was given by Schoeman and Archibald (1976-) in which its further confusion with parts of *Achnanthes adamantiformis* Archibald (1971 : 21, Figs 4, 5) is shown. A full discussion of this confusion is found under "Comments" for *Navicula adamantiformis* (Schoeman and Archibald 1976-). In a subsequent review of Cholnoky's paper on the diatoms from Marble Hall (Cholnoky 1970) certain strong similarities between *Fragilaria microrhombus* Cholnoky (1970 : 14, Figs 2-4) and the apparent rapheless valves of *A. cogitata* were noted. An examination of the type slide of *F. microrhombus* (MH 21 - NIWR = S.A. Ref. Slide No. 47) showed conclusively that Cholnoky erroneously placed this taxon in the genus *Fragilaria*, as many of the specimens on this slide had clearly visible raphe branches. From Cholnoky's original analysis sheet for this sample it is evident that he had some doubt concerning the correct genus of this taxon, as he drew one specimen with raphe branches. A TEM examination of these specimens revealed that all valves possessed raphe branches. Furthermore two frustules

were observed in which both valves had raphe branches (Fig. 24). These observations prove beyond doubt that the taxon is a *Navicula*. According to the rules of Botanical Nomenclature this taxon is therefore renamed *Navicula microrhombus* (Cholnoky) Schoeman and Archibald.

In illustrating *Navicula microrhombus* only specimens from the type slide (MH 21 - NIWR) for *Fragilaria microrhombus* Cholnoky (1970) were used. For further illustrations of this species the plates of *Achnanthes cogitata* Archibald (cf. Schoeman and Archibald 1976-) should also be referred to, as this taxon is now known to be identical to *N. microrhombus*. It must be borne in mind, however, that the apparent rapheless valves of *A. cogitata* are in fact those valves of *N. microrhombus* in which the raphe branches are so indistinct that, under the light microscope, they appear to be lacking.

Having placed this taxon in the genus *Navicula* it shows the closest similarity to *Navicula muciculoides* Hustedt (1942 : 59, Figs 98-102), and there is some possibility that the two species may be the same. On the present evidence, however, *N. microrhombus* appears to differ from *N. muciculoides* on the basis of its more rhombic valve shape, much shorter raphe branches and more or less constant size of 6-7 μm .

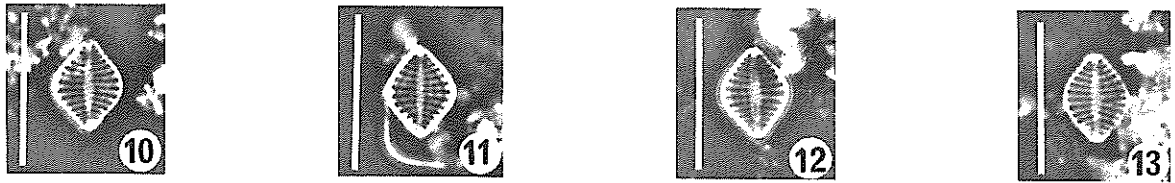
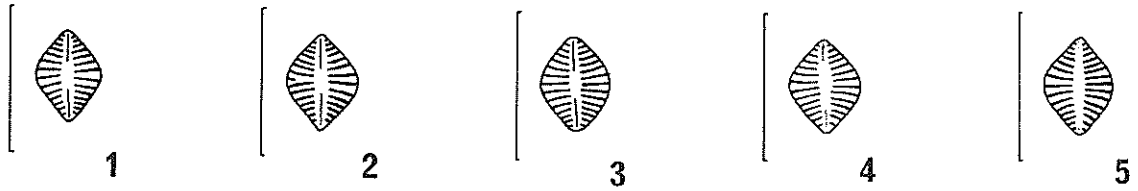
Distribution:

This small taxon has only been observed from a few localities in South Africa. Archibald (1971, as *A. cogitata*) recorded it from the Vaal River at Standerton and Villiers, and in the Waterval River in the Vaal Dam catchment. Cholnoky (1970, under *F. microrhombus*) found it in the fish ponds of the Transvaal Provincial Administration Fisheries division at Marble Hall. Archibald (unpublished data) noted a few specimens from the Sundays River in the Eastern Cape Province.

References:

- Archibald, R.E.M. (1971) Diatoms from the Vaal Dam catchment area, Transvaal, South Africa.
Botanica mar. Suppl. 14 : 17-70.
- Cholnoky, B.J. (1970) Hydrobiologische Untersuchungen in Transvaal III. Die Fischteiche von Marble Hall.
Botanica mar. Suppl. 13 : 5-44.
- Hustedt, F. (1942) Süßwasser-Diatomeen des indomalayischen Archipels und der Hawaii-Inseln.
Int. Revue ges. Hydrobiol. Hydrogr. 42 : 1-252.
- Schoeman, F.R. & Archibald, R.E.M. (1976-) *The diatom flora of Southern Africa*. No. 2, February 1977.
CSIR Special Report WAT 50. No page numbers; series of plates with text.
Pretoria, Graphic Arts Division of the CSIR.

Navicula microrhombus (2)



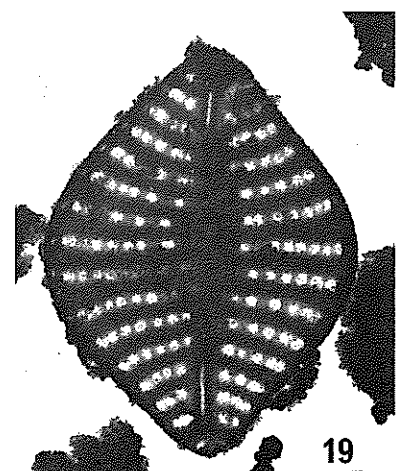
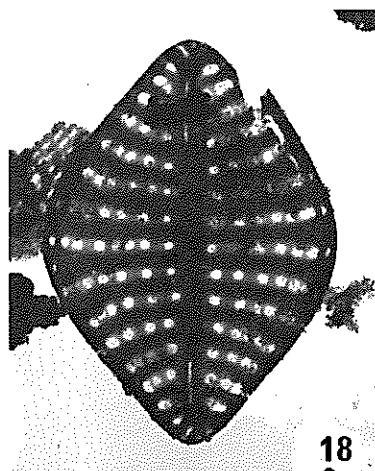
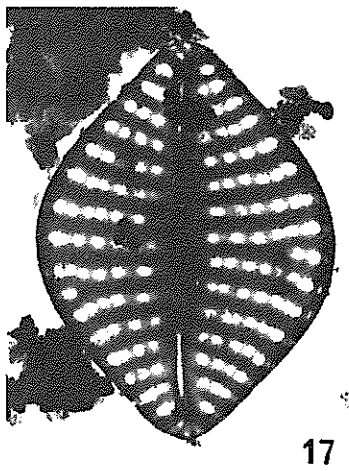
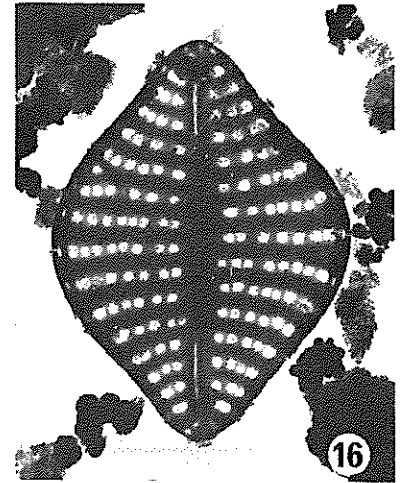
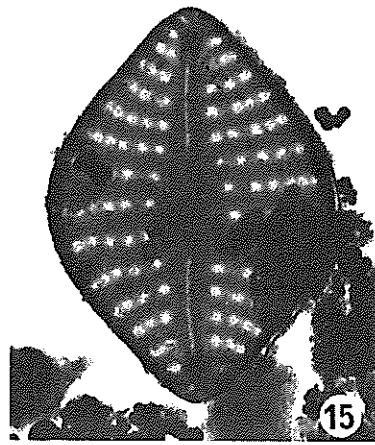
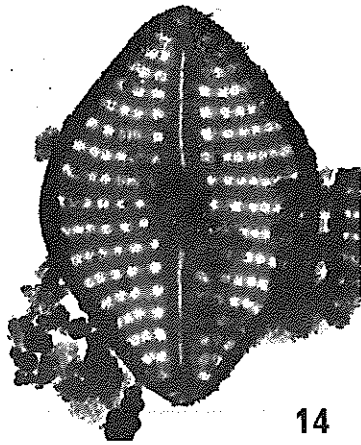
Navicula microrhombus (Cholnoky) Schoeman & Archibald

Figs 1-5 : Drawings. Fish-pond at Marble Hall, Transvaal. Holotype Slide
No. MH 21 (NIWR) = S.A. Ref. Slide No. 47.

Figs 6 - 13 : LM. Same material as above. Note distinct raphe in Figs 6, 9, 12.

Figs 1-13 : Scale = 10 μ m.

Navicula microrhombus (3)



Navicula microrhombus (Cholnoky) Schoeman & Archibald

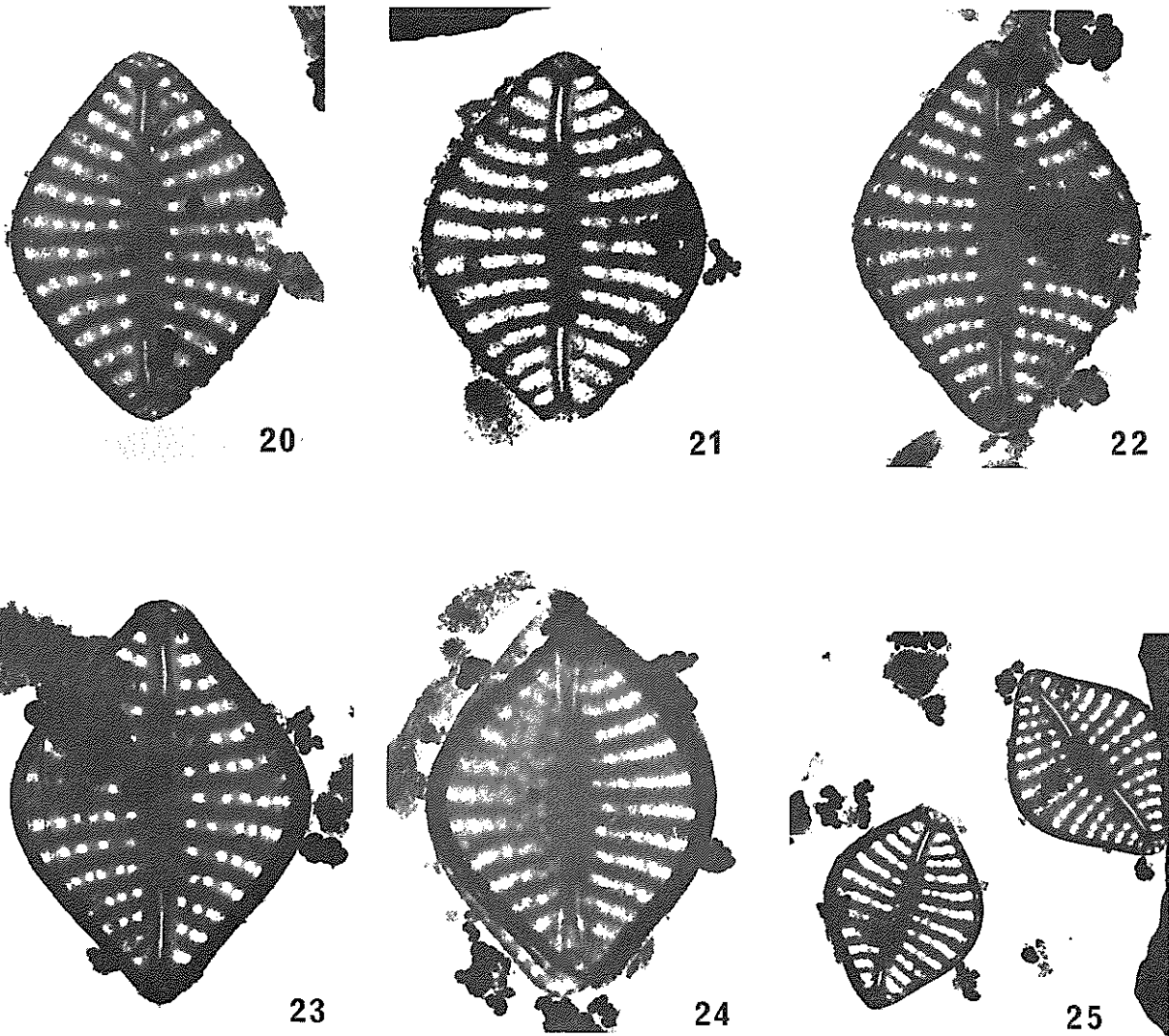
Figs 14-19 : TEM. Fish-pond at Marble Hall, Transvaal. Material No. MH 21 (NIWR).

Figs 14, 15 : Specimens with long raphe branches.

Figs 16-19 : Specimens with short raphe branches.

Figs 14-19 : X 8 200.

Navicula microrhombus (4)



Navicula microrhombus (Cholnoky) Schoeman & Archibald

Figs 20-25 : TEM. Fish-pond at Marble Hall, Transvaal. Material No. MH 21 (NIWR).

Figs 20-23 : Specimens with short raphe branches.

Fig. 24 : Frustule showing both valves with short raphe branches.

Fig. 25 : Two valves showing variation in raphe lengths.

Figs 20-24 : X 8 200. Fig. 25 : X 5 100.

Navicula muciculoides Hustedt

Hustedt 1942 : 59, Figs 98-102.
Hustedt 1961-66 : 231, Fig. 1351.

Description:

Valves broadly rhombic-lanceolate; poles generally slightly protracted into short, relatively acute subrostrate apices; length 8-10 μm , breadth 4,5-5,0 μm . Raphe straight and filiform; central pores relatively widely separated; terminal fissures not resolved. Axial area narrow, linear-lanceolate; central area absent. Transapical striae radial throughout, 22-26 in 10 μm near the centre and up to 28 in 10 μm at the poles, occasionally with one or two shortened intercalated striae at the centre; striae under phase contrast indistinctly punctate.

S.A. Ref. Slide Nos : 63-65.

Comments:

Through the kind favour of Dr R. Simonsen we obtained from the Hustedt Collection in Bremerhaven a small quantity of the original uncleaned material (Hustedt AS 1281, Wallacea Expedition sample P. 255) from which this species was described. From this material we prepared three slides (S.A. Ref. Slide Nos 63-65). During a thorough examination of these slides we observed only eight specimens (Figs 1-11) which conform entirely to Hustedt's description. The material was also examined under TEM, but owing to the extreme scarcity of individuals not a single specimen was observed.

A single record of this species from Southern Africa has been made by Cholnoky (1970 : 22) from Marble Hall (Transvaal), where he claimed to have observed a number of specimens. However, despite a search of the slide concerned (sample 31 = MH32 - NIWR) no representatives of this taxon could be found. We feel that Cholnoky misidentified specimens of *Navicula frugalis* Hustedt (1961-66 : 234, Fig. 1356) as this species. Cholnoky's uncertainty of his identification of this taxon is indicated in his original analysis sheet by a number of exclamation marks placed after the species name *Navicula muciculoides*.

This taxon appears to be closely related to *Navicula microrhombus* (Cholnoky) Schoeman and Archibald (1976-). It differs however by its slightly larger size and the longer and constant length of the raphe branches, which were always clearly visible.

Distribution:

Owing to a misidentification Cholnoky (1970) has erroneously recorded this species from Marble Hall in the Transvaal.

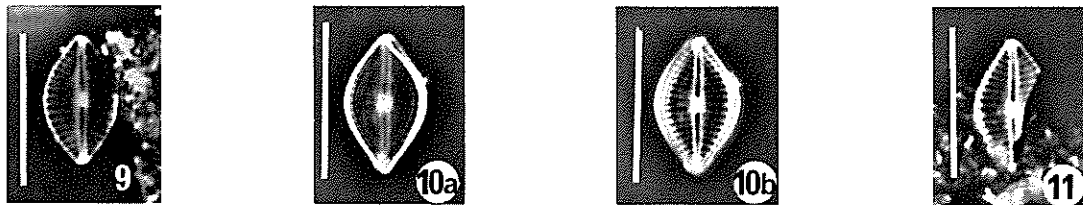
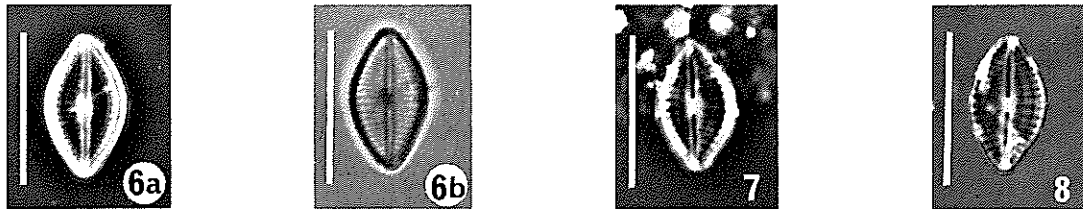
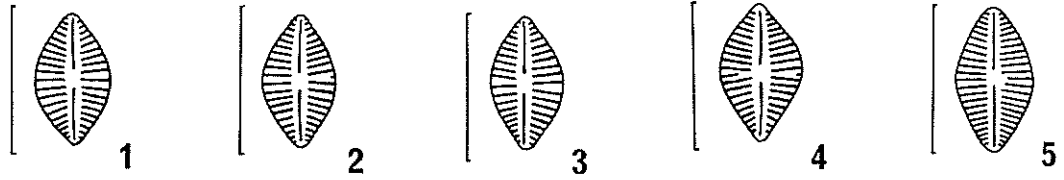
References:

- Cholnoky, B.J. (1970) Hydrobiologische Untersuchungen in Transvaal III. Die Fischteiche von Marble Hall. *Botanica mar.* Suppl. 13 : 5-44.
- Hustedt, F. (1942) Süßwasser-Diatomeen des indomalayischen Archipels und der Hawaii-Inseln. *Int. Revue ges. Hydrobiol. Hydrogr.* 42 : 1-252.
- Hustedt, F. (1961-66) Die Kieselalgen. IN: L. Rabenhorst, *Kryptogamen-Flora von Deutschland, Österreich und der Schweiz*, Vol. 7, Part 3, 816 p. Leipzig, Akademische Verlagsgesellschaft Geest & Portig K.-G.
- Schoeman, F.R. & Archibald, R.E.M. (1976-) *The diatom flora of Southern Africa*. No. 3, September 1977. CSIR Special Report WAT 50. No page numbers; series of plates with text. Pretoria, Graphic Arts Division of the CSIR.

The Diatom Flora of Southern Africa No. 3.
F.R. Schoeman and R.E.M. Archibald.
CSIR Special Report WAT 50.
September, 1977.



Navicula muciculoides (2)



Navicula muciculoides Hustedt

Figs 1-5 : Drawings. Lyon, Luzon Island, Philippines. Hustedt Material
No. AS 1281, Wallacea Expedition Sample P.255.

Figs 6 - 11 : LM. Same material as above.

Fig. 6 : A valve viewed under different illumination.

6a - Phase contrast illumination.

6b - Bright field illumination.

Fig. 10 : Valve with different aspects in focus.

10a - Valve outline in focus.

10b - Transapical striae in focus.

Figs 1-11 : Scale = 10 μ m.

Navicula seminulum Grunow

Grunow 1860 : 552, Pl. 2, Fig. 3.
Grunow in Van Heurck 1880-83 : Pl. 14, Figs 8-10.
Van Heurck 1885 : 107.
Geitler 1932 : 15-41, Figs 2-10.
Hustedt 1961-66 : 241, Fig. 1367.

Synonym:

Navicula saugeri Desmazières, cf. Grunow in Van Heurck 1880-83 : Pl. 14, Fig. 8A.

Description:

Valves elliptical (in smallest forms almost circular) to linear-elliptical; poles variable from relatively long, broadly protracted rounded apices to broadly rounded ends; length 3-21 μm , breadth 2-6 μm . Raphe straight and filiform; terminal fissures indistinct. Axial area narrow and linear. Central area a rectangular to quadratic region almost reaching the margin of the valve in many cases, due to shortening of the central striae; shortening of these striae variable from just visible at the margin to about half the normal striae length; spacing and number of shortened striae (1-4) at the centre variable, either equal or uneven in number on either side of the central nodule. Transapical striae relatively robust, radial throughout, in some specimens apparently less so at the poles; 18-22(24) in 10 μm ; indistinctly punctate in a few specimens.

Under TEM the raphe is seen as a narrow slit with small central pores slightly deflected to one side of the valve, and curved terminal fissures bending towards the opposite margin of the valve. The transapical striae consist of a double row of puncta (60-84 in 10 μm , usually about 70), generally diagonally aligned. Towards the centre of the valve the double row of puncta degenerates in most cases into a single row. For a more detailed description of the structure of the valve consult Okuno (1974 : 25, Pl. 883).

S.A. Ref. Slide No. : 61

Comments:

The original description of Grunow (1860 : 552) differs somewhat from later descriptions in respect of the number of striae in 10 μm . This diagnosis gives 15,5 striae in 10 μm (assuming 1" = 27,1 mm - cf. Explanatory Notes 2). Coarse striae counts such as this are found annotating Grunow's earlier drawings (cf. Herbarium sheets in the Naturhistorisches Museum in Vienna). However in his later studies of this taxon the annotations against the drawings give counts of around 20 striae in the centre and up to 24 striae in 10 μm towards the poles. These are reflected in his drawings in the Van Heurck Atlas (1880-83 : Pl. 14, Figs 8-10) where we measured 18-22 striae in 10 μm . We have also examined a number of Grunow's slides of this taxon including those (Nos 1361, 1580 - Vienna) from which the drawings in the Van

Heurck Atlas (1880-83 : Pl. 14, Figs 8B, 9bis and 10) were made. The number of striae in the specimens on these slides varied between 18-22 in 10 μm . As far as we are aware the type slide for this taxon cannot be traced, and we therefore accept Grunow's illustrations in Van Heurck (1880-83) as the true *N. seminulum*.

In contrast Lund (1946 : 68) observed specimens of *N. seminulum* having much finer striation, viz. "20-25 in all but the smallest valves where they may be up to 28-30 in 10 μm ". From a literature review and our own observations the latter values appear rather high for this taxon.

In examining Grunow's material for *Navicula minima* Grunow it was found that Van Heurck's Types du Synopsis des Diatomées de Belgique No. 142 (Vienna) marked as *Navicula minima* Grun. var. is most certainly *N. seminulum* and cannot be considered as *N. minima*. A few of these specimens are illustrated in Figs 4-6.

The TEM examination of *N. seminulum* from Southern Africa has shown that it is indeed the same taxon as studied by Granetti (1968a, b, c), Lange-Bertalot and Bonik (1976 : Fig. 28) and Okuno (1974 : Pl. 883). In a rich material from the Modderfontein Stream (Transvaal) a number of abnormal forms were observed amongst numerous typical examples (Figs 21-38). The majority of the small forms showed teratological abnormalities as illustrated by Granetti (1968c) and intermediates (e.g. our Fig. 39) between these and the normal structure. One other example of an abnormal structure is illustrated in Fig. 40. Here the structure of the striae has degenerated to such an extent that most striae have only a single row of puncta, while some at the centre lack puncta altogether. These simplified striae resemble those of *N. minima* Grunow (cf. Granetti 1968b), but the wider spacing of the striae (18-20 in 10 μm) precludes it from *N. minima*.

Distribution:

N. seminulum is widespread in Natal, the Transvaal, South West Africa and Lesotho. It was also frequently found in waters of the Western Cape Province and a few examples were recorded in the Eastern Cape Province from the Sundays River (Archibald : unpublished data) and at Rhodes in the North-eastern Cape Province by Schoeman (1973). In the Orange Free State the species was observed from Ladybrand and Golden Gate (Schoeman 1969; 1970). Cholnoky (1962) recorded it from Swaziland.

References:

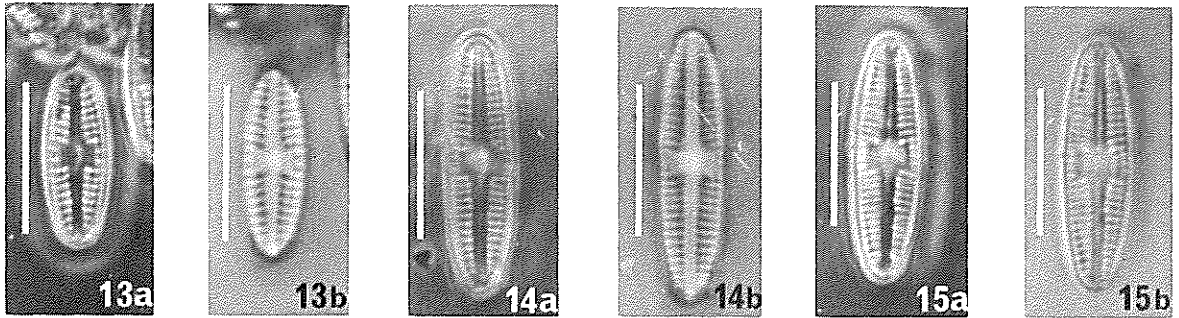
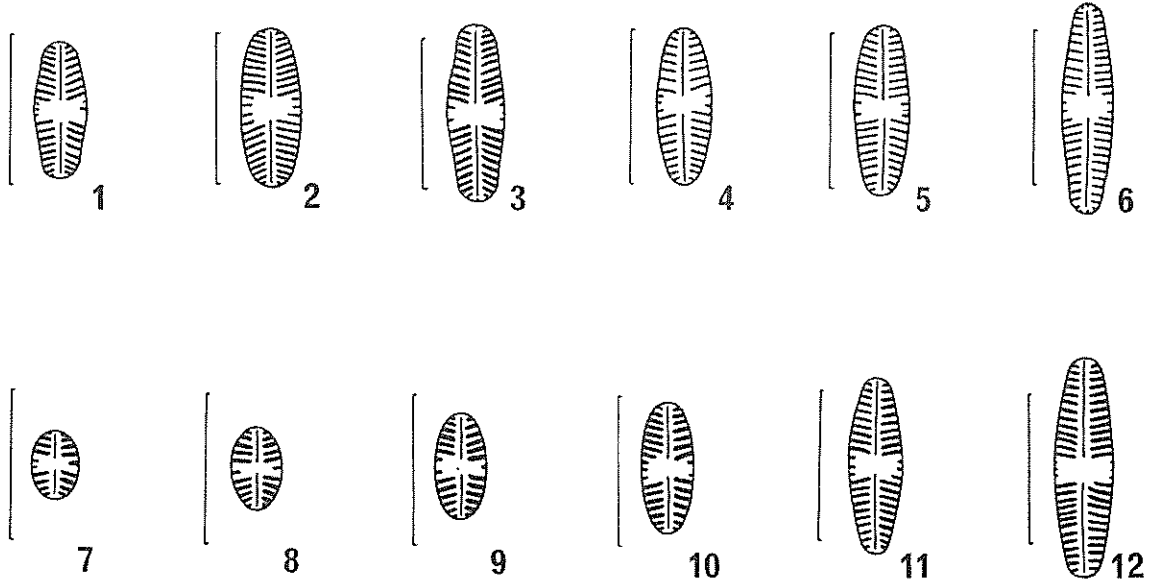
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Anvers, J. Ducaju & Co.
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Text : 235 p. and 3 pls.
Anvers, J. Ducaju & Co.



Navicula seminulum (3)



Navicula seminulum Grunow

Figs 1-3 : Drawings. Rade Gund, Liechtenstein. Grunow Slide No. 1580 (Vienna).

Figs 4-6 : Drawings. Van Heurck Type Slide No. 142 (Vienna).

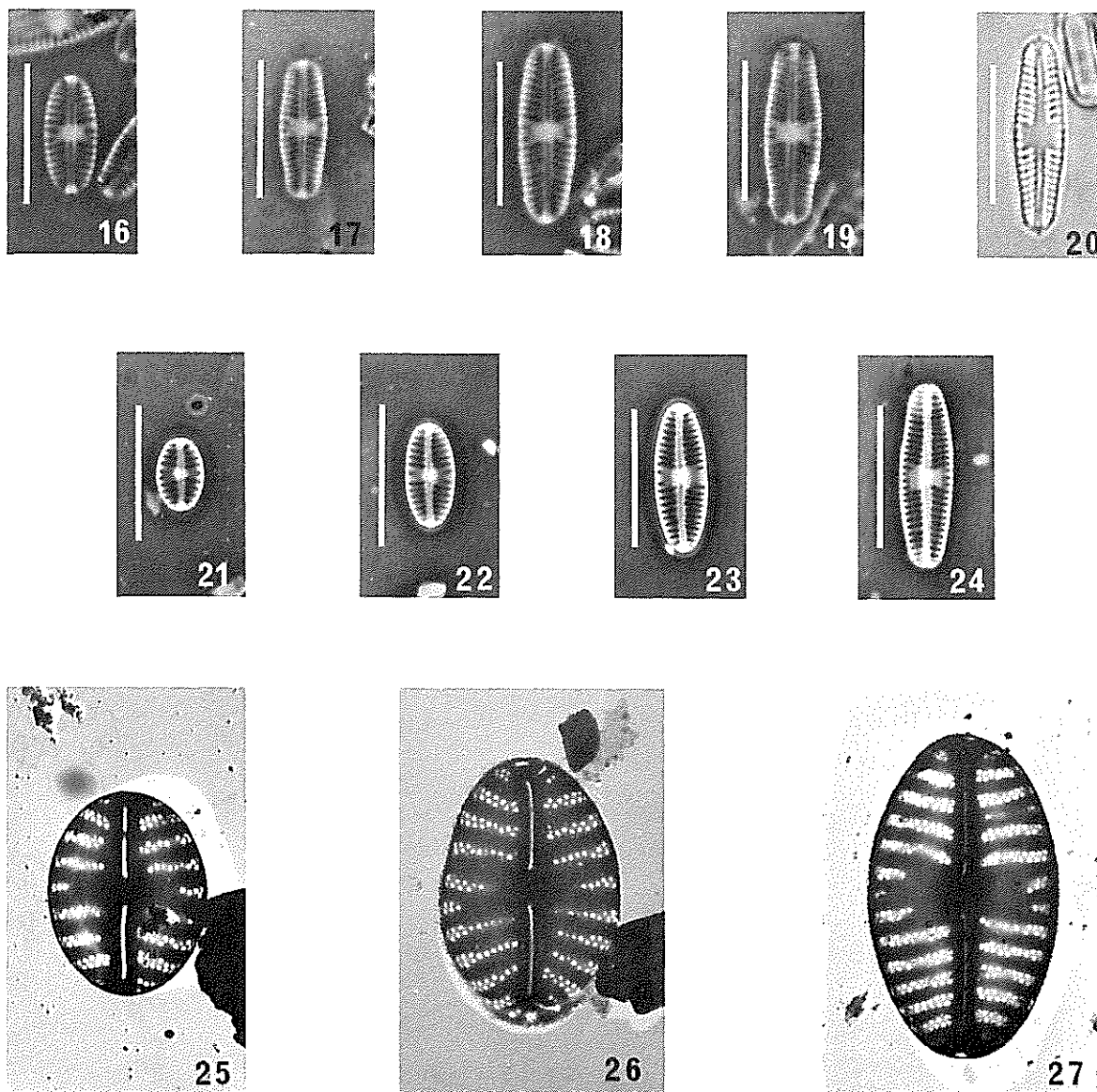
Figs 7-12 : Drawings. Modderfontein Stream, Transvaal.

Figs 13-15 : LM. Grunow Slide No. 1361 (Vienna).

13a, 14a, 15a - Phase contrast illumination.

13b, 14b, 15b - Bright field illumination.

Figs 1-15 : Scale = 10 μ m.



Navicula seminulum Grunow

Figs 16-19 : LM. Radegund, Liechtenstein. Grunow Slide No. 1580 (Vienna).

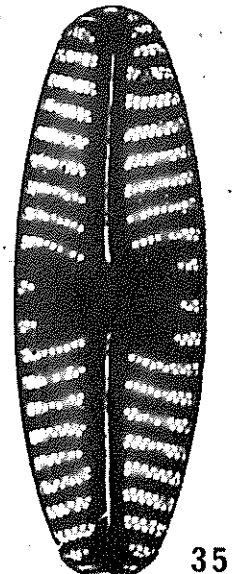
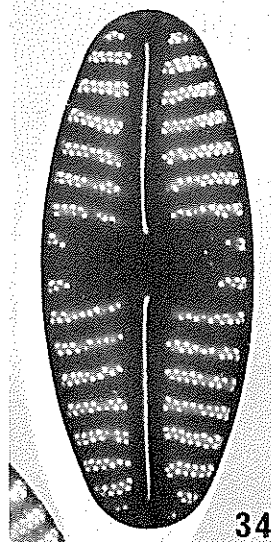
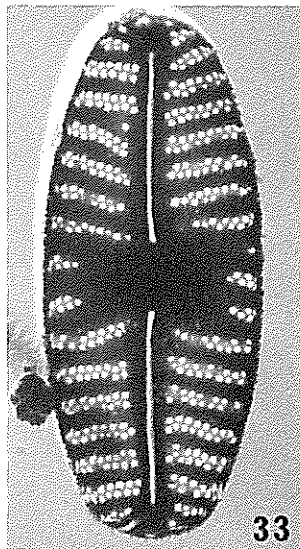
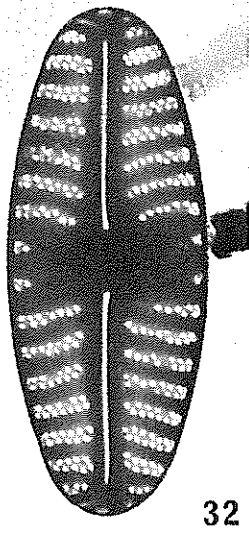
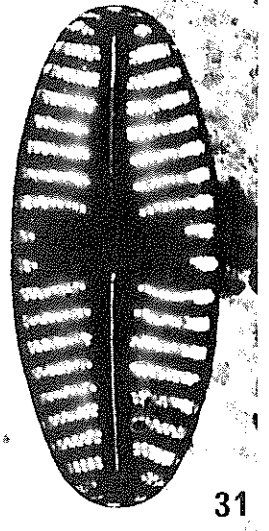
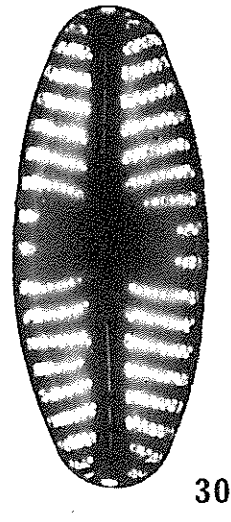
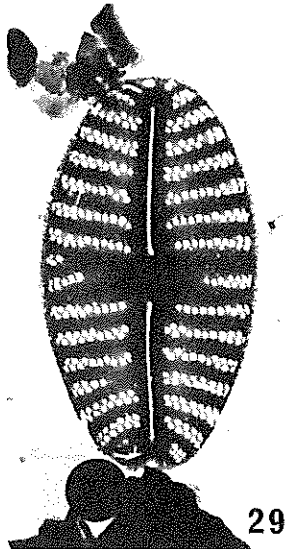
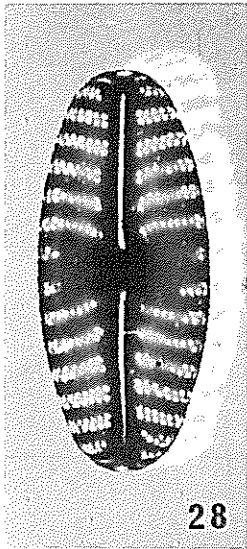
Fig. 20 : LM. Groenendal. Grunow Slide No. 2599 (Vienna).

Figs 21-24 : LM. Modderfontein Stream, Transvaal.

Figs 25-27 : TEM. Modderfontein Stream, Transvaal.

Figs 16-24 : Scale = 10 μ m. Figs 25-27 : X 7 500.

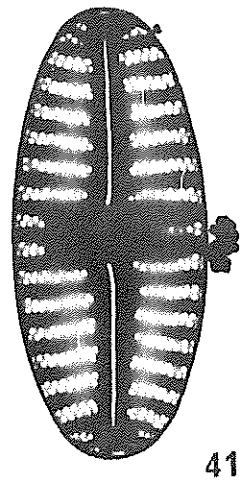
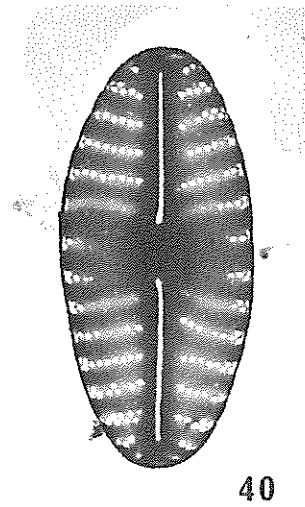
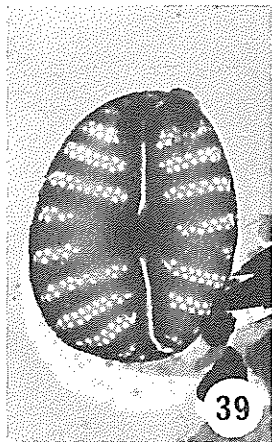
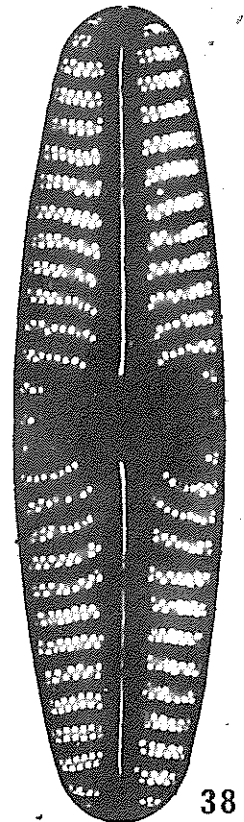
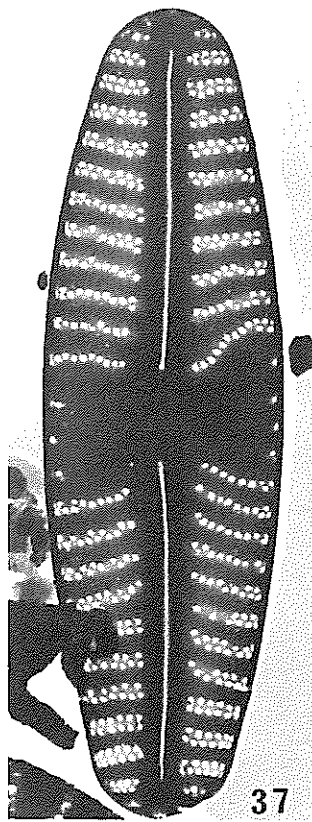
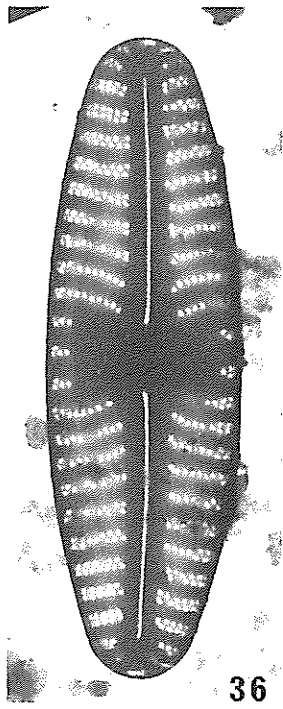
Navicula seminulum (5)



Navicula seminulum Grunow

Figs 28-35 : TEM. Modderfontein Stream, Transvaal.

Figs 28-35 : X 7 500.

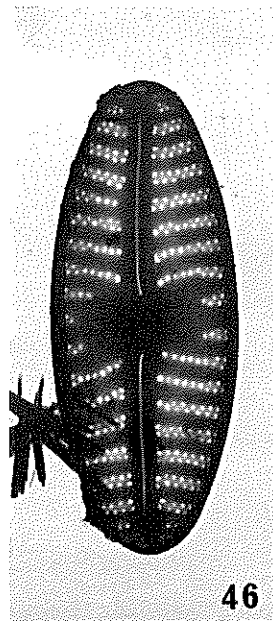
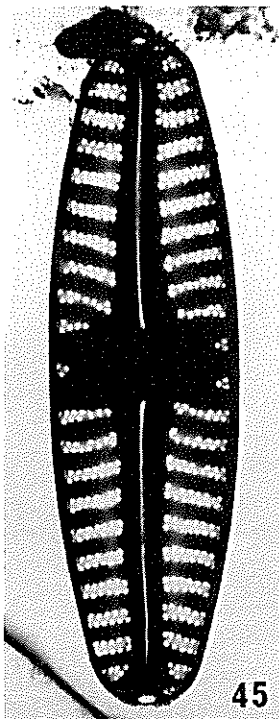
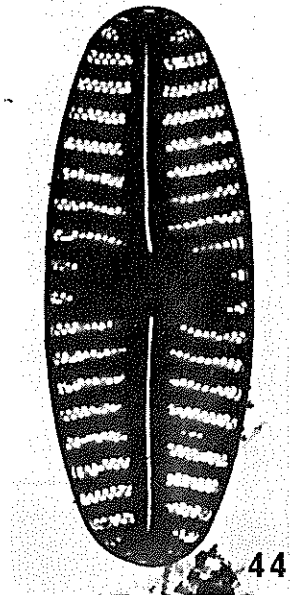
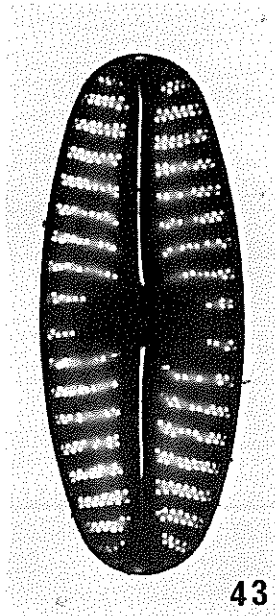
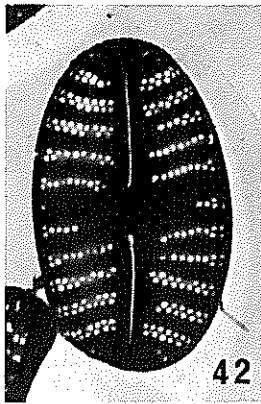


Navicula seminulum Grunow

Figs 36-40 : TEM. Modderfontein Stream, Transvaal.

Fig. 41 : TEM. Hennops River, Transvaal.

Figs 36-41 : X 7 500.



Navicula seminulum Grunow

Figs 42-44 ; TEM. Swakopmund Sewage Works, South West Africa.

Fig. 45 : TEM. Netherlands. Leg. H. van Dam.

Fig. 46 : TEM. Pabalong, Berea District, Lesotho.

Figs 42-46 : X 7 500.

Navicula tackei Hustedt

Hustedt 1942 : 194, Figs 6, 7.
Hustedt 1961-66 : 277, Fig. 1407.

Description:

Valves linear-lanceolate to linear-elliptical with slightly protracted broadly rounded apices; length 16-25 μm , breadth 5-7 μm . Raphe branches straight and filiform with small but conspicuous central pores; terminal fissures usually indistinct, but when visible, small and directed to the same margin of the valve. Axial area narrow and linear; central area generally a narrow fascia more or less reaching the margin, sometimes a smaller rectangular or even unilateral area. Transapical striae fine, radial and becoming parallel at the poles, (22) 24-26 in 10 μm near the centre and up to 32 in 10 μm at the poles; in the region of the fascia the transapical striae variable in length and spacing, generally wider than on the rest of the valve.

S.A. Ref. Slide Nos : 48, 49, 66.

Comments:

The systematic position of this taxon is questionable, since its transapical fascia is strongly reminiscent of the stauros in the genus *Stauroneis*. The distinction between the genera *Stauroneis* and *Navicula* is somewhat nebulous (cf. Hustedt 1931-59 : 756; Patrick & Reimer 1966 : 357). The most accepted characteristic separating the two genera is the transapical structureless expansion of the central nodule to the margin of the valve (= stauros) in *Stauroneis*. Nevertheless, under the light microscope it is sometimes difficult to determine whether a fascia-like central area is due to an expansion of the central nodule or just a plain structureless area. The problem is further aggravated by the presence of marginal striae in the stauros of some *Stauroneis* species. *Navicula tackei* bears a strong resemblance in many characteristics to *Stauroneis palustris* Hustedt (1931-59 : 795, Fig. 1140). It is indeed very difficult to separate these two species on the basis of Hustedt's descriptions. Perhaps the main difference between them lies in the presence of occasional relatively longer striae in the fascia of *N. tackei*.

We have examined Hustedt's type slide (N10,84 - H.B.) on which there are three ringed specimens (Figs 4-6). Furthermore we prepared a permanent slide (S.A. Ref. Slide No. 66) from Hustedt's original uncleaned material (Mat. Nr. E.1012 - Zweiter Tümpel an der Warturmer Heerstrasse - cf. Hustedt 1942 : 185) obtained from Dr R. Simonsen, Curator of the Hustedt collection in Bremerhaven. A further small number of specimens were observed on this slide (Figs 1, 2, 7, 8). These have been ringed and the slide placed in our reference slide collection. We are satisfied that these specimens are in every way identical with those found by Schoeman (1973 : 161) in Lesotho, except that the latter were slightly larger (Figs 3, 9-11). Due to the scarcity of speci-

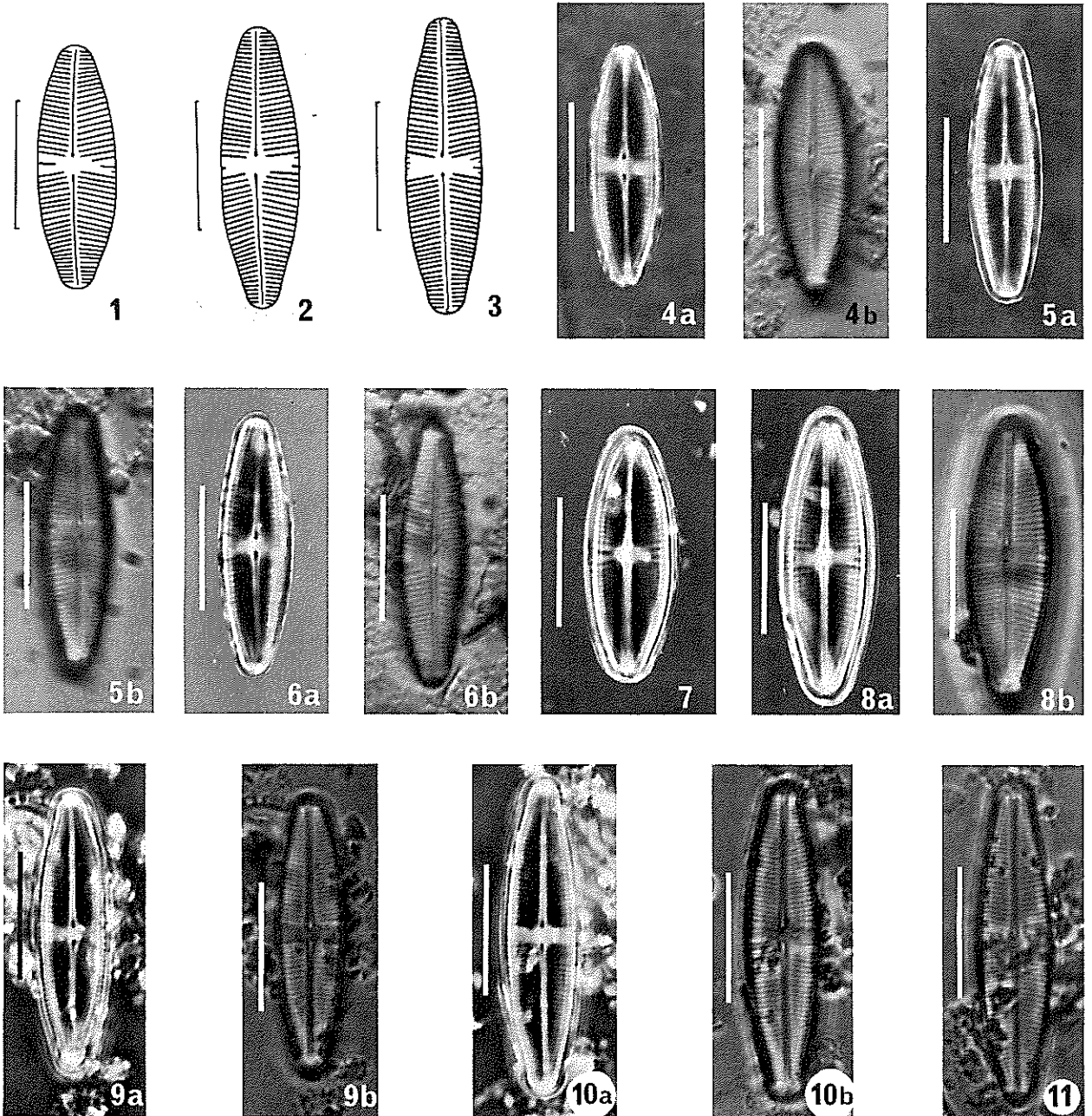
mens in Hustedt's material (E.1012) we were unable to locate, on a large number of grids, any examples for examination under TEM.

Distribution:

This species has only been recorded in three samples from Lesotho (Schoeman 1973 : 161).

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Navicula tackei Hustedt

Figs 1, 2 : Drawings. Waturmer Heerstrasse, Bremen, Germany. Hustedt Material No. E1012.

Fig. 3 : Drawing. Mount Moorosi District, Lesotho.

Figs 4-6 : LM. Bremen-Wartum Tümpel 1. Hustedt Holotype Slide No. N10,84 (H.B.).

4a, 5a, 6a - Phase contrast illumination.

4b, 5b, 6b - Oblique light illumination.

Figs 7, 8 : LM. Waturmer Heerstrasse, Bremen, Germany. Hustedt Material No. E1012.

8a - Phase contrast illumination, 8b - Oblique light illumination.

Figs 9-11 : LM. Mount Moorosi District, Lesotho.

9a, 10a - Phase contrast illumination.

9b, 10b, 11 - Oblique light illumination.

Figs 1-11 : Scale = 10 μ m.

Nitzschia rautenbachiae Cholnoky

Cholnoky 1957a : 76, Figs 228-232.

Description:

Valves lanceolate (small forms), linear-lanceolate to linear with cuneate poles in the more linear forms; length 16-72 μm , breadth 4,5-6,0 μm . Canal raphe marginal but difficult to resolve; fibulae indistinct corresponding with the costae in number, (11) 12-14 (15) in 10 μm . Transapical costae robust and rib-like; transapical striae prominent, (11) 12-14 (15) in 10 μm , alternating with the transapical costae and composed of a single row of large puncta (10-16 in 10 μm).

Studies of the valves with the electron microscope revealed its complicated and unique structure. Externally the valve face is slightly convex with a marginal keel running along one side of the valve (Figs 22, 26-28). The valve face is traversed by well developed raised ridges, the costae, forming an alternating series of transapically aligned ridges and troughs (Figs 21, 24). The striae are composed of a single row of more or less oval puncta lying at the base of these troughs (Figs 13, 14, 16, 20, 21). The pores in the striae are separated from each other by slight cross ridges (CrR) between the costae (cf. Fig. 25). Along the margin opposite the keel each costa is armed with a flat, round, arrowhead-like projection (Pr) attached by a short stalk (Figs 17, 22, 26). The point of attachment (PA) of these projections to the costae is clearly seen in Fig. 26. The keel appears to be a well silicified inverted V-shaped structure with the outer fissure of the canal raphe (RF) running as a narrow slit along the apex (Figs 15, 20, 22). No interruption of this fissure was observed. The keel appears to be strengthened on each side by a series of buttresses (Figs 20-22, 26-28), which are probably continuous with the transapical costae. Extending from these buttresses on both sides of the keel there is a series of small, flat, bifurcate projections (Figs 22-24). These projections are free of the valve surface as can be seen in Fig. 24, where one of the projections has broken off.

Internally the valve structure is relatively simple (Figs 29-35). The valve face is slightly concave and has no prominent elevated costal ridges. The internal openings of the puncta are similar in size and shape to the external apertures. In contrast the interspaces (I) of the canal raphe are much larger and more or less circular openings (Figs 32-34). The fibulae (F) separating the interspaces are short, almost rectangular siliceous strips continuous with the costae (Fig. 33).

Girdle bands are present but their structure is still not absolutely clear. Each cell appears to have two girdle bands, whose edges in direct contact with the valve are serrated (Figs 36, 37).

S.A. Ref. Slide Nos : 50, 51, 75.

Comments:

Under the electron microscope *N. rautenbachiae* has a valve structure quite unique, as far as we are aware, in the genus *Nitzschia*. We could find nothing similar in the literature available to us. Cholnoky (1957a : 76) first considered this taxon as a member of the group *Tryblionellae*, but was later uncertain where to place this species (cf. Cholnoky 1970 : 30 under *N. pseudocarinata* = *N. siliqua* Archibald). The valve structure of *N. rautenbachiae* as seen under the electron microscope clearly excludes this taxon from the *Tryblionellae*, and in fact from any other presently recognised *Nitzschia* group. The only species with a similar structure is *N. siliqua* Archibald (1966 : 267, Fig. 62), a taxon recently described from South Africa. An improved description and discussion of *N. siliqua* is given in the present work (Schoeman and Archibald 1976-). The function of the bifurcate and arrowhead-like projections adorning the outer surface of *N. rautenbachiae* is not understood, and needs further research.

Foged (1976 : 43, Pl. 21, Fig. 13) noted and illustrated a form from Sri Lanka which he identified with some reservation as *N. rautenbachiae*, since it had denser striation than previously recorded for this taxon. The valve shape and dimensions of Foged's example suggest that it is rather a specimen of *N. siliqua* Archibald.

Distribution:

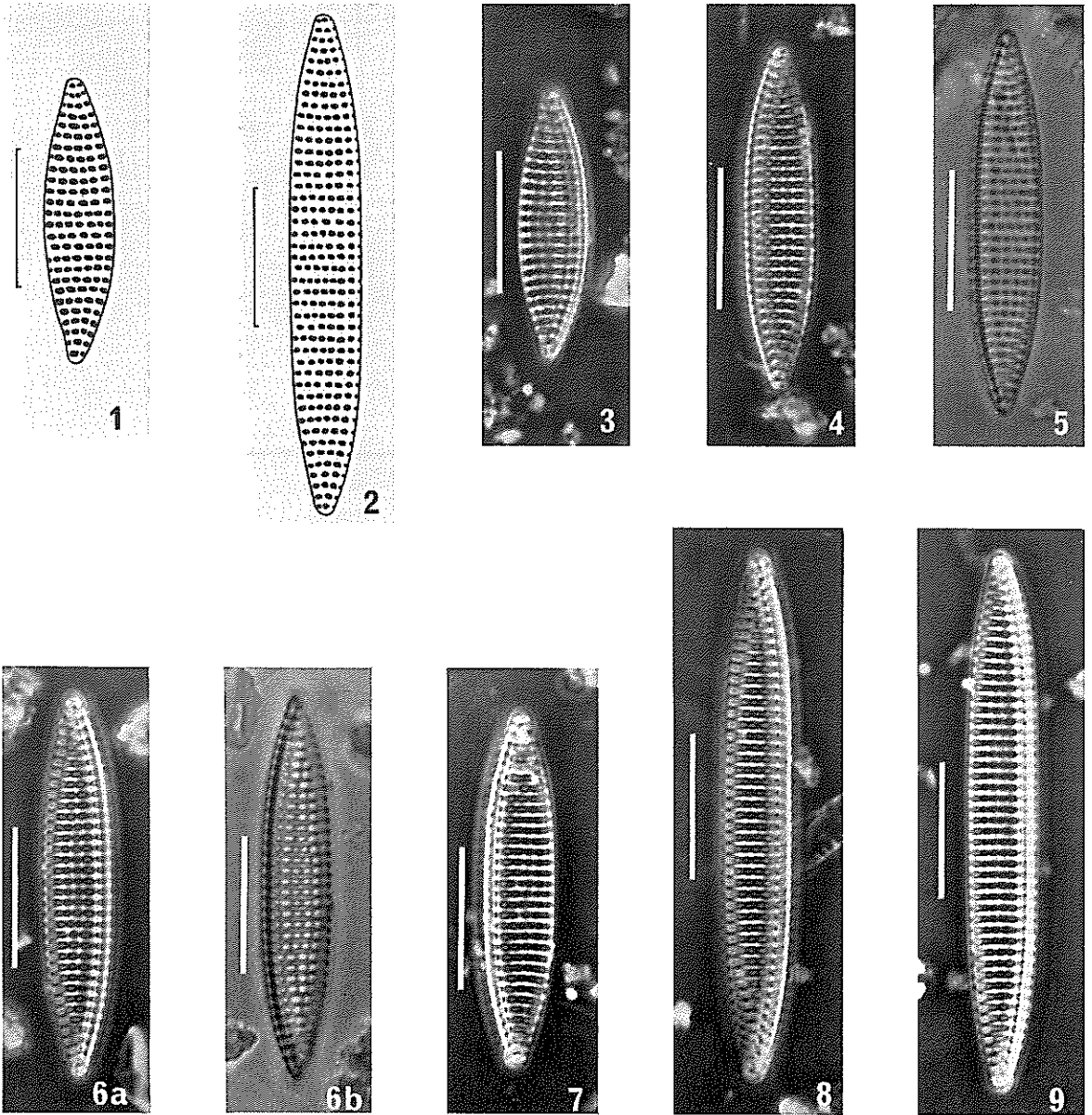
In the Cape Province *N. rautenbachiae* is reported from Malmesbury and the Little Karroo (Cholnoky 1959) and from the Sundays and Fish Rivers of the Eastern Cape Province (Archibald : unpublished data). Cholnoky (1957a; 1957b; 1960; 1968) recorded the species from North-eastern Natal and the Port Shepstone district. *N. rautenbachiae* is found also in the extreme Northern Transvaal and in the Limpopo River near Messina (Cholnoky : unpublished data). It was frequently observed in the rivers of the Vaal Dam catchment in the South-eastern Transvaal and North-eastern Orange Free State (Archibald 1971). Schoeman (1973) recorded the species from a small stream near Zastron in the Orange Free State.

References:

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Port. Acta biol. (B) 6 : 53-93.
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Öst. bot. Z. 106 : 1-69.
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Nova Hedwigia 2 : 1-128.
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No page numbers; series of plates with text.
Pretoria, Graphic Arts Division of the CSIR.



Nitzschia rautenbachiae Cholnoky

Fig. 1 : Drawing. Hluhluwe River, Natal.

Fig. 2 : Drawing. Zastron District, Orange Free State.

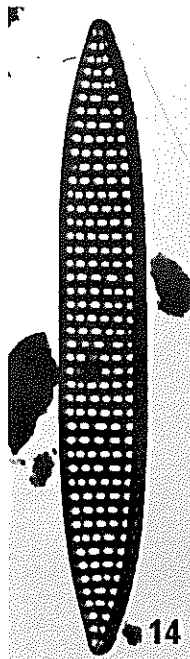
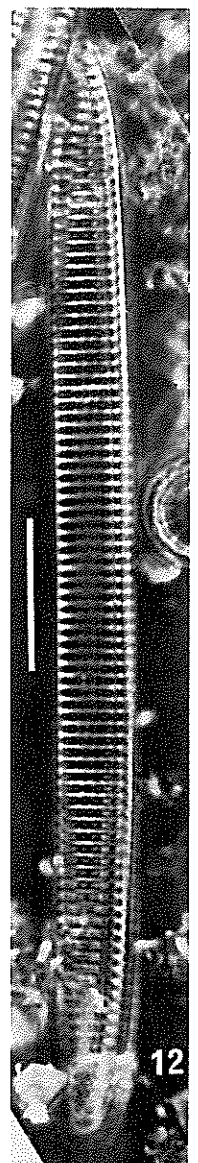
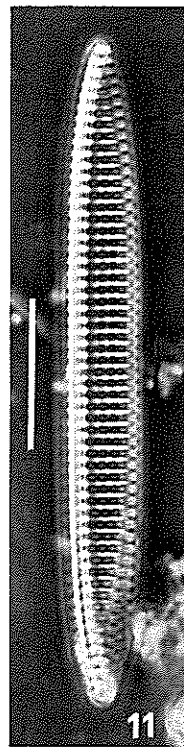
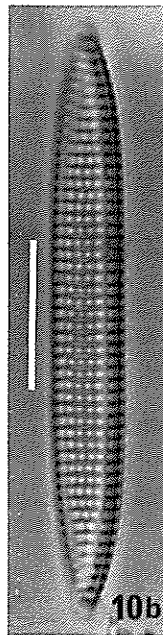
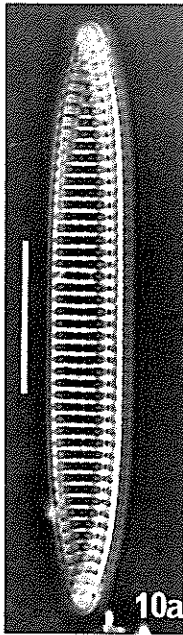
Figs 3-6 : LM. Hluhluwe River, Natal.

3, 4, 6a, 7 - Phase contrast illumination.

5, 6b - Bright field illumination.

Figs 7-9 : LM. Zastron District, Orange Free State.

Figs 1-9 : Scale = 10 μ m.



Nitzschia rautenbachiae Cholnoky

Figs 10, 11 : LM. Zastron District, Orange Free State.

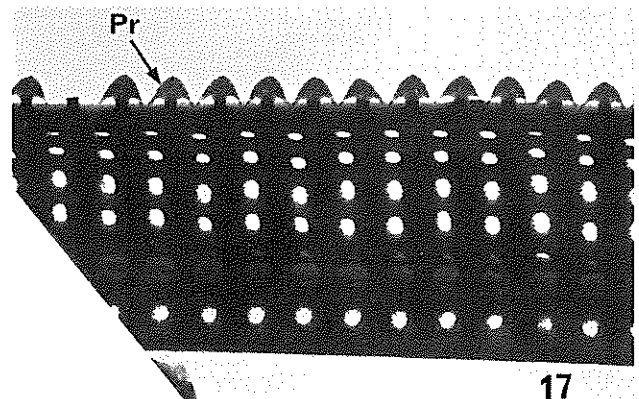
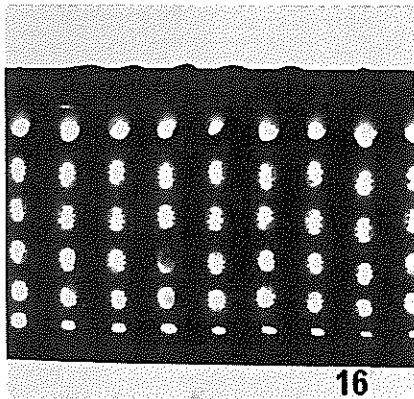
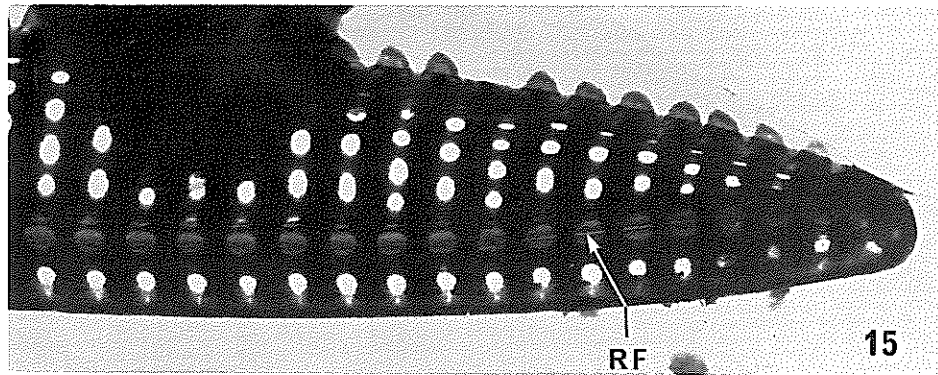
10a, 11 - Phase contrast illumination.

10b - Bright field illumination.

Fig. 12 : LM. Sundays River, Cape Province.

Figs 13, 14 : TEM. Zastron District, Orange Free State.

Figs 10-12 : Scale = 10µm. Figs 13, 14 : X 2 200.



Nitzschia rautenbachiae Cholnoky

Figs 15-17 : TEM. Zastron District, Orange Free State.

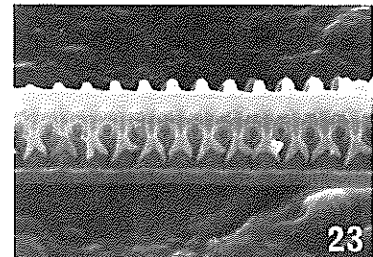
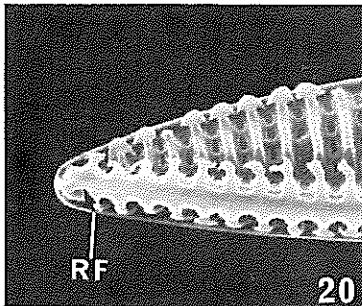
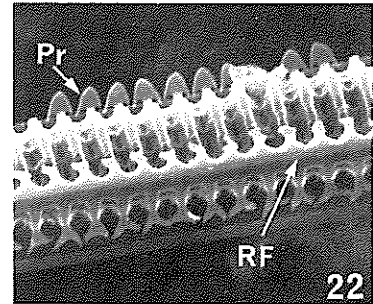
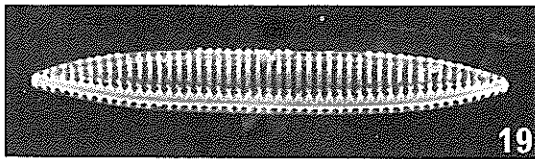
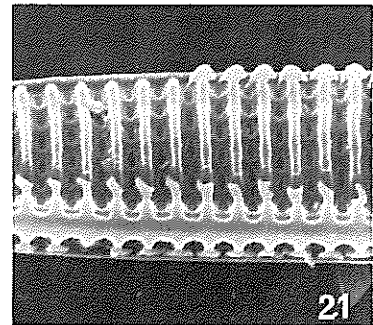
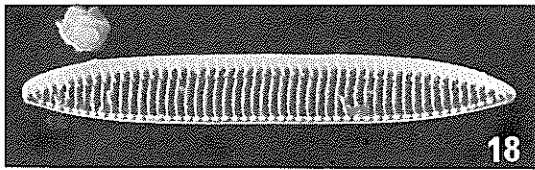
Fig. 15 - Valve tilted, showing canal raphe.

Fig. 16 - Structure of transapical striae.

Fig. 17 - Valve tilted, showing stalked projections.

RF = raphe fissure; Pr = projection.

Figs 15-17 : X 8 200.



Nitzschia rautenbachiae Cholnoky

Figs 18-23 : SEM. Zastron District, Orange Free State.

Fig. 18 : Note row of arrowhead-like projections on lower margin.

Figs 19-23 : Micrographs of a single specimen (exterior views).

19 - The complete valve.

20 - Left hand pole enlarged; note raphe fissure.

21 - Portion near centre enlarged; note keel and projections.

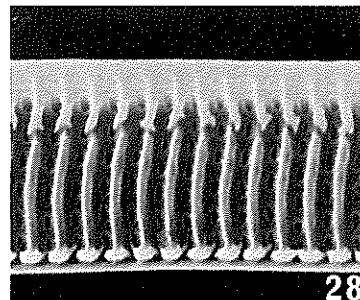
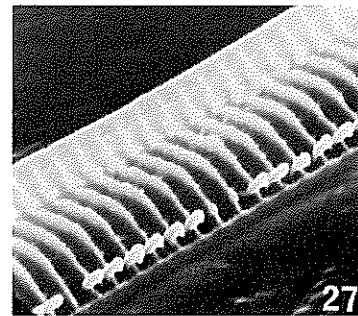
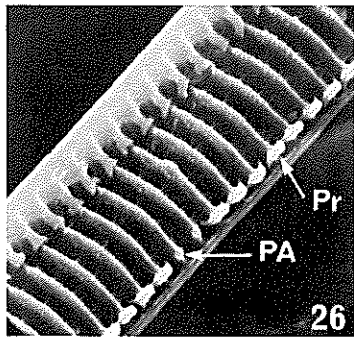
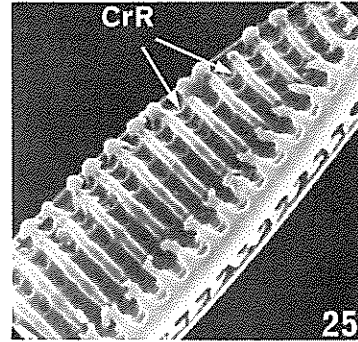
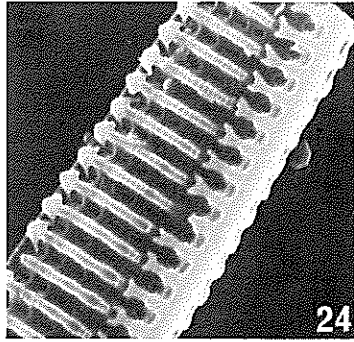
22 - Same portion near centre tilted 40°.

23 - Same portion near centre tilted 60°.

Pr = projection; RF = raphe fissure.

Figs 18, 19 : X 2 000. Figs 20-23 : X 6 000.

Nitzschia rautenbachiae (7)



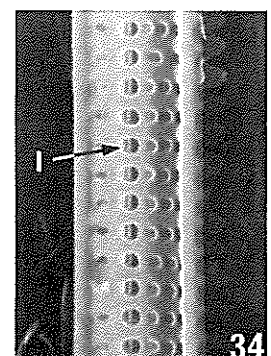
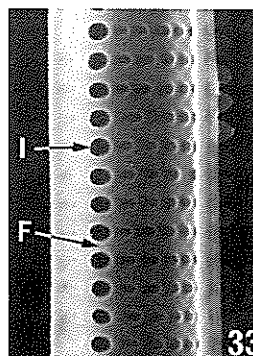
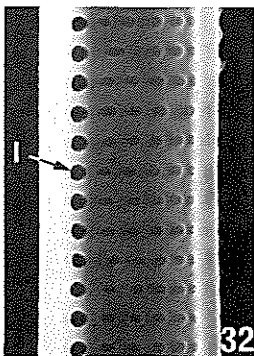
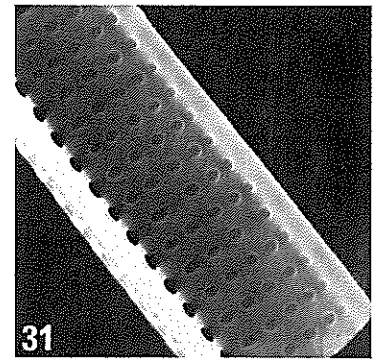
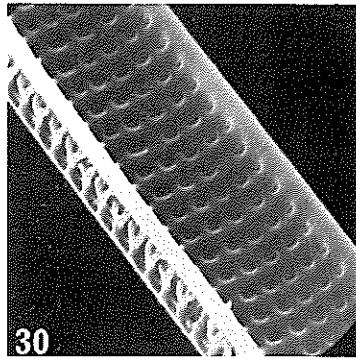
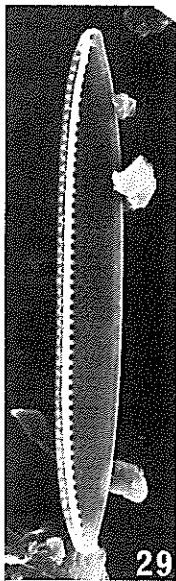
Nitzschia rautenbachiae Cholnoky

Figs 24 - 28 : SEM, external views of portions of the valve showing its structure. Zastron District, Orange Free State.

Figs 26, 27 - Same specimen; Fig. 27 - Specimen tilted a further 20°.

CrR = cross ridge; PA = point of attachment of projection; Pr = projection.

Figs 24-28 : X 6 000.



Nitzschia rautenbachiae Cholnoky

Figs 29-34 : SEM, internal views showing valve structure. Zastron District, Orange Free State.

Fig. 29 : Complete valve.

Figs 30-34 : Portions of another valve tilted through 100°.

30 - Initial viewing position.

31 - Tilted 40°.

32 - Tilted 60°.

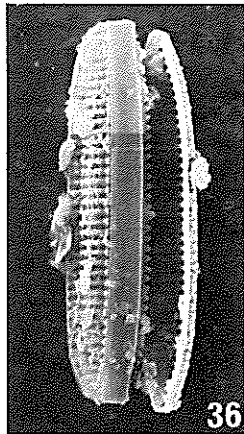
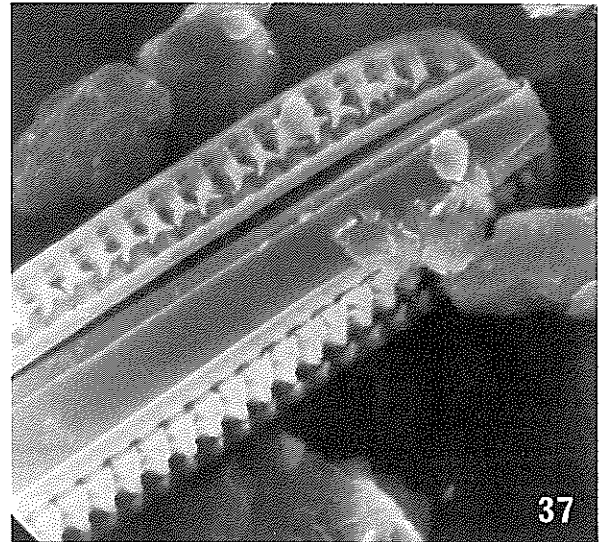
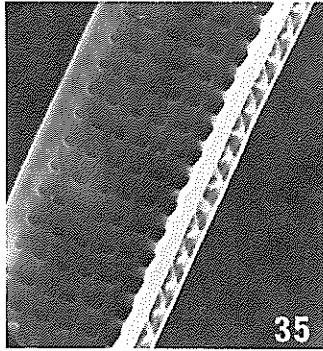
33 - Tilted 80°.

34 - Tilted 100°.

F = fibula; I = interspace.

Fig. 29 : X 2 000. Figs 30-34 : X 6 000.

Nitzschia rautenbachiae (9)



Nitzschia rautenbachiae Cholnoky

Fig. 35 : SEM, internal view of portion of valve. Zastron District, Orange Free State.

Fig. 36 : SEM, external view of slightly separated frustule. Great Fish River, Cape Province.

Fig. 37 : SEM, external view of portion of frustule in girdle view. Zastron District, Orange Free State.

Figs 35, 37 : X 6 000. Fig. 36 : X 1 900.

Nitzschia siliqua Archibald

Archibald 1966 : 267, Fig. 62.

Archibald 1971 : 54, Fig. 244.

Synonym:

Nitzschia pseudocarinata Cholnoky 1970: 30, Figs 13-15.

Description:

Valves linear, narrowing more or less abruptly at the ends into cuneate poles with small distinctly capitate apices; length 18-30 μm , breadth 3-5 μm . Canal raphe marginal, not always readily distinct; similarly, fibulae not always clear, but corresponding in number with the transapical costae, 16-18 in 10 μm . Transapical striae prominent, 16-18(19) in 10 μm , slightly curved at the poles; striae punctate, 24-30 relatively large puncta in 10 μm .

Examined under the electron microscope the structure of the external surface of the valve is shown in Figs 19-30. The valve face is slightly convex with a marginal canal raphe running along one side of the valve (Figs 20, 21, 25, 28). The surface is crossed by a series of transapical ridges, the costae (Figs 27-29). In the depressions between the costae single rows of more or less circular puncta (Figs 12-18, 23), separated from each other by low transverse ridges (Figs 27-29), constitute the transapical striae. The keel (K - Figs 25, 28), bearing the external raphe fissure at its apex, is well developed and strengthened on either side by a series of buttresses, which are probably continuous with the costae. The external raphe fissure (RF) is distinctly seen in Fig. 18. Along the valve margin opposite the keel each costa is armed with a short spine (Sp - Figs 18, 28).

The internal structure of the valve is comparatively simple (Figs 31-37). In the light of Fig. 37 the transapical costae are not as prominently raised above the surface as they are externally, whereas the striae have a structure much the same as on the outer surface. The canal raphe interspaces (I - Figs 18, 34, 35) are prominent and circular when viewed from directly above. Separating the interspaces are short rectangular strips, the fibulae (F - Figs 18, 31-36).

S.A. Ref. Slide Nos: 52-55.

Comments:

Cholnoky (1970 : 30, Figs 13-15) described a *Nitzschia* species, *N. pseudocarinata*, from Marble Hall (Transvaal) with characteristics very similar to *N. siliqua*. Having examined Cholnoky's type material (MH 13 - NIWR = S.A. Ref. Slide No. 54) it was quite evident that the two species are identical. This opinion was confirmed by the examination of another sample from the Northern Transvaal (NT 84 - NIWR = S.A. Ref. Slide No. 55) containing a rich population of a *Nitzschia* species identified by Cholnoky (unpublished data) as *N. pseudocarinata*. Accordingly *N. pseudocarinata* has been sunk into *N. siliqua* Archibald (1966), the earlier legitimate epithet. Cholnoky (l.c.) considered *N. pseudocarinata* (= *N. siliqua*) as having a

close affinity to *N. rautenbachiae* Cholnoky (1957 : 76, Figs 228-232). Our examination of *N. rautenbachiae* and *N. siliqua* under the electron microscope supports this view entirely. In fact, the valve structure of these two species appears at present to be unique and could form the basis of a new group in the genus *Nitzschia*.

Cholnoky (1970 : 30) claimed that in exceptional cases the breadth of the valve reached 6,0 μm . From Cholnoky's original analysis sheet it is evident that this claim was based on one example, which also had a striae density of 13 in 10 μm . The dimensions of this specimen appear, therefore, to be suspect and consequently have been omitted from the diagnosis given above.

Foged (1976 : 43, Pl. 21, Fig. 13), with some doubt, recorded and illustrated a *Nitzschia* specimen as *N. rautenbachiae* Cholnoky (1957), noting that the striae were slightly denser than normal for this taxon. The valve shape and dimensions of Foged's specimen suggest that it is most likely an example of *N. siliqua*.

A species which may be considered synonymous with *N. siliqua* is *N. affinis* Manguin (1952 : 101, Pl. 9, Fig. 183). The latter taxon agrees closely in most respects with the description of *N. siliqua*, differing mainly in slightly denser striation of the valve surface, transapical striae which are apparently not distinctly punctate, and very distinct fibulae. *N. siliqua*, on the other hand, has a canal raphe and fibulae which are not always distinct. Unfortunately we have not examined any of Manguin's type material to determine whether these differences are in fact real. Nevertheless, should the two taxa prove to be identical they must be united. In this regard *N. affinis* Manguin, although described earlier than *N. siliqua*, is, however, not valid, being a homonym of *N. affinis* Grunow (1862 : 577, Pl. 12, Figs 13a, b). Manguin's epithet would therefore have to be rejected in favour of *N. siliqua*, the earliest valid name of this taxon.

Distribution:

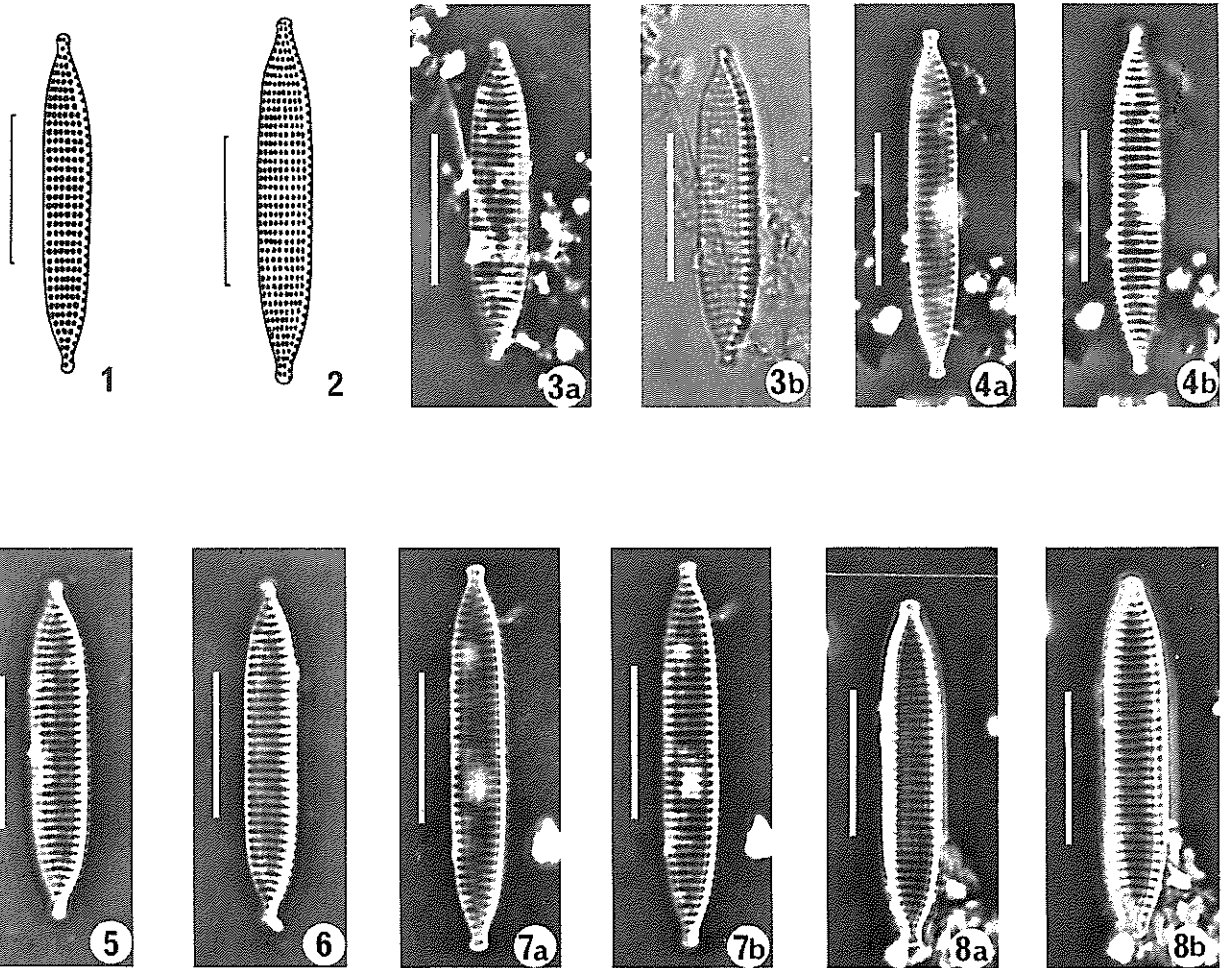
This species has at present been recorded from a few, rather scattered localities in the Transvaal and the Eastern Cape Province. Cholnoky (unpublished data) observed it near Messina in the Limpopo and Sand Rivers, as well as in the Mogalakwena River (Northern Transvaal). He also found it at Marble Hall in the Central Transvaal (Cholnoky 1970). Archibald (1971) reported this species from the Kaffirspruit and Waterval River, both tributaries of the Vaal River in the Southern Transvaal. It is also recorded in the Eastern Cape Province from the Sundays and Great Fish Rivers (Archibald : unpublished data).

References:

- Archibald, R.E.M. (1966) Some new and rare diatoms from South Africa. *Nova Hedwigia* Suppl. 21: 253-269.
- Archibald, R.E.M. (1971) Diatoms from the Vaal Dam catchment area, Transvaal, South Africa. *Botanica mar.* Suppl. 14 : 17-70.

Nitzschia siliqua (2)

- Cholnoky, B.J. (1957) Neue und seltene Diatomen aus Afrika.
III. Diatomeen aus dem Tugela-Fluss-system, hauptsächlich
aus den Drakensbergen in Natal.
Öst. bot. Z. **104** : 25-99.
- Cholnoky, B.J. (1970) Hydrobiologische Untersuchungen in Transvaal III.
Die Fischteiche von Marble Hall.
Botanica mar. Suppl. **13** : 5-44.
- Foged, N. (1976) Freshwater diatoms in Sri Lanka (Ceylon).
Bibliothca phycol. **23** : 1-113.
- Grunow, A. (1862) Die österreichischen Diatomeen nebst Anschluss einiger
neuen Arten von andern Lokalitäten und einer kritischen
Uebersicht der bisher bekannten Gattungen und Arten.
Verh. zool.-bot. Ges. Wien **12** : 315-472, 545-588.
- Manguin, E. (1952) Bacillariophyceae. IN: P. Bourrelly & E. Manguin,
Algues d'eau douce de la Guadeloupe et dépendances,
recueillies par la Mission P. Allorge en 1936, pp. 33-139.
Paris, Société d'Édition d'Enseignement Supérieur.



Nitzschia siliqua Archibald

Fig. 1 : Drawing. Kalk River near Balfour, Transvaal. Holotype Slide
No. Vaal 402 (NIWR) = S.A. Ref. Slide No. 52.

Fig. 2 : Drawing. Fish-pond, Marble Hall, Transvaal.

Figs 3, 4 : LM. Kalk River near Balfour, Transvaal. Holotype Slide
No. Vaal 402 (NIWR) = S.A. Ref. Slide No. 52.

3a - Specimen in phase contrast illumination.

3b - Same specimen in oblique illumination.

4a - Another specimen with outline in focus.

4b - Same specimen with striae in focus.

Figs 5-7 : LM. The Great Fish River, Eastern Cape Province.

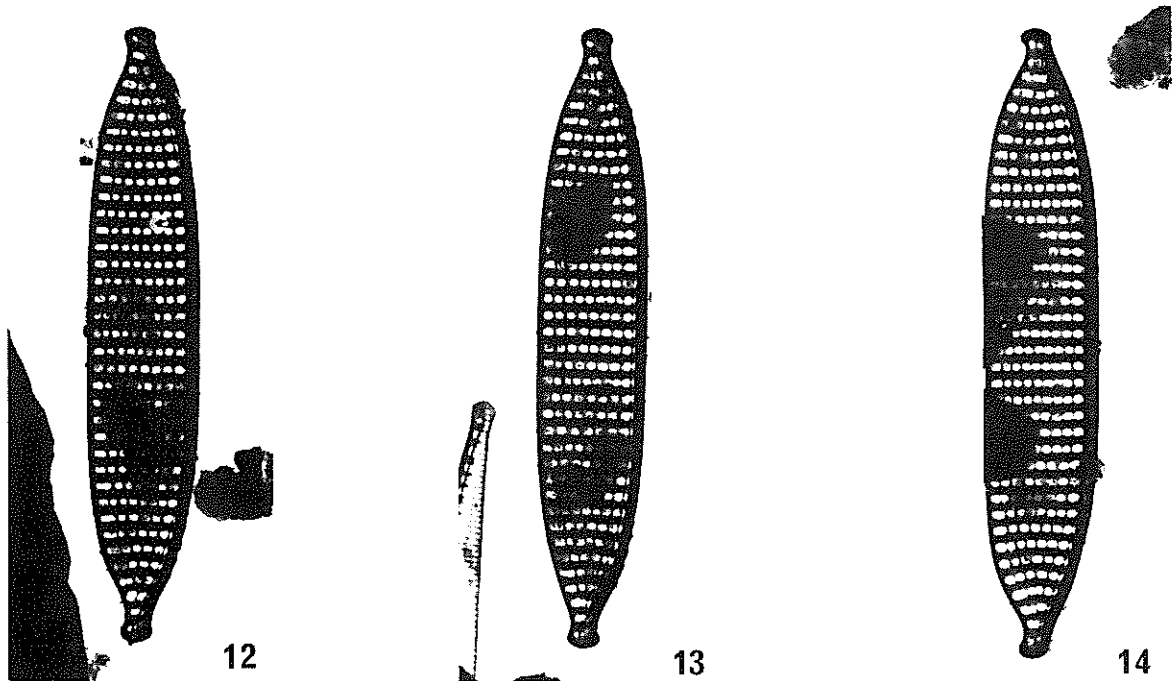
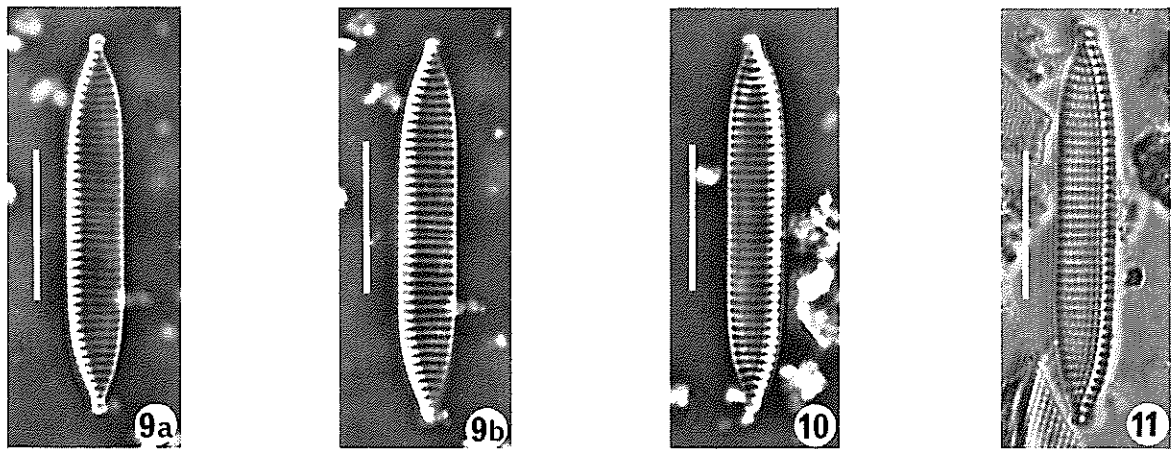
7a - Specimen with outline in focus.

7b - Same specimen with striae in focus.

Fig. 8 : LM. Fish-pond, Marble Hall, Transvaal.

8a - Outline in focus. 8b - Striae in focus.

Figs 1-8 : Scale = 10 μ m.



Nitzschia siliqua Archibald

Figs 9-11 : LM. Mogalakwena River, Northern Transvaal.

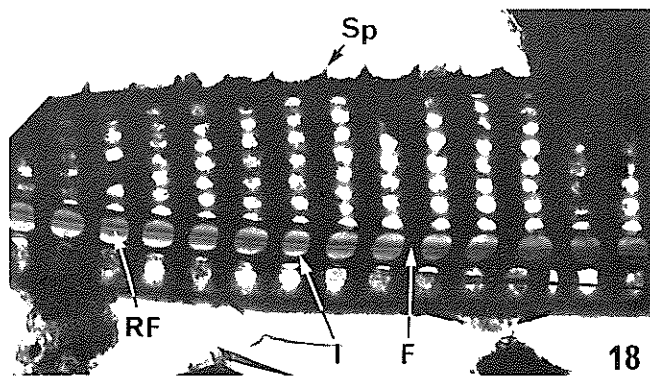
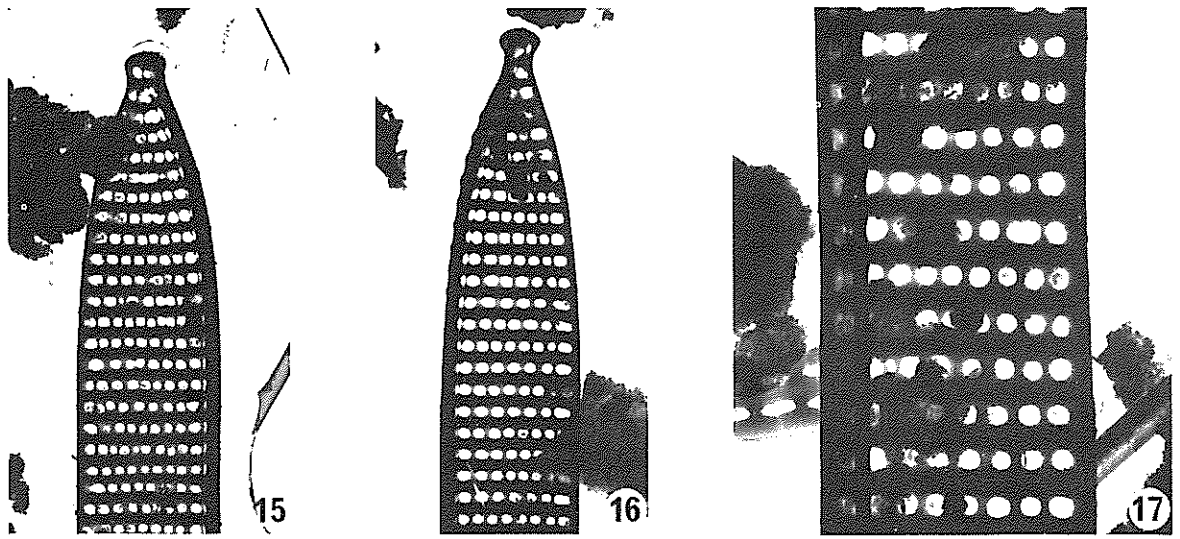
9a - Specimen with outline and fibulae in focus.

9b - Same specimen with striae in focus.

11 - Specimen in oblique light illumination showing puncta composing the striae.

Figs 12-14 : TEM. Great Fish River, Eastern Cape Province.

Figs 9-11 : Scale = 10 μ m. Figs 12-14 : X 3 800.



Nitzschia siliqua Archibald

Fig. 15 : TEM. Great Fish River, Eastern Cape Province.

Figs 16, 17 : TEM. Mogalakwena River, Northern Transvaal.

Fig. 16 : Part of valve with capitate apex.

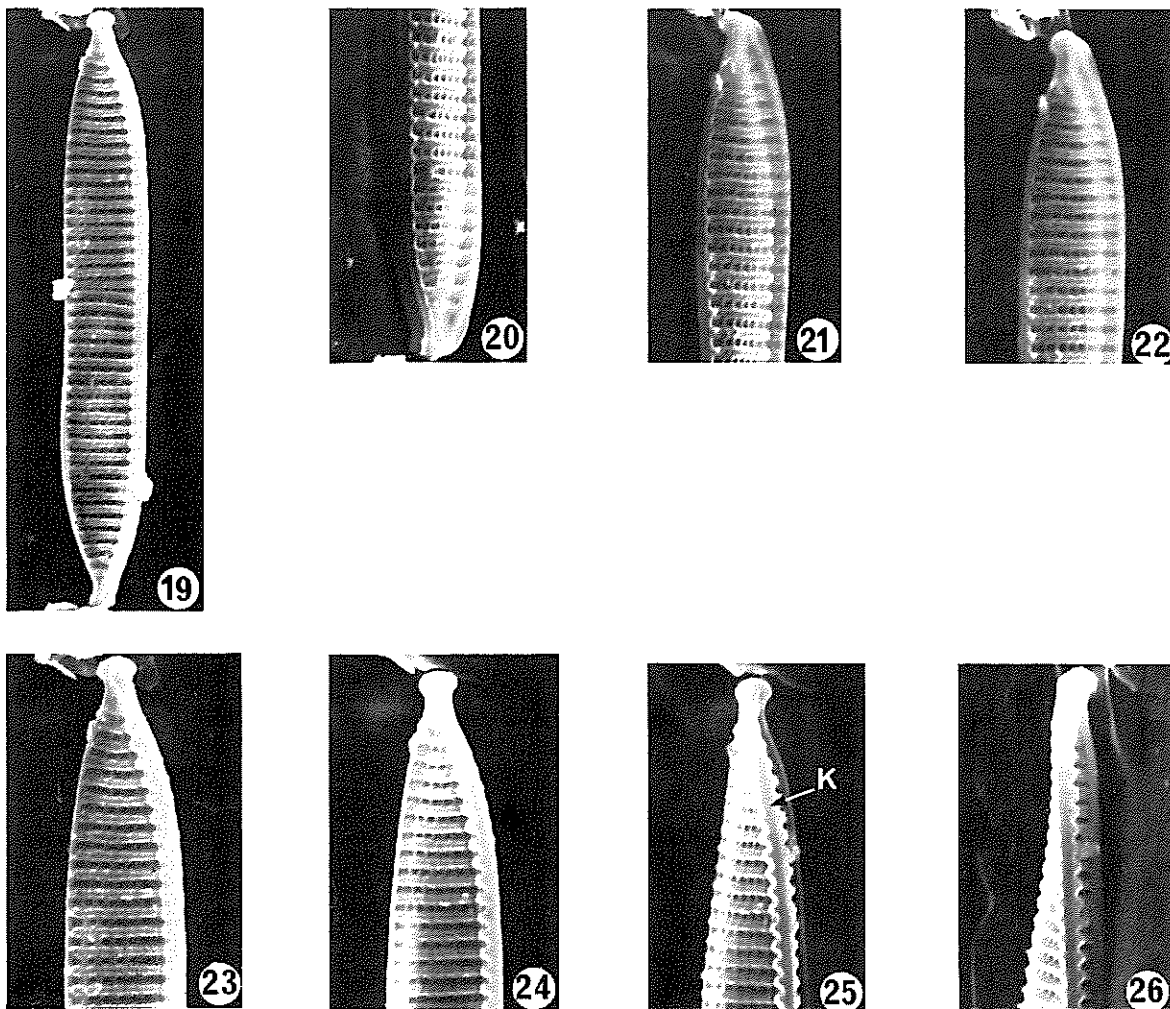
Fig. 17 : Central part of a valve enlarged.

Fig. 18 : TEM. Great Fish River, Eastern Cape Province.

Specimen lying obliquely showing canal raphe and marginal spines.

F = fibula; I = interspace; RF = raphe fissure; Sp = spine.

Figs 15, 16 : X 5 000. Figs 17, 18 : X 10 500.



Nitzschia siliqua Archibald

Figs 19-26 : SEM, external views of different aspects of one specimen.

Mogalakwena River, Northern Transvaal.

Fig. 19 : The whole valve.

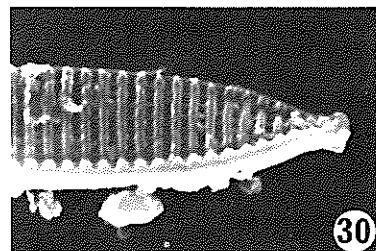
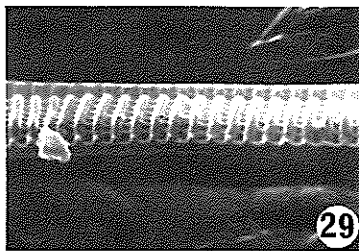
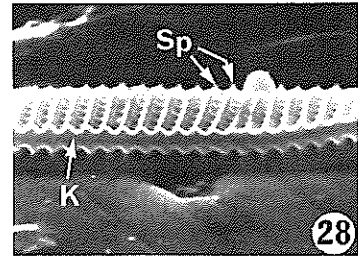
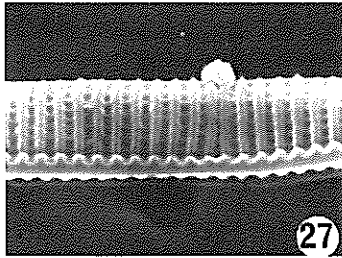
Fig. 20 : The lower pole enlarged and tilted.

Figs 21-26 : The upper pole enlarged and tilted anti-clockwise round the apical axis at various degrees.

K = keel.

Fig. 19 : X 3 200. Figs 20-26 : X 4 400

Nitzschia siliqua (7)



Nitzschia siliqua Archibald

Figs 27-29 : SEM, external views showing enlargements of the central part of Figure 19 viewed from different aspects. Mogalakwena River, Northern Transvaal.

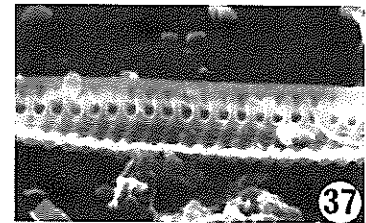
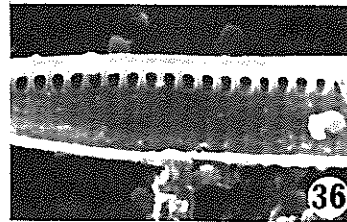
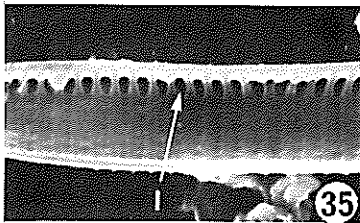
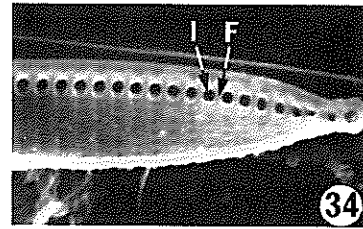
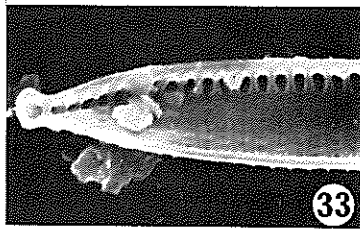
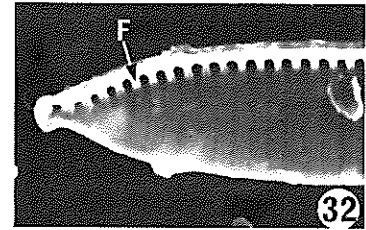
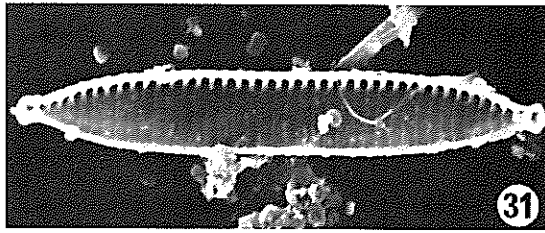
Figs 27, 28 : Central part of the valve viewed in two planes.

Fig. 29 : The same section of the valve rotated horizontally through 180° and viewed in the same plane as Figure 28.

Fig. 30 : SEM, external view of apex of another specimen, Great Fish River, Eastern Cape Province.

K = keel; Sp = spine.

Figs 27-30 : X 4 400.



Nitzschia siliqua Archibald

Figs 31, 32, 34, 36, 37 : SEM, internal views. Great Fish River, Eastern Cape Province.

Fig. 31 : A whole valve.

Figs 32, 34 : Poles of two different specimens enlarged.

Figs 36, 37 : A section of Figure 31 enlarged and viewed from two angles.

Figs 33, 35 : SEM, internal views of different aspects of a single specimen.

Mogalakwena River, Northern Transvaal.

Fig. 33 : Enlargement of one pole.

Fig. 35 : Enlargement of the centre of the same valve.

F = fibula; I = interspace.

Fig. 31 : X 3 200. Figs 32-37 : X 4 400.

Rhoicosphenia lesothensis Schoeman

Schoeman 1973 : 221, Figs 85-91.

Description:

Frustules in girdle view geniculate, therefore one valve concave and the other convex. Valves slightly heteropolar to almost completely isopolar, elliptical to lanceolate with either broadly rounded poles (generally small specimens) or poles protracted into rostrate or capitate apices; length 4,5-13,5 μm , breadth 2,3-3,3 μm . Pseudosepta absent. **Concave valve:** raphe well developed, straight and filiform; central nodule present, distinct in girdle view; central pores not conspicuous; terminal fissures not resolved. Axial area linear to linear-lanceolate; central area not distinct. Transapical striae very fine, not resolved under the LM. **Convex valve:** raphe relatively well developed, but raphe branches distinctly shorter than on the concave valve (length of raphe fissures 60-75% of valve length); no central nodule visible even in girdle view; central pores not conspicuous and terminal fissures not resolved. Axial area linear to linear-lanceolate; central area indistinct. Transapical striae very fine, not resolved under the LM.

Examination under the TEM (Figs 21-28) revealed the delicate structure of the valve. The terminal fissures (TF - Fig. 21b) are small and hook-shaped ending a short distance from the margin of the valve. The transapical striae, 42-46 in 10 μm , are radial, becoming parallel to slightly convergent at the poles. They consist of single rows of small, oval to roundish puncta, 50-68 in 10 μm . Around the apical margin of the poles there is a single row of puncta (e.g. Figs 21b, 24). The central area (indicated on some LM drawings) is asymmetrical and variable in shape, one side always larger than the other, in many cases reaching the valve margin; the width of the central area appears to be generally greater on the convex valves bearing the shorter raphe branches. The diffuse lighter patches observed in the TEM micrographs (e.g. Figs 21b, 25) in the axial and central areas are shown by the SEM micrograph (Fig. 29) to be a series of depressions (D) in the external valve surface.

S.A. Ref. Slide No. : 62.

Comments:

Despite a number of discrepancies, Schoeman (1973 : 221) placed this taxon in the genus *Rhoicosphenia*. The validity of this concept is strengthened in the light of recent TEM studies of this taxon. Features of our specimens which indicate the genus *Rhoicosphenia* are -

- i) the slightly heteropolar valves (sometimes very difficult to discern);
- ii) the geniculate frustules in girdle view;
- iii) the concave valves with a well developed raphe;
- iv) the convex valves with a reduced raphe (see note below); and

- v) the central nodule of the concave valves clearly visible in girdle view.

On the other hand, factors which do not suggest placing it in the genus *Rhoicosphenia* are firstly, the lack of pseudosepta (cf. *R. vanheurcki* Grunow in Hustedt 1931-59 : 432, Fig. 881), and secondly, the absence of evidence that the cells of this taxon are attached to the substrate by mucilage stalks. The above evidence therefore favours retaining this taxon in the genus *Rhoicosphenia*, and since, to the best of our knowledge, it cannot be related to any of the known *Rhoicosphenia* species, its description as a new species in this genus by Schoeman (l.c.) is vindicated.

As far as we are aware, the raphe on the convex valve of all other species in the genus *Rhoicosphenia* is rudimentary (in *R. vanheurcki* Grunow no raphe is shown at all). In our specimens, however, the raphe on the convex valves cannot be considered rudimentary. Nevertheless, although it is better developed than in other *Rhoicosphenia* species, it is significantly reduced in comparison with the raphe on the concave valve. We are therefore satisfied that even though the raphe of the convex valves in our specimens is not rudimentary, its reduced nature fulfils the requirements for the genus *Rhoicosphenia*.

Although the LM diagnosis given above states that the central area on the concave and convex valves is indistinct, a number of the LM illustrations show valves drawn with central areas. These areas were, however, not distinctly seen on the specimens, and represent a region of different optical density, as indicated by the lighter or darker shade when viewed under phase contrast (see LM photographs). The area demarcated is suggested by its lighter shade to be either a structureless region or an area of thicker silica deposition.

Distribution:

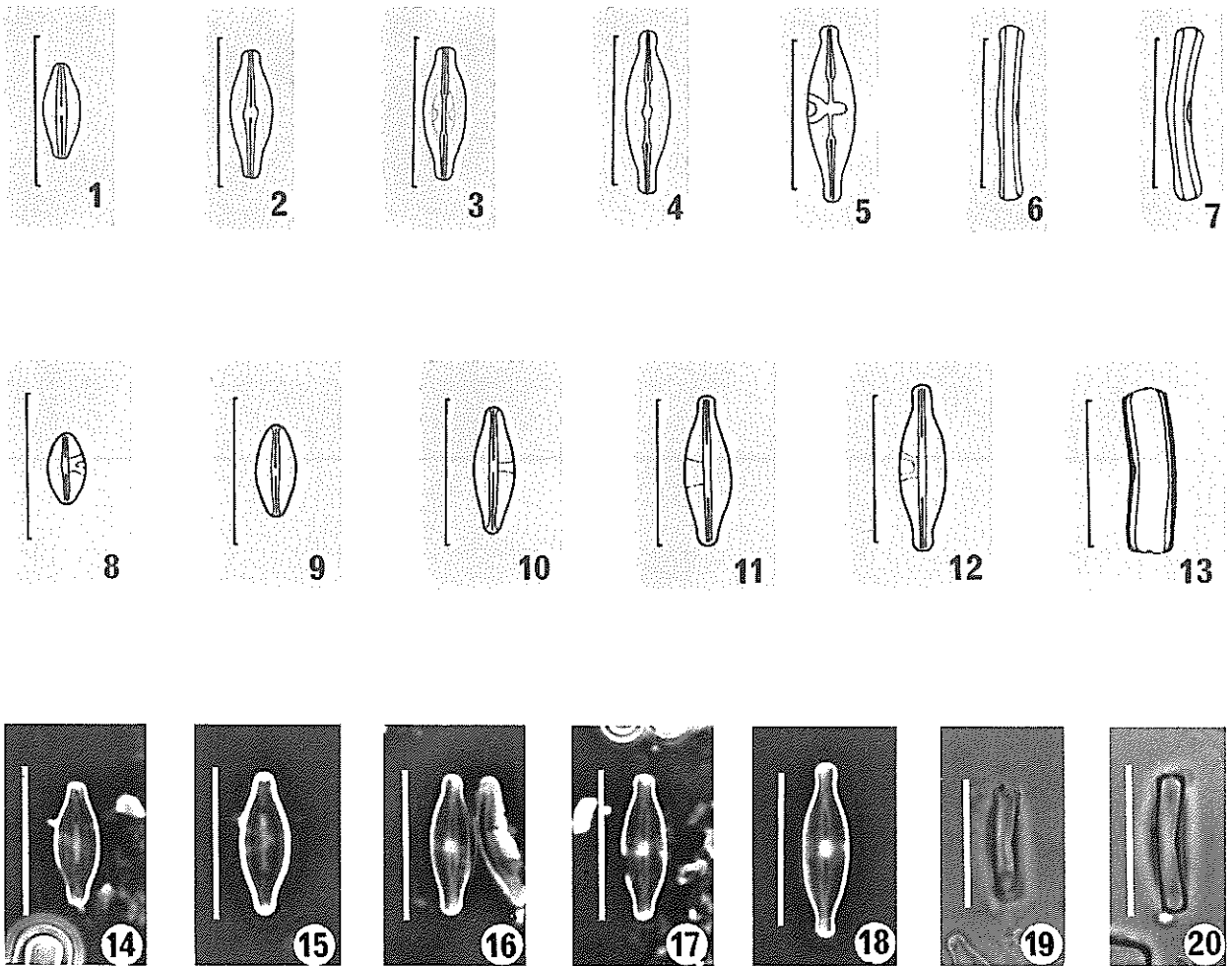
This species has been recorded only from a spring and its effluent stream at Paballong near 'Mamathe in the Berea district of Lesotho.

References:

- Hustedt, F. (1931-59) Die Kieselalgen. IN : L. Rabenhorst, *Kryptogamen-Flora von Deutschland, Österreich und der Schweiz*, Vol. 7, Part 2, 845 p.
Leipzig, Akademische Verlagsgesellschaft Geest & Portig K.-G.
- Schoeman, F.R. (1973) *A systematical and ecological study of the diatom flora of Lesotho with special reference to the water quality*. 355 p. and 10 pls.
Pretoria, V & R Printers.

The Diatom Flora of Southern Africa No. 3.
F.R. Schoeman and R.E.M. Archibald.
CSIR Special Report WAT 50.
September, 1977.

Rhoicosphenia lesothensis (2)



Rhoicosphenia lesothensis Schoeman

Figs 1-13 : Drawings. Paballong, Berea District, Lesotho.

Holotype Slide No. JG 13 (NIWR) = S.A. Ref. Slide No. 62.

Figs 1-7 : After Schoeman (1973).

6, 7 - Frustules in girdle view.

Figs 8-13 : Original.

13 - Frustule in girdle view.

Figs 14-20 : LM. Same material as above.

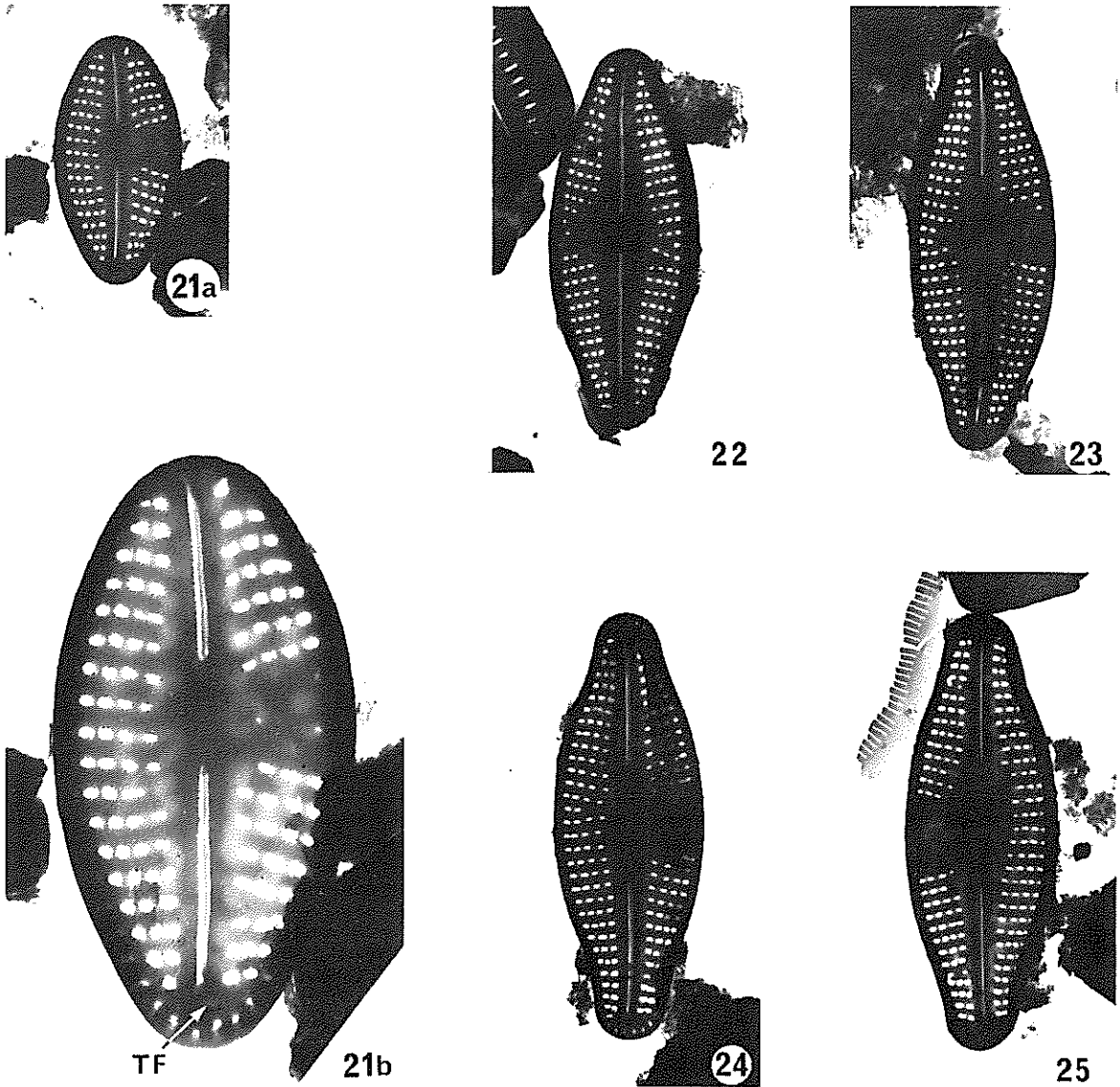
Figs 14, 15 : Convex valves with short raphe branches.

Figs 16-18 : Concave valves with long raphe branches.

Figs 19, 20 : Frustules in girdle view. Bright field illumination.

Note the central nodule on the concave valve.

Figs 1-20 : Scale = 10 μ m.



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Figs 21-25 : TEM. Paballong, Berea District, Lesotho.

Fig. 21 : Probably a concave valve with abnormally short raphe branches.

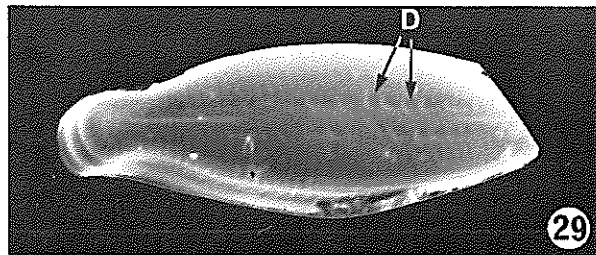
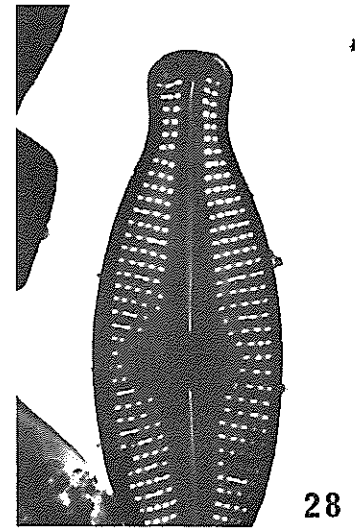
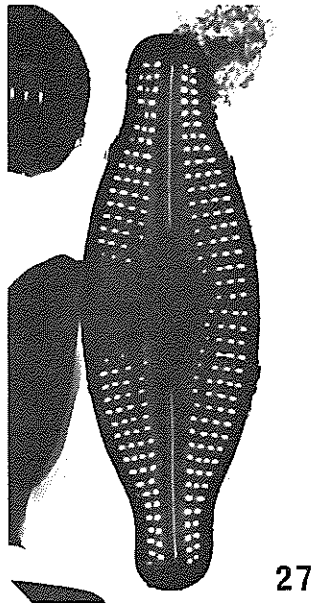
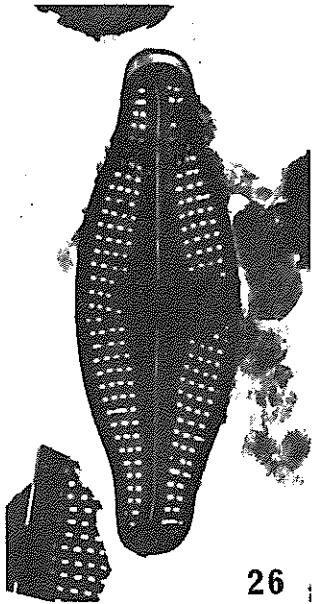
21b - Enlargement showing the terminal fissure (TF) and diffuse lighter patches in the axial and central areas.

Fig. 22 : Concave valve with long raphe branches.

Figs 23-25 : Convex valves with short raphe branches.

25 - Note diffuse lighter patches in the axial and central areas.

Figs 21a, 22-25 : X 7 500. Fig. 21b : X 18 000.



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Figs 26-28 : TEM. Paballong, Berca District, Lesotho.

Figs 26, 28 : Concave valves with long raphe branches.

Fig. 27 : Convex valve with short raphe branches.

Fig. 29 : SEM. Same material as above. External view of a convex valve with short raphe branches. Note the depressions (D) in the axial and central areas, seen as diffuse lighter patches in the TEM micrographs, Figures 21b and 25.

Figs 26-29 : X 7 500.