A contribution to the floral anatomy of *Leptospermum laevigatum*

D.T. Johnson  
University of Transkei, Umtata, Transkei

Introduction  
Although the general morphology of the Myrtaceae has been investigated repeatedly and reported in many taxonomic publications, detailed studies of the internal structure and ontogeny of the flower of the genus *Leptospermum* do not exist.

The last reasonably comprehensive account of the floral morphology of *Leptospermum* was by Bentham (1866). A publication by Erdtman (1971) contains data on pollen morphology.

Material and Methods  
Material of *Leptospermum laevigatum* (Soland. ex Gaertn.) F. Muell was collected from introduced but naturalized plants from various localities in the South Western Cape. Voucher specimens have been deposited in the herbarium of the University of the Western Cape.

Mature and developing flowers were fixed in F.A.A. (Johansen 1940). Material for histological examination was dehydrated in a tertiary butyl alcohol series (Johansen 1940) and embedded in paraplast with a melting point of 60 °C. Floral buds were sectioned serially at 15 — 24 μm and stained with Astra blue and Safranin. Photomicrographs were made with a Wild stereomicroscope and Leitz photomicroscope using 35 mm Panatomic X film.

Observations  
Floral morphology  
**Inflorescence.** Although the flowers are solitary, one occasionally finds a cyme. The flower, although described as sessile or nearly so (Bentham 1866), has a pedicel of 2 — 3 mm. Each flower is subtended by bracts which imbricate and bracteoles which cohere. Both bracts and bracteoles are deciduous.

**Perianth.** Each flower has five free sepals and five free petals which imbricate in the bud. The calyx, while in the bud stage, is pubescent, but is glabrous at a later stage. The sepals and petals are inserted on the outside of the circular hypanthium ledge.

**Stamens.** Numerous stamens are free and inserted in a single row on the inside of the hypanthium ledge (Figure 12). Anthers are dorsifixed but versatile with four microsporangia which dehisce longitudinally.

A single prominent oil gland occurs at the tip of the connective (Figure 1h). In surface view, the epidermal cells overlying the gland appear as a disc between the two anther lobes. These epidermal cells are large, polygonal and...
Figures 70—77. Gyrosigma rautenbachiae Cholnoky, sample 82, SEM internal views. 70. Centre of valve. Note the axial rib within the alveolar groove (× 4000). 71. Central nodule of specimen in 70 enlarged and turned. Note the two, short, longitudinal costae (× 6000). 72. Part of a valve showing the axial rib (AR), helictoglossa (H) and tooth-like projections (P) (× 4000). 73. Pole of a specimen in 72 turned and tilted to illustrate the wedged helictoglossa (× 6000). 74. Pole of another valve seen from a different angle (× 6000). 75. Pole of a valve showing the internal raphe fissure (RF) emerging onto the crest of the axial rib and terminating on the helictoglossa (× 6000). 76. Cross-section of a valve showing the double-walled structure in which the striae are composed of loculate areolae. Note the tooth-like projections (P) (× 6000).

Figure 77. Gyrosigma rautenbachiae Cholnoky, Pienaar’s River (PR 11), Transvaal. Cholnoky type material. SEM, external view of cross-section through the valve wall along the raphe shows that the raphe has the form of a deep tongue and groove structure (× 6000).

Microscopes has revealed that our specimens of Cymbella microcephala Grunow should be divided into two groups. This has been discussed in the light of the available literature and comparisons have been made with examples of this species from the van Heurck Type Slide No. 211. Unfortunately we were unable to obtain unmounted type material of C. microcephala for electron microscopy. Nevertheless, our observations have focused attention on this problem.

We have also been able to compare our specimens of Gyrosigma rautenbachiae Cholnoky with Cholnoky’s type material. This has enabled us to furnish light microscope photographs and electron micrographs for this species which is previously only been illustrated in the literature by a line drawings.

A number of other taxa are also listed for the record but do not require further comment as they are well known.

Acknowledgements

This paper is published with the approval of the Director of the National Institute for Water Research. Our sincere thanks are due to Dr R.E.M. Archibald for his valuable criticism of this manuscript, and Mrs V.H. Meaton for the final photographic prints. We are also indebted to Dr O. Alambo of the Botanical Museum in Lund, Sweden, and Dr. U. Passauer of the Naturhistorisches Museum in Vienna for their willingness to assist us with the loan of diatom slides and exsiccati.

References


cf. Okuno 1974, plate 864; Cox 1979, plate 2, figure 10) and a slit like aperture to the exterior (Figure 77). Figure 77 provides a particularly good illustration of the raphe structure. A slight lateral displacement of the valve wall along the raphe shows that it has the form of a deep tongue and groove structure. This can be compared to similar structures in *Stauroneis phoenicenteron* and *Pinnularia microstauron* (cf. Krammer 1981a, plate 3, figures 18, 19 and plate 5, figure 42 respectively). A small number of *G. rautenbachiae* valves were recorded from sample B2.

**Conclusions**

With the aid of type material we have been able to establish the true identity of *Cymbella cymbiformis* Agardh, a species whose taxonomy has previously been much confused.

Critical examination under both light and electron
The valve dimensions for the two groups of *C. rocephala* as distinguished in this study are as follows:

**Group 1:**
- Length 14.0 – 22.5 μm, breadth 3.3 – 4.4 μm.
- Transapical striae 24 – 26 in 10 μm dorsally (off centre), 22 – 26 in 10 μm ventrally and 27 – 30 in 10 μm at the poles (dorsally and ventrally).

**Group 2:**
- Length 13.7 – 19.0 μm, breadth 3.4 – 4.4 μm.
- Transapical striae 26 – 32 in 10 μm (usually a little less dense on the ventral side) and 28 – 34 in 10 μm at the poles (dorsally and ventrally).

**Description of Cymbella microcephala**

Heurck's Type Slide No. 211:

- Valves vary in shape from linear-lanceolate to almost incompletely linear forms, 12.5 – 16.5 μm long and 3.4 – 4.0 broad. The poles are protracted with rostrate, subulate or capitate apices. Some valves have a convex dorsal margin and an almost straight ventral margin. The raphe branches appear robust and arcuate with the convex side directed towards the ventral valve margin. The central pores are not conspicuous and the hooked terminal fissures are directed near the dorsal margin of the pole and curve down towards the ventral margin. The axial area is narrow, owing the curvature of the raphe branches and shows a slight expansion on the outside. The central area therefore becomes somewhat shallower so that the rib is often projects above the inner valve surface (Figures 73, 74, 75). Internally the central area of the valve the axial rib is expanded into a spinel-shaped central nodule (Figures 68, 71). On either side of this central nodule there is a short longitudinal costa (both of equal length) which does not extend further than this region (Figures 68 – 71; cf. *G. attenuatum sensu* Cox 1979, plate 1, figure 8). It is interesting to note that Cox illustrates *G. attenuatum* with both uneven (Cox 1977a, plate 4, figure 29) and even (Cox 1979, plate 1, figure 8) length axial costae. Further towards the poles, along the edge of the axial groove on the side opposite to that facing the opening of the raphe fissure in the axial rib, there is a row of tooth-like projections (Figures 72, 74, 76). In Figures 76 and 77 the valve is also shown as a double walled structure having a thin outer wall and a slightly thicker inner wall. The striae are clearly visible under SEM (Figure 67; cf. *C. microcephala* Grunow based on material for EM examination. Our studies have, nevertheless, shown the taxonomy of this species to be more complex than is generally known.

**G. attenuatum**

- The well developed terminal nodule takes the form of a lipped structure or helictoglossa in which the distal ends of the raphe terminate (Figures 64, 65). In Figures 64 and 66, while externally, the proximal ends of the raphe fissure are hooks curving in opposite directions. These external hooked proximal raphe endings are clearly visible under SEM (Figure 67; cf. *G. attenuatum sensu* Jackson & Lowe 1978, figure 3) and extend across two rows of the longitudinal striae on either side of the central nodule. They differ from those of *G. attenuatum sensu* Cox (1977b, plate 4, figure 31; 1979, plate 1, figure 1) which appear sinuate in the curved portion and do not cut across the striae. Internally the raphe fissures extend only a short distance onto the central nodule and end abruptly in slightly expanded pores (Figure 68). Figure 67 shows the arrangement of the pores in intersecting traverse and longitudinal striae. The raphe runs in an axial rib which is flush with the valve surface on the outside (Figure 67) but internally is a ridge lying within a groove (Figures 69, 71, 74, 76). The external (Figure 67) and internal (Figures 69, 76) raphe fissures run along the side of the axial rib except at their internal proximal and distal ends where they emerge on the crest of the rib (Figures 68, 75). In the central parts of the valve the groove containing the axial rib appears to be rather deep (Figures 70, 71) but towards the poles it becomes shallower so that the rib often projects above the inner valve surface (Figures 73, 74, 75). Internally at the centre of the valve the axial rib is expanded into a spinel-shaped central nodule (Figures 68, 71). On either side of this central nodule there is a short longitudinal costa (both of equal length) which does not extend further than this region (Figures 68 – 71; cf. *G. attenuatum sensu* Cox 1979, plate 1, figure 8). It is interesting to note that Cox illustrates *G. attenuatum* with both uneven (Cox 1977b, plate 4, figure 29) and even (Cox 1979, plate 1, figure 8) length axial costae. Further towards the poles, along the edge of the axial groove on the side opposite to that facing the opening of the raphe fissure in the axial rib, there is a row of tooth-like projections (Figures 72, 74, 76). In Figures 76 and 77 the valve is also shown as a double walled structure having a thin outer wall and a slightly thicker inner wall. The striae are comprised of loculate areolae with a more or less rectangular occluded inner opening (Figure 76;
appear to lie in a groove with a crenulate margin. This structure is clarified when valves are viewed under the SFM. The slit-like pores are then seen to represent the outer pore openings on the surface of the valve, while the internal pore openings are round (cf. Ehrlich 1973, plate 7, figure 6) thereby creating the crenulate image observed under TEM. The round internal pore openings lie in narrow grooves which are separated by transapical costae (Figures 54—56).

Under TEM the striae of the group 2 specimens (Figures 52, 53) consist of round to oblong-shaped pores (40—44 in 10 μm) which lie within very narrow grooves that possess straight (non-crenulate) sides (Figure 53; cf. Figures 59, 60 as examples from Lesotho previously identified as *C. microcephala*). When viewed (under SEM) from the inside of the valve (Figures 57, 58) these straight-sided grooves (group 2 specimens) are found to be narrower than those of the group 1 valves. The structure of the outer valve surface (group 2) as seen under SEM is basically similar to that illustrated by Ehrlich (1973, plate 7, figure 5) and Gerloff et al. (1978, plate 11, figure 3). The illustration of Krammer (1981b, plate 1, figure 7) of the outer surface of a *C. microcephala* valve depicts both round and transapically...
ent of inner and outer raphe fissures from the perpendicular plane. Grunow's drawings in van Heurck (1880–83, plate 8) illustrate a slight dorsal curvature of the raphe anch in his Figures 36 and 37 and a ventral one in his figure 39! According to Krammer's classification (1979, plate 3, figure 22) our specimens belong to the group Cymbellaceae possessing lateral raphe systems. Our TEM micrographs also clearly illustrate the narrow axial area which follows the curvature of the raphe branches. A central area is absent, though occasionally there may be a slight dening around the central nodule. The terminal areas are tall.

Cox (1977a, 431, plate 3, figures 13–15) recorded three types of striae pores within the genus Cymbella. The pore structure of our specimens does not fit any of her types. Under TEM we observed two distinct transapical striae types thereby lending support to the division of our specimens into two C. microcephala groups. The striae of specimens in our group 1 (Figures 47–51) contained 36–41 puncta in 10 μm. These puncta are linear or slightly dumbbell in shape and are aligned with their long axes parallel to the striae. Near the valve apices a few pores occasionally assume a trifid shape. Under TEM we also observed that in these specimens (Figure 51) the transapically aligned slit-like pores

![Image of Cymbella microcephala specimens](image-url)
of the structure can be seen, though in valve outline they do resemble this taxon. Grunow’s first reference to C. microcephala is to be found in van Heurck’s Atlas (1880–83, plate 8, figures 36–39) of the diatoms of Belgium, and van Heurck (1885, 63) cited his Type Slide No. 211 as containing this species. Since Grunow (in van Heurck 1884—87, series 9) substantiated the identity of C. microcephala on van Heurck’s Type Slide No. 211 we may thus assume it is either the syntype slide or properly authenticated material for this taxon. We examined this slide (obtained from the Grunow diatom collection in Vienna) and found that the specimens (Figures 39–46; cf. Patrick & Reimer 1975, 33, plate 4, figures 12, 13) resemble many of our group 2 valves. A description of the valves observed on this slide (No. 211) is given at the end of the discussion on C. microcephala. According to van Heurck (1885, 63) the raphe is weakly arcuate, but specimens we examined on the van Heurck Type Slide No. 211 usually had raphe branches slightly more arcuate than those illustrated by Grunow in van Heurck (1880–83, plate 8, figures 36–39). Hustedt’s illustrations (1930, 351, figure 637; 1949, plate 1, figures 34–38), on the other hand, tend to depict almost straight raphe branches which come closer to our group 1 specimens.

It was only after completing an EM study on the Pretoria Salt Pan specimens (with emphasis on the transapical striae) that we found better evidence for our suspected separation of this taxon into 2 groups, as mentioned earlier. Under TEM (both groups) the raphe in valvar view (Figures 47–50, 52) is more or less centrally placed. The terminal fissures (Figures 48, 49) are directed ventrally and the small central pores sometimes show a slight dorsal deflection (Figures 47, 50, 52). The central section of each raphe branch (Figures 47–50, 52; cf. Geissler et al. in Helmcke & Krieger 1963, 33, plate 391, figure lower left) is ventrally curved and appears band-shaped owing to slight displace-
Cymbeformis was recorded from two samples, B1 and B2.

C. microcephala Grunow (Figures 29–60). The initial examination of the slides showed this species to be the dominant taxon in samples B1 and B9. Further study under the light microscope revealed that these specimens could be divided into two groups on the grounds of some minor differences, namely, C. microcephala group 1 (Figures 29–34) and C. microcephala group 2 (Figures 5–38). Group 1 specimens were recorded from sample B9, while a few examples were also present in sample B1. Group specimens were present only in sample B1, where they presented the dominant diatom taxon.

Valves of group 1 have almost straight or slightly curved raphe branches whereas those in group 2 have clearly arculate and slightly thicker raphe branches. The number of oral transapical striae (off centre) is usually between 24 and 26 in 10 μm for group 1 and slightly denser for group (26 – 32 in 10 μm). However, the occasional intermediate specimen was inevitably present, making it extremely difficult to distinguish between the two groups. The transapical striae of specimens in both groups may be radial throughout or can become parallel or even convergent at the poles.

Examination of the available literature revealed that very little of the variation displayed by C. microcephala has been illustrated. Hustedt (1949, plate 1, figures 34 – 38) and Schoeman (1970, 52, plate 1, figures 15 – 22) figure some valve variation and Schoeman (1970), based on his light microscopy studies of Lesotho material, has proposed the sinking of C. rutneri Hustedt (in Schmidt et al. 1874–1959, plate 373, figures 39 – 44; Hustedt 1937–38, 421, plate 25, figures 4 – 9; cf. Schoeman 1969, 43, figures 15 – 17) into the C. microcephala species. Electron microscopical studies of C. rutneri-type material may prove otherwise.

According to VanLandingham’s ‘Catalogue of the fossil and recent genera and species of diatoms and their synonyms’ (1969, 1212 – 1213), the earliest reference to this taxon comes under the name Cymbella minuscula Grunow and comprises a series of figures in Schmidt et al. (1874–1959 (1875), plate 9, figures 58 – 61). Our photographic copy of these illustrations is poor and little
The distal ends are deflected dorsally (Figures 13, 20). The central nodule is very thickened internally (Figures 15, 24) thereby obscuring the proximal raphe endings (cf. Cox 1977a, 432). The distal ends of the axial rib are also thickened and are developed on the dorsal side into a two-lipped structure, the helictoglossa (Figures 17, 25—27) in which the inner raphe fissure terminates (Figure 18). The distal ends of the inner raphe fissures appear to run ventrally along the base of the raised axial rib before entering the helictoglossae. From the thickened terminal nodule there is a fairly broad extension towards the dorsal margin (Figures 17, 26, 27) separating the striae from the mucilage pore area (apical pore field). Cox (1977a) has suggested that the development of a hooded raphe ending seems to be associated with the presence of a mucilage pore area at the valve apex. Externally these mucilage pores appear as rows of small closely arranged circular openings (Figure 20; cf. Cox 1977a, plate 5, figure 30) which are separated internally by narrow ribs (Figures 17, 27). On the ventral side of the central area two or occasionally three stigmata are present. Furthermore, specimens with a single stigma were observed in Agardh’s-type material. Externally they appear as rather conspicuous, simple, circular openings (Figures 12, 19; cf. Krammer 1981a, plate 3, figure 20). Internally they are slit-like and are partly occluded by outgrowths of silica (Figures 15, 22—24; cf. Cox 1977a, 434).
camera lucida with adjustable magnification changer. The original drawings were made at a magnification of 4000× and then suitably reduced for reproduction.

Additional material (slides and exsiccata) for comparative purposes was obtained from the University of Lund Botanical Museum in Sweden (for *Cymbella cymbiformis* Agardh), the Naturhistorisches Museum in Vienna (for *Cymbella microcephala* Grunow) and the NIWR diatom collection in Pretoria (for *Gyrosigma rautenbachii* Cholnoky). Terminology used is that suggested by the Working Party on Diatom Terminology (Anon. 1975; Ross et al. 1979).

**Observations and Discussion**

A further number of diatom taxa identified from samples collected in the vicinity of the Pretoria Salt Pan are listed below in alphabetical order. Where necessary, their dimensions and some comments on their structure are also given.

1. *Achnanthes engelbrechtii* Cholnoky (Figures 1 — 3)
   - Cholnoky 1955, 16, figures 1—8.
   - Cholnoky 1959, 7, figures 16—33.
   - Length 8,0—11,0 μm, breadth 3,5—4,2 μm. Transapical striae (raphe and raphelass valves) 16—18 in 10 μm (a little denser at the apices).
   - This species shows some similarity to *A. pinnata* Hustedt 1922, 123, plate 9, figures 15—18; 1937—38, 201, plate 13, figures 54—57 and a detailed study of Hustedt's type material is required to make a proper comparison. It is also interesting to note that under TEM the striae structure is reminiscent of that of *A. lanceolata* Brébisson ex Kutzing. *A. engelbrechtii* occurred only rarely in sample B9.

2. *Achnanthes exigua* Grunow
   - Schoeman & Archibald 1977, no. 3.
   - Schoeman & Ashton 1982a, 84, figures 1—8, 75—79, 05—110.
   - Length 8,0—12,0 μm, breadth 4,3—5,0 μm. Transapical striae: raphe valve 26—28 in 10 μm near the centre (slightly denser at the poles); raphelass valve 25—27 in 10 μm near the centre (denser at the poles).
   - *A. exigua* was observed in samples B2 and B4.

3. *Achnanthes lanceolata* Brébisson ex Kutzing Hustedt 1931—59, 408, figure 863.
   - Patrick & Reimer 1966, 269, plate 18, figures 1—10.
   - A few valves were recorded from sample B2.

4. *Bulboforma ovais* (Kützing) Kützing var. affinis (Kützing) van Heurck ex De Toni.
   - Patrick & Reimer 1975, 69, plate 13, figures 3,4.
   - A single specimen was observed in sample B2.

5. *Bulboforma veneta* Kützing (Figures 4, 5)
   - Schoeman & Archibald 1978, no. 4.
   - Schoeman & Archibald 1979, no. 5.
   - Length 18,0—27,5 μm, breadth 3,2—4,0 μm. Transapical striae on the dorsal side, punctate, 26—28 in 10 μm, more widely spaced at the centre (about 22 in 10 μm) and slightly denser at the poles (28—30 in 10 μm); striae along the ventral side 28—30 in 10 μm. A critical study of this taxon has been presented by Schoeman and Archibald (1978; 1979). Under SEM the fairly high dorsal mantle is partially seen in Figure 4. Also clearly visible is the outer raphe fissure. Stems run in a broad, flat, axial rib which is slightly extended dorsally to form a poorly developed conopeum (previously referred to as a flap by Schoeman & Archibald 1978; 1979). Externally the terminal fissure of the raphe is strongly recurved towards the dorsal side (Figure 5) ending in the last punctum of the most distal dorsal stria.
   - *A. veneta* was recorded from samples B1 and B5.

6. *Cyclotella atomus* Hustedt
   - Schoeman & Archibald 1976, no. 1.
   - Diameter 4,0—5,0 μm; marginal costae 13—15 in 10 μm. This species was observed in sample B9.

7. *Cyclotella meneghiniana* Kützing
   - Schoeman & Archibald 1980, no. 6.
   - A few valves were observed in sample B5.

8. *Cymbella cymbiformis* Agardh (Figures 6—28)
   - Length 70,0—89,0 μm, breadth about 16,0 μm (one specimen 12,5 μm). Transapical striae (dorsal and ventral) about 8 in 10 μm near the centre but denser at the poles, 12—16 in 10 μm. The striae are punctate with 14—20 puncta in 10 μm (20—22 in 10 μm according to Krammer 1980, 232, figures 15,16) but denser at the poles. In our specimens two conspicuous stigmata are located on the ventral margin of the central area (Figure 10), while occasionally a third smaller stigma is also visible.
   - There appears to be a great deal of confusion concerning the taxonomy of this taxon and its relationship with other closely related taxa, namely, *C. cistula* (Hemprich) Kirchner and *C. affinis* Kützing (cf. Schoeman 1973, 55; Patrick & Reimer 1975, 54—55; Reichardt 1981, 502—503). This is partly due to Hustedt's (1955, 50—51) investigation and interpretation of this taxon in which he concluded that *C. cymbiformis* was characterized by the lack of an isolated stigma in the central area. It is evident that Hustedt (1955) did not examine any Agardh material and based his observations mainly on the Kützing material of *Cocconeuma cymbiforme* Kützing. We were fortunate to obtain some of the Agardh (1830, 10) type material from Stangby (No. 4612) for EM study from the University of Lund Botanical Museum (Sweden), together with a lectotype slide prepared from this material by Reimer (vide Patrick & Reimer op. cit.). Some illustrations of the Agardh-type specimens (Figures 6—9, 12—18) are presented here for the purpose of direct comparison with our valves (Figures 10, 11, 19—27), which were found to be identical.
   - Under TEM the pores of the transapical striae appear linear and are aligned with their long axes perpendicular to the striae (Figure 28). In lightly cleaned material these slit-like pores are very narrow, but harsh cleaning results in etching so that the pores appear wider and more oblong in shape. SEM examination showed that these slit-like pores represent the outer openings of the striae pores (Figures 12, 13, 19). The internal openings of these pores appear to be larger (round-oblong) and open into transapically aligned grooves (Figures 14, 22, 23).
   - According to Krammer's classification (1979, 1005, plate 3, figure 22, plate 4, figures 40, 41) the raphe system is of the reverse-lateral type. It lies in an axial rib which is rather flat externally (Figure 12), but appears as a raised ridge internally (Figures 15, 18, 24, 27). Viewed under SEM the external raphe fissure becomes sinuate near the valve centre with a ventrally directed arch terminating in a fairly conspicuous central pore which also bends ventrally (Figures
The diatom flora in the vicinity of the Pretoria Salt Pan, Transvaal, Republic of South Africa. Part II

F.R. Schoeman and P.J. Ashton
National Institute for Water Research, Council for Scientific and Industrial Research, Pretoria

Introduction

The hypersaline Pretoria Salt Pan with its saline artesian spring is the only example of a maar lake in southern Africa. In a recent publication, the diatom flora of this floristically unknown system was discussed (Schoeman & Ashton 1982a). The water sources in the farmlands (the Soutpan agricultural experimental farm) surrounding the salt pan and its volcanic crater consist of a perennial stream and several boreholes whose hydrochemistry is quite different to that of the spring feeding the Pretoria Salt Pan. Since the diatom flora of the surface waters in this area was virtually unknown, the diatoms recorded from these different water sources were studied by both light and electron microscopy. The first results dealing with several taxa recorded from this area have already been published (Schoeman & Ashton 1982b).

This is the second in a series of three contributions covering the diatom flora recorded in the vicinity of the Pretoria Salt Pan. Of the ten species described in this publication, three viz. *Cymbella cymbiformis* Agardh, *C. microcephala* Grunow and *Gyrosigma rautenbachiae* Cholnoky, are discussed in detail with notes on their taxonomy and valve structure, the latter based on both light and electron microscopy. In an attempt to verify the correct identity of these taxa, certain authenticated materials were also examined.


Materials and Methods

Methods for the preparation and examination of the diatom samples (light and electron microscopy) have also previously been presented (Schoeman & Ashton 1982b). The line drawings (Figures 14—16) were made with the aid of a Zeiss...