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Observation of Electron Dense Fibrillar Bodies in the Desmid *Closterium lunula*

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Mit 1 Abbildung

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Summary

MEINDL U. & URL W. G. 1985. Observation of electron dense fibrillar bodies in the desmid *Closterium lunula*. – Phyton (Austria) 25 (2): 297–300, with 1 figure (plate). – English with German summary.

Electron dense fibrillar bodies are scattered in the cytoplasm of non-growing cells of *Closterium lunula*. The bodies measure about 0,25 µm in diameter and consist of fibrils which are wound up to form coils. In cross section the fibrils appear as dots with a diameter of approximately 17 nm and a center to center spacing of 20 nm. There is no visible relationship between fibrillar bodies and other ultrastructural components of the *Closterium* cell. Fibrillar bodies are only present in *Closterium lunula* but not in *Closterium ehrenbergii*. Although similarities to viral inclusion bodies of various other plant cells could be observed, the nature of the fibrillar bodies is unknown.

Zusammenfassung

MEINDL U. & URL W. G. 1985. Beobachtung von elektronendichten fibrillären Körpern in der Desmidiacee *Closterium lunula*. – Phyton (Austria) 25 (2): 297–300, mit 1 Abbildung (Tafel). – Englisch mit deutscher Zusammenfassung.

Im Cytoplasma von nicht wachsenden *Closterium lunula* Zellen liegen zahlreiche elektronendichte fibrilläre Körper in unregelmäßiger Anordnung. Die Körper weisen einen Durchmesser von ungefähr 0,25 µm auf und bestehen aus Fibrillen, die zu Knäuel aufgewunden sind. Im Querschnitt erscheinen die Fibrillen als Punkte mit einem Durchmesser von ca. 17 nm und einem Abstand von 20 nm. Es besteht keine erkennbare Beziehung zwischen den fibrillären Körpern und anderen ultrastruktu-

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rellen Komponenten der *Closterium*-Zelle. Fibrilläre Körper sind nur in *Closterium lunula*-Zellen anzutreffen nicht jedoch in *Closterium ehrenbergii*. Obwohl gewisse Ähnlichkeiten zu Viruskörpern verschiedener anderer Pflanzenzellen beobachtet werden können, bleibt die Natur der fibrillären Körper ungeklärt.

Introduction

Closterium lunula is one of the largest desmids measuring about 660 µm in length and approximately 100 µm in thickness at the middle of the cell. The two cylindric chloroplasts of *Closterium* are characterized by ridges running parallel to the longitudinal axis of the cell. The ends of the cell are occupied by vacuoles, which are characteristic for the *Closteria* and have been proved to contain $BaSO_4$-crystals (BROOK & al. 1980).

Various earlier studies were concerned with light microscopic observations on the biology of *Closterium lunula* (BURIAN 1961, 1964, URL 1967) as well as with the resistance of this alga against heavy metals (URL 1955), chemical treatment (LOUB 1951, URL 1959) and centrifugation (URL 1978).

Ultrastructural investigations on desmids especially on *Micrasterias* have demonstrated that the cytoplasm of these cells contains numerous different vesicles which depending on their function and the time of their appearance during cell development vary in size and form (KIERMAYER 1981). In *Closterium littorale* especially large vesicles probably containing mucilage material, small vesicles as well as small vacuoles and bundles of fine fibrils have been observed to be components of the cytoplasm (PICKETT-HEAPS & FOWKE 1970).

In course of ultrastructural studies on *Closterium lunula* a new cytoplasmic component has been found and will be described in the present paper.

Material and Methods

Cells of *Closterium lunula* were collected in a peat-bog of the Austrian alps (Seethalersee, Salzburg) and after a special washing procedure were cultivated in a "desmid medium" (SCHLÖSSER 1982) with added soil extract. The cultures were kept under semisterile conditions at constant temperature and a special illumination rhythm (for method see KIERMAYER 1968). For electron microscopy cells of *Closterium lunula* were fixed with 1% glutaraldehyde and 2% OsO_4 as it was suggested for *Micrasterias* (KIERMAYER 1968). After dehydration with ethanol the cells were embedded in Epon 812, sectioned on a Ultracut (Reichert) and viewed on a Philips 400T transmission electron microscope at 60 kV.

Results and Discussion

Ultrastructural studies on non-developing cells of *Closterium lunula* exhibit numerous dark contrasted bodies which are located in the cyto-

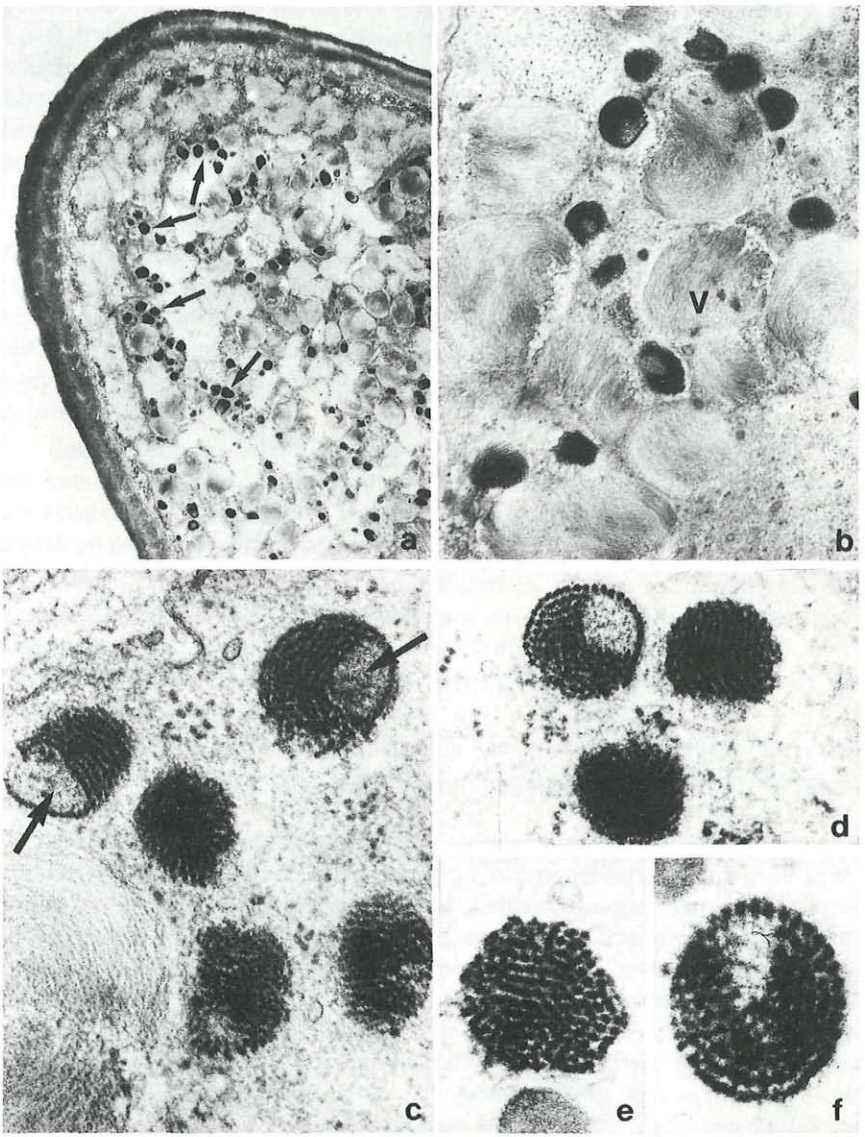

Fig. 1. Electron dense fibrillar bodies in the cytoplasm of *Closterium lunula*. a: arrangement of the fibrillar bodies in the cytoplasm. Arrows point a groups of fibrillar bodies, × 5,500; b: group of fibrillar bodies located between mucilage vesicles (V), × 20,400; c: fibrillar bodies at higher magnification. Arrows point at fibril-free sections of the bodies, × 64,500; d: fibrillar bodies with fibrils encountered in cross section and longitudinal section, × 57,300; e, f: arrangement of the fibrils in cross section, e: × 76,500, f: × 109,000.

plasm besides other components (Fig. 1a). At higher magnification (Fig. 1b–f) the bodies appear to consist of electron dense fibrillar structures which are wound up thus forming a coil-like aggregation (Fig. 1c). The fibrillar bodies (FB) measure about 0,25 µm in diameter and have never been seen to be surrounded by a membrane. In cross section the fibrils of the bodies appear as dots with a diameter of about 17 nm and a constant center to center spacing of approximately 20 nm. The fibrils seem to be in contact with one another by a fuzzy material. Within one and the same body the fibrils are often seen in cross section as well as in longitudinal section (Fig. 1c, d). The shape of the whole body probably is spherical with a section of nearly all the examined bodies free of any fibrils and apparenty filled with a low contrasted material (Fig. 1c, arrows. 1d, f). It therefore might be supposed that the FB are hollow structures or at least exhibit a low depression.

Concerning the arrangement of the FB within the cytoplasm, no favoured location had been observed, nor are there any relations to other ultrastructural components. It rather seems that the FB are irregulary scattered in the cytoplasm often being arranged in groups (Fig. 1a, arrows).

Fibrillar bodies had been encountered in all the examined cells of *Closterium lunula* but not in *Closterium ehrenbergii* which in respect to morphology and systematic position is similar to *Closterium lunula*. Nor have FB been observed in the ultrastructural studies of PICKETT-HEAPS & FOWKE (1970) on *Closterium littorale*.

In *Closterium lunula* FB had already been observed in 1969 by RUTKOW (unpublished results) and by NEUHAUS (unpublished results) about ten years later.

The significance of the FB as well as their nature is unknown. The only similarity of FB to other ultrastructural components in plant cells that could be noticed so far is that to viral inclusion bodies. Various authors (AMELUNXEN & THALER 1967, ROBERTS & al. 1970, STEFANAC & LJUBESIC 1971, HONDA & MATSUI 1972, RAINE & al. 1975, GAILHOFER & al. 1977) have described viral inclusions to consist of isometric electron dense particles which are aggregated to bodies of different shape. In longitudinal sections the viral inclusions often appear to be of rod-like fibrils (AMELUNXEN & THALER 1967, RAINE & al. 1975) sometimes being arranged in whirls (GAILHOFER & al. 1977). Viral inclusion bodies have also been found in animal cells where they were characterized as "highly electron dense bodies which vary in diameter (0,2 µm–1 µm)" and ". . . are composed of densely packed granular and filamentous elements" (FRIEDMANN & LORCH 1984).

From the form and arrangement of viral particles or fibrils in different plant cells it might be supposed that the FB of *Closterium lunula* are a type of viral inclusions. However, the outer shape and the size of the viral aggregations do not correspond to the shape and size of the FB.

Since no other corresponding ultrastructural bodies had been found so far in plant cells the nature of the FB in *Closterium* still remains unclear.

References

AMELUNXEN F. & THALER I. 1967. Die Feinstruktur der Eiweißspindel von *Zygocactus truncatus*. – Z. Pflanzenphysiol. 57: 269–279.

BROOK A. J., FOTHERINGHAM A., BRADLY J. & JENKINS A. 1980. Barium accumulations by desmids of the genus *Closterium (Zygnemaphyceae)*. – Br. phycol. J. 15: 261–264.

BURIAN K. 1961. Über die Chloroplastenkontraktionen bei *Closterium lunula* und deren Reversibilität. – Protoplasma 53: 19–33.

— 1964. Die Chondriosomen im Plasma von *Closterium lunula*. – Protoplasma 59: 594–596.

FRIEDMANN A. & LORCH Y. 1984. Electron microscopic study of the development of Theiler's murine encephalomyelitis viruses propagated in vitro. – Biol. Cell 50: 127–136.

GAILHOFER H., THALER I. & RÜCKER W. 1977. Viruseinschlüsse in der Zellwand und in Protoplasten von in vitro kultivierten *Armoracia*-Geweben. – Protoplasma 93: 71–88.

HONDA Y. & MATSUI C. 1972. Electron microscopy of intracellular radish mosaic virus. – Phytopathology 62: 448–452.

KIERMAYER O. 1968. The distribution of microtubules in differentiating cells of *Micrasterias denticulata* BRÉB. – Planta 83: 223–236.

— 1981. Cytoplasmic basis of morphogenesis in *Micrasterias*. In: KIERMAYER O. (ed), Cytomorphogenesis in Plants. – Springer, Wien–New York.

LOUB W. 1951. Über die Resistenz verschiedener Algen gegen Vitalfarbstoffe. – Sitzungsber. Österr. Akad. Wiss. math.-nat. Kl. Abt. I 170: 1–8.

PICKETT-HEAPS J. D. & FOWKE L. C. 1970. Mitosis, cytokinesis and cell elongation in the desmid, *Closterium littorale*. – J. Phycol. 6 (2): 189–215.

RAINE J., WEINTRAUB M. & SCHROEDER B. 1975. Flexous rods and vesicles in leaf and petiole phloem of little-cherry diseased *Prunus* spp. – Phytopathology 65: 1181–1186.

ROBERTS D. A., CHRISTIE R. G. & ARCHERS M. C. 1970. Infection of apical initials in tobacco shoot meristems by tobacco ringspot virus. – Virology 42: 217–220.

SCHLÖSSER U. G. 1982. List of Strains. – Ber. Dtsch. Bot. Ges. 95: 181–276.

STEFANAC Z. & LJUBESIC N. 1971. Inclusion bodies in cells infected with radish mosaic virus. – J. gen. Virol. 13: 51–57.

URL W. 1955. Resistenz von Desmidiaceen gegen Schwermetallsalze. – Sitzungsber. Österr. Akad. Wiss. math.-nat. Kl. Abt. I, 164: 207–230.

— 1959. Vergleichende Untersuchungen über die Resistenz pflanzlicher Plasmen gegen Natriumkarbonat. – Protoplasma 51: 338–370.

— 1967. Das endoplasmatische Retikulum von Desmidiaceen im Phasenkontrast. – Protoplasma 64, 26–48.

— 1978. *Closterium lunula (Desmidiaceae)* – Elemente des endoplasmatischen Retikulums in zentrifugierten Zellen. – Publ. zu wiss. Filmen Sekt. Biologie, Serie 11, Nr. 34, 1–11 (Film E 2378, Göttingen).