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The genus *Ecdysichlamys (Chlorellales)*

Rod *Ecdysichlamys (Chlorellales)*

Jiří Komárek and Augusto Comas

Komárek J.[1]) et Comas A.[2]) (1984): The genus *Ecdysichlamys (Chlorellales)*. — Preslia, Praha, 56 : 13—28.

Using the method of numerical taxonomy with scaled features, 9 populations of unicellular green algae belonging to the genus *Ecdysichlamys* G. S. West 1912 were evaluated according to their morphology. Most of them were determined previously (with the exception of the type-species, *E. obliqua*) as *Oocystis*-species (mainly *O. asymmetrica*) or described as special taxa of this genus (*O. alpina*, *O. minuta*, *O. polymorpha*). For the present study, the authors have studied one natural population and two strains of two different species. Other populations were evaluated on the basis of published descriptions. The generic definition of *Ecdysichlamys* has been completed and revised, and discussed with respect to the genera *Oocystis* and *Scotiellopsis*, which have similarly shaped vegetative cells. The numerical evaluation yielded 5 species and one variety, namely *E. alpina*, *E. minuta* (with var. *vacuolata*), *E. periphytica*, *E. obliqua* (type-species), and *E. polymorpha*.

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INTRODUCTION

The genus *Ecdysichlamys* was described by G. S. West (1912) from wet soil in Angola (near Mossamedes), SW Africa, with one species, *E. obliqua*. The description of this genus (translated from Brunnthaler 1915) is as follows:

"Cells long-ellipsoidal with two pointed poles, at one side slightly convex, at the other almost semicircular, the ends with one small tooth. Chloroplast parietal, one, large, with one (rarely two) pyrenoids and with many small granules. Nucleus mostly laterally situated. Cell wall thick, slightly layered, the outer layers more or less irregularly diffluent. Cells located in a large mucilaginous colony, lying on the substrate. Reproduction by longitudinal and perpendicular division into 2—4 autospores."

The original description was completed by the unambiguous illustrations (Fig. 11).

E. obliqua had not been found later and the genus *Ecdysichlamys* was considered doubtful. Bourrelly (1972) supposes, e.g., generic identity with *Oocystis*. In 1964, we found the same alga in San Diego de los Baños in Cuba. The cells grew subaerophytically, making a layer over the effluent tube from the mineral springs and over the surrounding stones (Fig. 12). This material corresponded well with G. S. West's original description. The only difference is the "apical teeth"; in our material apical teeth-like thickenings of the cell wall occur, corresponding, however, quite with the West's iconotype (comp. Figs. 11 and 12).

We had the opportunity to study this alga in natural material (Komárek 1983) and in a culture (strain Komárek 1964/4). The preserved material has

been deposited in the collection of the Institute of Botany of the Cuban Academy of Sciences in Havana, the strain mentioned was deposited in the Collection of autotrophic organisms of the Czechoslovak Academy of Sciences in Prague, but later, during the restrictions of this collection, was eliminated. Further, we had at our disposal other similar material from an artificial reservoir Carlos Manuel de Cespedes, prov. Stgo. de Cuba/Oriente, Cuba, isolated in 1979 by HINDÁK (unpubl., strain Hindák 1979/351). This strain was determined as a blue-green alga *Synechococcus* sp. (in fact it contained *Synechocystis* sp. and *Phormidium* sp.) and was heavily contamined by the green, unicellular, *Ecdysichlamys*-like alga (Fig. 10). We had transferred this alga into the monospecific culture, which is now deposited in the collection of algal strains in the Department of Taxonomy of the Institute of Botany of the Cuban Academy of Sciences (strain Hindák 1979/351b,.

In spite of the fact that the genus *Ecdysichlamys* was not found again later on, further data and descriptions of algae corresponding to its generic diagnosis occur in the literature. The common features of algae mentioned were as follows: The more or less asymmetrical, ovoid or ellipsoidal cells, wart-like cell-wall thickenings at one or both poles, autospores closed in the mother cell walls for a part of life, and mother cell walls not distinctly widened round the cells. The algae were mostly isolated from soils and it seemed that it was easy to cultivate them. For example, L. MOEWUS (1953) described and drew a similar alga from the soils in Australia (New South Wales) under the name *Oocystis asymmetrica* W. WEST (Fig. 13) and unified it with the earlier found Australian alga, which had been published by PLAYFAIR (1916) and called *O. apiculata* var. *asymmetrica* (W. WEST) PLAYF. 1916. REISIGL (1964) described a species *Oocystis alpina* from the soils in the alpine zone of the Austrian Alps, habitually similar to the vegetative cells of *Ecdysichlamys* (Fig. 6). Two other similar algae were described from cultures, both as belonging to *Oocystis: O. polymorpha* GROOVER et BOLD (1968) and *O. minuta* GUILLARD et al. (1975). From them, the second species was re-discovered later by S. WATANABE (1978) in Japanese soils (Fig. 7), as well as a new variety of this species, var. *vacuolata*, which is characterized by the vacuolised cells (Fig. 9). In 1975, KOMÁROMY (1975a, 1975b) published under the name *Oocystis asymmetrica* another similar alga from Hungarian soils (Fig. 8).

It follows from the given data that all the findings mentioned were described as new species of the genus *Oocystis*, or were classified as *O. asymmetrica* W. WEST and *O. apiculata* var. *asymmetrica* (W. WEST) PLAYF., respectively. However, *O. asymmetrica* was described originally from the freshwater biotopes in Europe (England) and it differs from the described specimens by contrasting ecology, by larger cell dimensions (with the exception of *O. polymorpha*, where the cells are up to 21 μm long and 10.5 μm wide) and particularly by the shape of chloroplasts (many small discoid chloroplasts without pyrenoids). All mentioned *Ecdysichlamys*-like algae contain in the vegetative stage only one ± parietal chloroplast with a distinct pyrenoid. According to PRINTZ (1913) the type material of *O. asymmetrica* as well as of *O. apiculata* belong to the species *O. solitaria*, growing in moors and in slightly acidic waters with a great amount of water plants. ROBINSON & WHITE (1972), who studied "*Oocystis apiculata*"-cells from cultures using the EM-method, found the very similar fine structure as is known in *O. solitaria* and supported this opinion. *O. apiculata* was later comprehended

differently (comp. KOMÁREK & FOTT 1983), but always as a typical *Oocystis*-species with widened mother cell walls. That is why we have been interested in the generic characteristics of these algae and in their interspecific taxonomic relations.

GENERIC DEFINITION AND DISCUSSION

The genus *Ecdysichlamys* G. S. WEST 1912 is characterized by the following diacritical features: Unicellular, coccal green algae with purely autosporine reproduction. The autospores often remain closed in the slightly widened or not widened mother cell wall, which is enlarged and slightly gelatinized due to growing autospores, but never forming the wide mucilaginous, slackened envelope, distant from the daughter cells. The cells are asymmetrical with the apical thickenings at one or at both poles, in the youth spindle-like, later asymmetrically ellipsoidal or ovoid. The development of one or two apical thickenings is dependent on the position of autospores in the mother cell, where the daughter protoplasts differentiate in an oblique position. This feature is particularly conspicuous in the case when two autospores develop (comp. Figs. 6d—e, 10k, 11e, 12q). The chloroplast is uniform in all the known populations, parietal, a little irregular in the outline, and showing one pyrenoid.

According to WEST's (1912) diagnosis, *E. obliqua* grows in "large mucilaginous colonies". This feature corresponds with our materials of *E. obliqua* and with that of our new species, *E. periphytica*. However, the mucilaginous character of colonies results from the slightly gelatinized layers of the cell wall; the distinct and limited gelatinous mass is never formed. Special mucilaginous envelopes around the cells are lacking or very scarce and diffluent, and visible (in light microscope) only when using special staining procedures.

Several other algae were described, characterized by the above-mentioned features. This group of taxa seems to be uniform from the morphological point of view, with diacritical features distinguishable from all the other genera of the family *Oocystaceae*. The valid generic name for such algae is *Ecdysichlamys* G. S. WEST Ann. S. Afr. Mus. 9 (2) : 77, fig. 1 : 18—29, 1912. This genus differs from the nearest *Oocystis* A. BR. 1855 (of which it has been often considered) by the following features:

a) Asymmetrical shape of cells (e.i., by the one more convex side) and sometimes also different morphology of the cell poles. The cell shape is determined by the shape of autospores, which appear in the genus *Oocystis* only inside the mother cell wall of asymmetrical form, while in *Ecdysichlamys* the asymmetry of cells remains during the entire life cycle.

b) The cell wall in *Ecdysichlamys* is never distinctly widened, but only in a few populations slightly gelatinized cell wall layers were found; in these cases it seems to be that the cell wall is slightly distant from the inner group of autospores. SCHWERTNER & al. (1972) studied *Oocystis polymorpha* GROOVER et BOLD (our *Ecdysichlamys polymorpha*) electron microscopically and found a different structure of cell walls (with sporopolenin) as is known in *Oocystis* (comp., e.g., ROBINSON & WHITE 1972, etc.).

c) *Ecdysichlamys* has also the different morphology of chloroplasts. The species of *Oocystis* have one or more chloroplasts with ± rounded margins (with or without pyrenoids), which possess the tendency to divide during

the life cycle into more parts; in the cells of *Ecdysichlamys* there is only one parietal, massive chloroplast, usually with distinctly and irregularly waved or lobed margin. It divides only during the differenciation of autospores. In all populations of *Ecdysichlamys* the distinct pyrenoid with starch sheath was found.

d) The species of *Ecdysichlamys* characteristically occur in soils and it is possible to transfer them easily in cultures (in contrast to *Oocystis*), but, of course, these attributes cannot be used for generic definition.

Another genus of chlorococcal algae, reminiscent of *Ecdysichlamys*, is *Scotiellopsis* VINATZER 1975 (comp. PUNČOCHÁŘOVÁ & KALINA 1981). A habitually similar species is, in particular, *S. terrestris* (REISIGL) PUNČOCH. et KALINA 1981. The basic diacritical feature between both the genera, which separates them also into the different families *Oocystaceae* and *Chlorellaceae*, is the structure of the cell walls. In *Ecdysichlamys* the cell wall structure was supposedly similar to that in *Oocystis* (composed of several cellulose layers) due to the slight lamellation of the cell walls and their slight tightness round the developing autospores. On the basis of this feature, *Ecdysichlamys* was also joined with *Oocystis*. However, SCHWERTNER & al. (1972) found in *Oocystis polymorpha* the sporopolenin-type of cell walls, as is known in *Scotiellopsis*-species. Cell walls of the sporopolenin-type is probably the typical feature for *Chlorellaceae* (comp. PUNČOCHÁŘOVÁ & KALINA 1981). Because the structure of the cell walls has not been studied yet by the electron microscope for other *Ecdysichlamys*-species (part. in *E. obliqua*), the relation of both these genera (*Ecdysichlamys* and *Scotiellopsis*) and also the definitive taxonomic position of different *Ecdysichlamys*-species remains obscure. The generic coincidence of several species of *Ecdysichlamys* (under our conception) and *Scotiellopsis* is also possible.

Table 1. — List of features, used to the numerical evaluation

Cytomorphological features:

1 cell asymmetry
2 ovoid cells (one apical thickening)
3 ellipsoid cells (two apical thickenings)
4 solitary cells
5 doublings of cells
6 groups of cells (without mother cell walls)
7 colonies (with mother cell walls)
8 2 autospores
9 4 autospores
10 8 autospores
11 16 autospores
12 mother cell walls joined tightly to the cells
13 slightly gelatinized mother cell walls
14 lamellated cell walls
15 presence of vacuoles in cells

Size groups:

Length (μm) — 6—7.9; 8—9.9; 10—11.9; 12—13.9; 14—15.9; 16—17.9; 18—19.9; 20—21.9; 22—23.9; 24.

Width (μm) — 2—3.9; 4—5.9; 6—7.9; 8—9.9; 10—11.9; 12—13.9; 14—15.9; 16—17.9; 18—19.9; 20.

Ecological characters:

36 aeric, subaeric
37 edaphon
38 periphyton
39 not in mountains
40 high mountains
41 temperate zone
42 tropics

Further two species resembling *Ecdysichlamys* were isolated from soil and periphyton from Cuba (*Characium vacuolatum* LEE et BOLD 1974 and *Chlorolobion guanense* COMAS 1980). Both these species do not correspond with the diagnoses of the genera *Characium* and *Chlorolobion* respectively, and were transferred recently into a special genus *Apodococcus* HIND. 1984. Because both the species were isolated to monospecific cultures, their taxonomical relations can be elucidated in future.

According to our results, completed generic description of the genus *Ecdysichlamys* G. S. WEST 1912 is as follows (comp. KOMÁREK & FOTT 1983): Cells rarely solitary, mainly growing in mucilaginous colonies with irregularly, densely arranged cells, sometimes covering the substrate by a green layer. Cells ovoid, spindle-like or widely ellipsoidal, mostly slightly irregular and asymmetrical with one side more convex, at one or both poles pointed or roundly pointed, and one or both with wart-like thickenings; in colonies, the cells occur little shifted and arranged in the same direction, mainly in an oblique position. Cell wall smooth, thick, slightly lamellated, the outer layers more or less irregularly diffluent. Morphologically limited mucilaginous envelopes lacking, rarely inconspicuous and diffluent mucilage present. Chloroplast one, parietal, large, mainly waved or lobed on the margin, with one (rarely with two) pyrenoids. Nucleus situated excentrically (laterally). Reproduction by 2—4—8—(16) autospores, enclosed for a long time in the mother cell wall or being liberated by the rupture and partly by the fine gelatinization of the mother cell wall. The mother cell walls are not widened but from tight envelopes round the daughter cells. The type species is *E. obliqua* G. S. WEST 1912, described from wet soils in Angola.

REVIEW OF THE SPECIES

Methods

Nine populations were evaluated corresponding with the generic definition of *Ecdysichlamys* according to their diagnoses or iconotypes. Two populations were studied from both the natural and cultured materials (B), or only from the culture respectively (C). The characteristics of other taxa were derived from the literature. The list of the algae evaluated is as follows:

A — Original description of the type-species, *Ecdysichlamys obliqua* G. S. WEST 1912, from the soil near Mossamedes, Angola.

B — The sample of *Ecdysichlamys obliqua* collected from the subaeric periphyton near the mineral spring in San Diego de los Baños, prov. Pinar del Rio, Cuba. The material was studied both in the natural population and transferred to a culture (strain KOMÁREK 1964/4); description see in KOMÁREK (1983).

C — The strain HINDÁK 1979/351b, isolated as a contaminant of the Cyanophycean strain HINDÁK 1979/351, coming from the periphyton of the artificial reservoir Carlos Manuel de Cespedes near Contramaestre, prov. Stgo. de Cuba/Oriente, Cuba.

D — Description of the species *Oocystis polymorpha* GROOVER et BOLD 1968, isolated as a contaminant of one strain of *Chlorella*, USA (Texas).

E — Description of *Oocystis asymmetrica* sensu KOMÁROMY (1975a, 1975b), found in the wet soil surface near a creek in Mátra mountains, Hungary.

F — Description of the species *Oocystis minuta* GUILLARD et al. 1975, based on material in culture, isolated from the soils in the USA, and of the second material of this species, described by S. WATANABE (1978) from soils in Japan.

G — Original description of *Oocytis minuta* var. *vacuolata* S. WATAN. 1978, given from soils in Japan.

H — Description of *O. asymmetrica* sensu L. MOEWUS (1953) from soils of New South Wales, Australia. Because the description of this alga is rather poor and from the figures it was

possible to derive only few further data, the evaluation of this material must be taken critically.

I — Original description of *Oocystis alpina* REISIGL 1964 from the alpine soils in Ötztal-Alpes, Austria.

The generic characteristics of all the above-mentioned algae seem to be uniform; however, the systematics of different species is unclear. Between

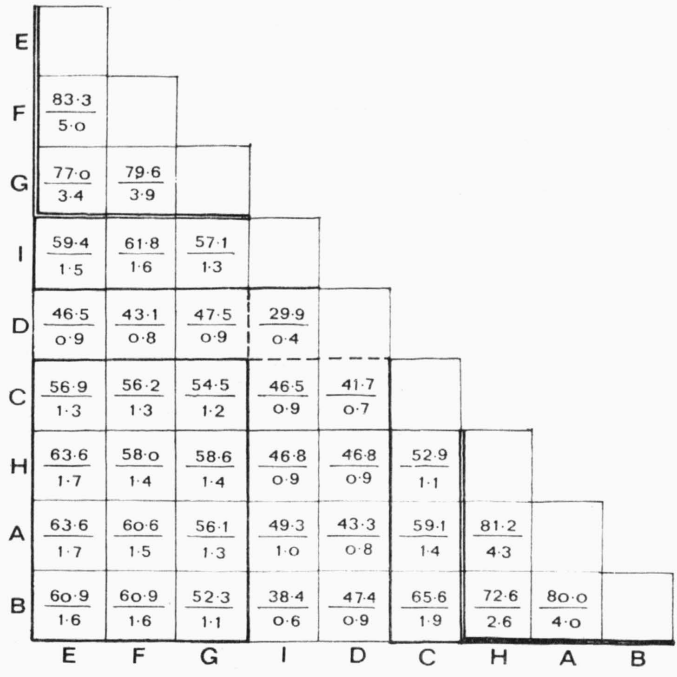

Fig. 1. — The % of similarity (upper number) and the ratio R (common features : differing features; lower number) between the populations evaluated.

all the populations there occur small differences and it was very difficult to fix the hierarchy of features among them. Therefore, we have used the phenotypic comparison using the numerical method (SNEATH & SOKAL 1973). As one of the main imperfections of this method is the conformity of all the features (comp., e.g. MCNEILL 1974, ADAMS 1975), we tried at least to scale the features with respect to their specificity, stability and uniformity.

We used 42 features in our evaluation (Table 1), from which 35 were of cytomorphological character and 7 features concern the ecological properties. The cell dimensions (length and width) were divided into 20 size groups. Main difficulties we found were especially in the lack of some data in the literary descriptions (particularly in *Oocystis asymmetrica* sensu L. MOEWUS). In such cases we have used the average value of the parallel evaluation of both possibilities. To the coding of frequency of the selected features we used the following criteria:

Absence of the feature 0
Facultative occurrence of the feature in less than 50 % of specimens 1
Facultative occurrence of the feature in more than 50 % of specimens 2
Obligatory occurrence of the feature 3

In the size groups the presence and absence in each of the groups was marked by the values 1 and 0, respectively. To clarify the differences between the different populations, the set of coded features was handled as follows:

a) The value of common features C_{ij}

$$C_{ij} = \sum_{k=1}^{K} \begin{cases} 1 \text{ for } x_{ik} = x_{jk} = 0 \\ \min (x_{ik}, x_{jk}) \text{ else} \end{cases}$$

b) The value of different features D_{ij}

$$D_{ij} = \sum_{k=1}^{K} |x_{ik} - x_{jk}|$$

where x_{ik}, x_{jk} denote the coded values of the k-th feature in the i-th and j-th populations compared, and K represents the total number of features.

In all the populations the differences between the taxa were studied by computing the following values:

(a) The ratio R of the value of common features (C) to the value of different ones (D), i.e.

$$R_{ij} = \frac{C_{ij}}{D_{ij}}$$

The values of features were described from the comparison of coded features, according to the above given scale, between all couples of populations i and j (OTUs).

(b) The % of similarity (I) was calculated according to the formula

$$I_{ij} = 100 \frac{C_{ij}}{C_{ij} + D_{ij}}$$

(c) Taxonomical distance (T) was counted according to the formula

$$T_{ij} = \frac{\sqrt{\sum (x_{ik} - x_{jk})^2}}{K}$$

where K denotes the number of all features. In the program used OTUL/Krakow the resultant values are subtracted from 1 ($1 - T_{ij}$) to obtain the data and phenograms comparable to that of the correlation coefficient (Figs. 3—4).

(d) Correlation coefficient (r) was calculated according to the formula

$$r_{ij} = \frac{\sum x_{ik} x_{jk} - \frac{\sum x_{ik} \sum x_{jk}}{K}}{\sqrt{\left[\sum x_{ik}^2 - \frac{(\sum x_{ik})^2}{K}\right] \left[\sum x_{jk}^2 - \frac{\sum x_{jk})^2}{K}\right]}}$$

For elaboration of data the program OTUL/Krakow was used, computed at the Institute of mathematics of the Cuban Academy of Sciences in Havana. The results are given in the Figs. 1—5.

Results and discussion

In spite of the lack of many characteristics in different populations, all the numerical procedures yielded similar results. From Figs. 1—5, it follows clearly that the largest taxonomical similarity is between the populations

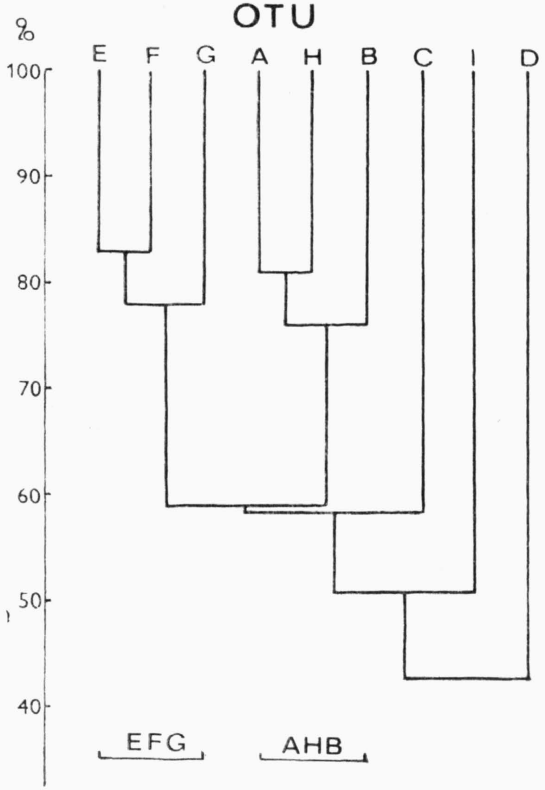

Fig. 2. — Dendrogram of the % of similarity between the populations (A—I).

A—B—H and E—F—G. The % of similarity between them varies about 80 %, both taxonomic distance and correlation coefficient are positive, and the correlation coefficient is greater than 0.2. The population A represents the type-species of the genus *Ecdysichlamys*, e.i. *E. obliqua* from Angola, and to this species it is possible to join two further collections, *E. obliqua* from Cuba (B) found and published by KOMÁREK (1983), and *Oocystis asymmetrica* sensu L. MOEWUS (1935) from Australia (H). However, this second material could not be arranged in this group without objections, because of the lack of data published about this alga.

The populations E—F—G contain only the soil algae from the temperate zone, namely *Oocystis minuta* GUILL. et al. 1975 from the USA together with the specimens from Japan (S. WATANABE 1978), *O. minuta* var. *vacuolata* S. WATAN. 1978, also from Japanese soils, and *Oocystis asymmetrica* sensu KOMÁROMY (1975a, 1975b) from Hungary. Altogether they probably re

present a special species, the correct name of which must be *Ecdysichlamys minuta* (GUILL. et al.) comb. nova. Because the var. *vacuolata* (G) differs from the type only by one qualitative feature (Fig. 5), which did not influence substantially the numerical evaluation (Figs. 1—4), it is possible to take it for a subspecific taxon in the sense of S. WATANABE. However, it must also be transferred into the genus *Ecdysichlamys*.

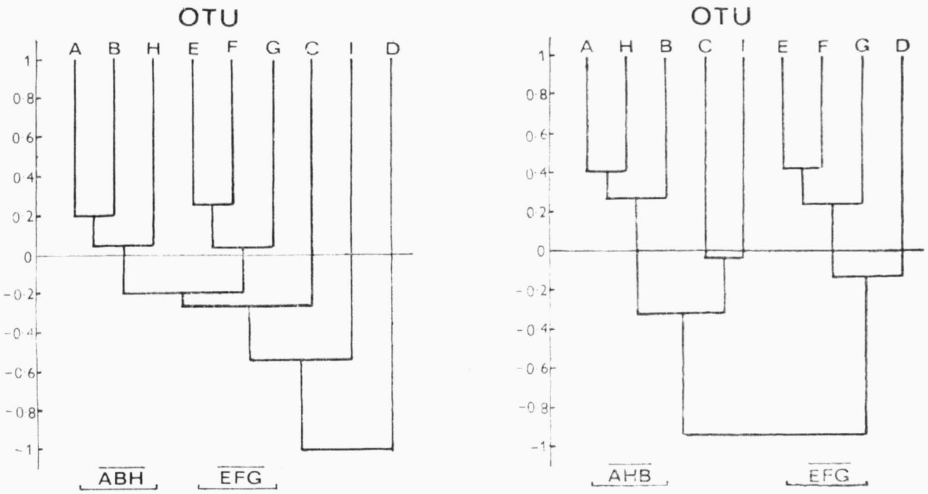

Fig. 3. — Dendrogram of the taxonomic distance between the populations (A—I).
Fig. 4. — Dendrogram of the correlation coefficient between the populations (A—I).

The last three populations (C, D, and I) have an isolated position and they must be taken for different species. The population C has a closer position to *E. obliqua* (ABH; Fig. 1), but the difference justifies its classification as a new species from the freshwaters of Cuba. It was not yet validly described and we name it therefore as *Ecdysichlamys periphytica* spec. nova. The alga D has the most isolated position (Figs. 1—3). However, the most important differences are in its larger cell dimensions found in culture, in which there always exists wider variability of different features than occur in nature. It was described originally as *Oocystis* and its valid name in the genus *Ecdysichlamys* is *E. polymorpha* (GROOVER et BOLD) comb. nova. The population I, described from the alpine soils in the Austrian Alps, represents a special species and is renamed as *Ecdysichlamys alpina* (REISIGL) comb. nova. To all the species we give a short description and add the determination key.

Descriptions of the species

1. *Ecdysichlamys alpina* (REISIGL) comb. nova (Fig. 6)

Basionym: *Oocystis alpina* REISIGL Österr. bot. Z. 111 : 402, 1964.

Cells solitary or in groups, mainly ovoid, when young slightly asymmetrical, with one apical, wart-like thickening at one end of the cell, without distinct

gelatinous envelopes, ± 12×7 µm. Chloroplast parietal with one pyrenoid, protoplast mainly with one large vacuole. Cell wall thick, firm, in old cells slightly striate. Reproduction by two autospores, which are obliquely situated in the mother cell.

Isolated from alpine soils (over 3000 m) in Ötztal-Alps, Austria.

2. *Ecdysichlamys minuta* (GUILL. et al.) comb. nova

Basionym: *Oocystis minuta* GUILL. et al. Phycologia 14 : 13, 1975.

Cells solitary or in groups, spindle-like, elliptical or (rarely, in old cells) oval, ± asymmetrical, at one or both poles obtuse pointed or with a small,

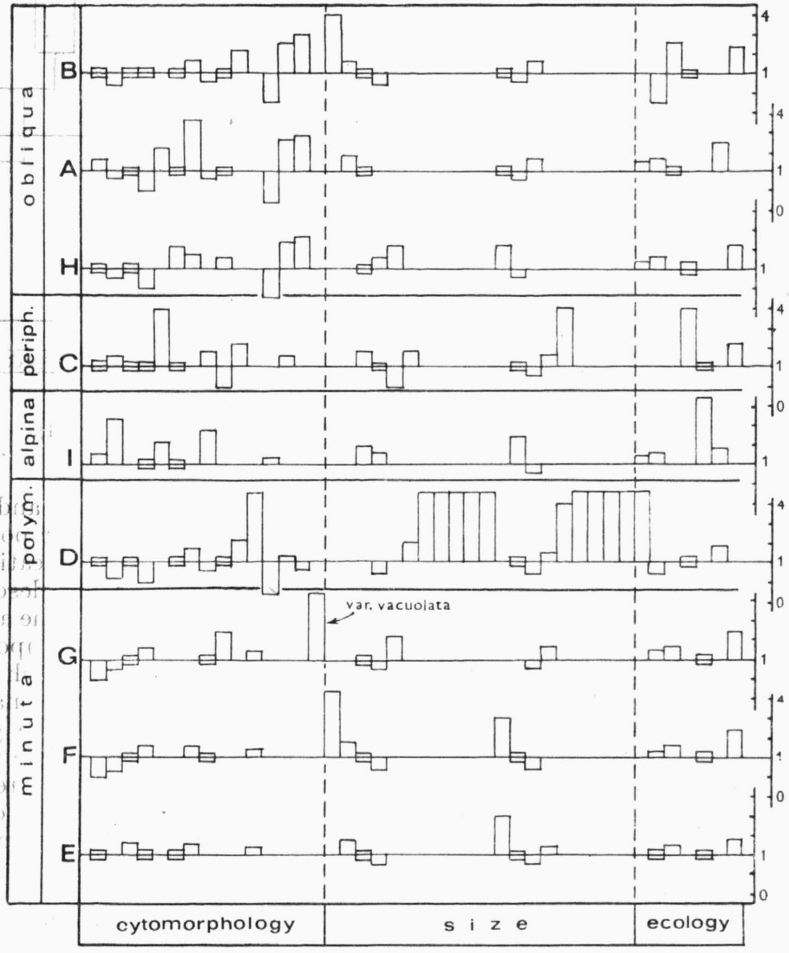

Fig. 5. — Comparison of the populations A—I according to the method of JENTYS-SZAFEROWA (1959). The histograms represent the ratios between (i) the middle values of 42 features in the different (single) populations, and (ii) the middle values of the same feature derived from all the populations evaluated.

wart-like thickenings, without distinct mucilaginous envelopes, 6—16× ×2—10 μm. Chloroplast one, parietal, with a waved margin, and with one pyrenoid. Reproduction by (2)—4—(8) autospores, ± tetrahedrally placed in the mother cell, and liberated by rupture of mother cell wall.

Var. *minuta* (Figs. 7, 8)

Syn.: *Oocystis asymmetrica* sensu KOMÁROMY Ann. Hist.-Nat. Mus. Nat. Hung. 67 : 19, 1975a; sec. KOMÁROMY 1975b.

Protoplast of the vegetative cells without many vacuoles, cells 6—14× ×2—10 μm.

Known from soils in the USA, Japan and Hungary; slightly halophile (?).

Var. *vacuolata* (S. WATAN.) comb. nova (Fig. 9)

Basionym: *Oocystis minuta* GUILL. et al. var. *vacuolata* S. WATAN. J. Jap. Bot. 53 : 15, 1978.

Protoplast of the vegetative cells vacuolised, cells 10—16×6—9 μm.

Isolated from soils in Japan.

3. *Ecdysichlamys periphytica* spec. nova (Figs. 10, 16)

Diagnosis: Cellulae solitariae vel in coloniis irregularibus aggregatae, elliptice fusiformes, rregulariter ovatae vel ellipticae, minute asymmetricae, ad polos oblonge acuminatae, 9—15.5×

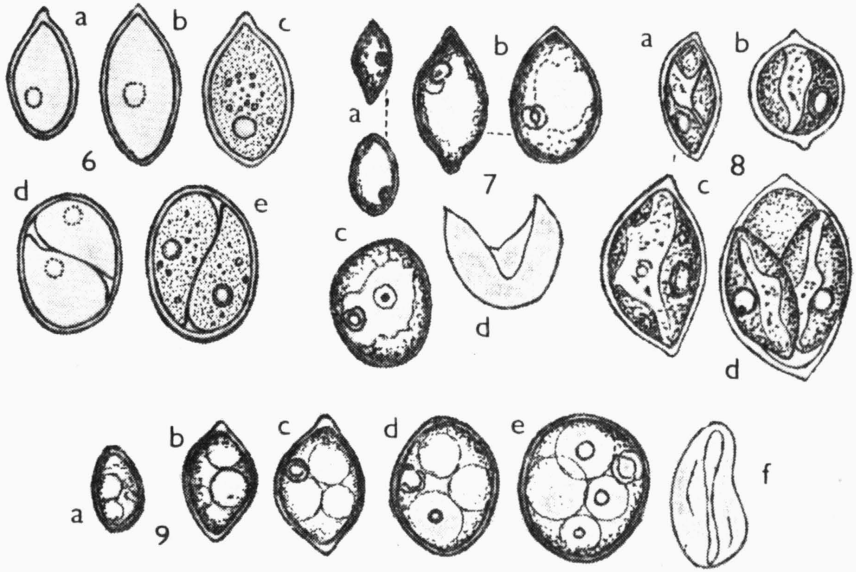

Fig. 6. — *Ecdysichlamys alpina* (REISIGL) comb. nova; **a**—**c** = solitary cells, **d**—**e** = autospore formation (according to REISIGL 1964).
Fig. 7. — *Ecdysichlamys minuta* (GUILL. et al.) comb. nova var. *minuta*; **a** = young cells, **b**—**c** = cells, **d** = mother cell wall (according to S. WATANABE 1978).
Fig. 8. — *Ecdysichlamys minuta* (GUILL. et al.) comb. nova var. *minuta*; **a**—**c** = cells, **d** = autospore formation (according to KOMÁROMY 1975).
Fig. 9. — *Ecdysichlamys minuta* (GUILL. et al.) comb. nova var. *vacuolata* (S. WATAN.) comb. nova; **a**—**e** = cells, **f** = mother cell wall (according to S. WATANABE 1978).

$\times 4-12$ µm. Membrana cellularum firma, hyalina, sine mucilagine, ad polo uno vel polos ambos leviter incrassata. Chloroplastum unum, parietale, plus minusve irregulariter alveiforme, cum pyrenoideo. Propagatio 2—8 autosporis, e cellula matricali ruptura membranae liberantur. — Habitatio: De periphyto lacus Carlos Manuel de Cespedes prope Contramaestre, Cuba, in cultura segregatur. — Iconotypus: figurae nostrae 10a, c—f, h—i, k—m.

Cells mainly solitary, a few in irregular groups (colonies), ovoid, spindle-like or widely ellipsoidal, ± asymmetrical with the apical wart-like thickenings at one or both poles of the cells, without distinct mucilaginous envelopes, $9-12-13.2(-15.5)\times 4-9.5-10.8(-12)$ µm. Chloroplast one, parietal, with a waved margin, and with one pyrenoid. Cell wall thick, firm. Reproduction by 2—(4—8) autospores, which are ± tetrahedrally situated in the mother cells, and liberated by the rupture of the mother cell wall.

Known only from cultures; isolated as a contaminant of a *Synechocystis*-strain, isolated from the water reservoir, prov. Stgo. de Cuba/Oriente, Cuba.

4. *Ecdysichlamys obliqua* G. S. West 1912 (Figs. 11—13, 15)

Syn.: ? *Oocystis asymmetrica* sensu L. Moewus Bot. Not. 153/4 : 411, Fig. 2, 1953.

Cells solitary, in groups or in colonies (closely enveloped by the mother cell wall), sometimes covering the substrate in a thin layer, ovoid, spindle-like

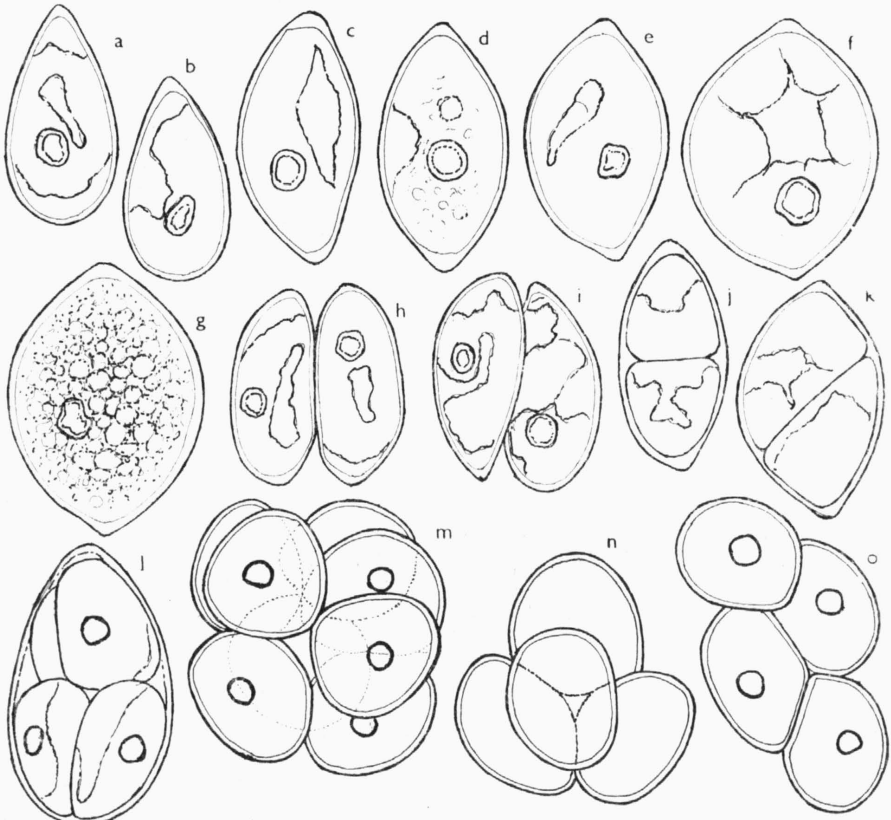

Fig. 10. — *Ecdysichlamys periphytica* spec. nova; **a**—**g** = solitary cells, h—**i** = doublings of young cells, **j**—**l** = autospore formation, **m**—**o** = groups of cells (orig.).

or ellipsoidal, ± asymmetrical, obtuse pointed on one or (mainly) both ends, usually with wart-like cell wall thickenings, with or without a very slight mucilage, (7—)8.7—14×(3.5—)5—10 μm. Chloroplast one, parietal with a waved margin, with one pyrenoid. Protoplast not vacuolised. Cell wall thick, firm, slightly lamellated in old cells, sometimes a little distant from the daughter cells. Reproduction by (2)—4—(8) autospores, ± tetrahedrally located in the mother cell, and liberated by the rupture of the cell wall.

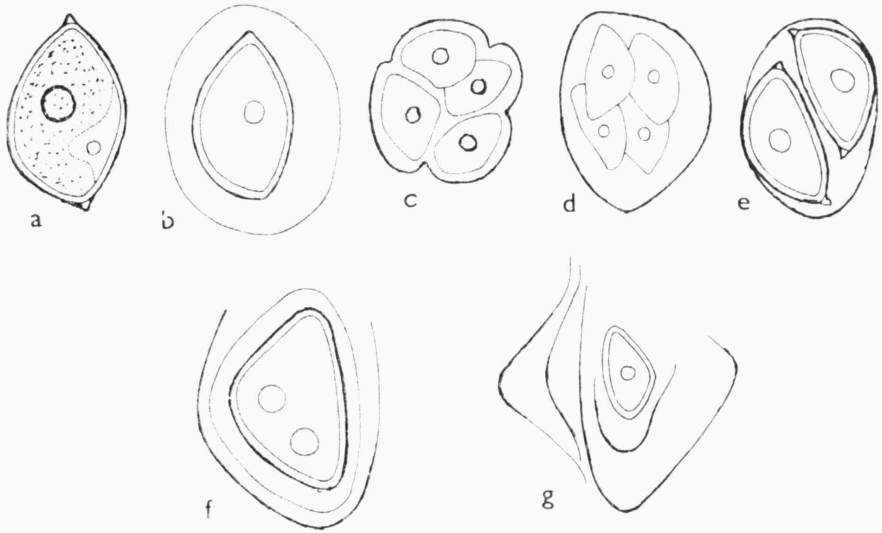

Fig. 11. — *Ecdysichlamys obliqua* G. S. West; **a** = cell, **b** = daughter cell in the mother cell wall, **c**—**e** = autospore formation, **f**—**g** = liberation of daughter cells from the lamellated mother cell wall (according to G. S. West 1912).

Grows on the surface of wet soil and rocks, known from Angola (near Mossamedes), Cuba (San Diego de los Baños) and (?) from the semi-desert soils in Australia (New South Wales, near Broken Hill).

5. *Ecdysichlamys polymorpha* (Groover et Bold) comb. nova (Fig. 14)

Basionym: *Oocystis polymorpha* Groover et Bold Southwest. Naturalist 13 : 129, 1968.

Cells solitary or agglomerated in groups and colonies, ovoid, spindle-like or ellipsoid-oval, ± asymmetrical, with wart-like thickenings at one or both poles of the cell, without distinct mucilaginous envelopes, 12—28×5.5 to 22 μm. Chloroplast one, parietal, with a waved margin, with one pyrenoid. Reproduction by 2—4—8—(16) autospores liberated by the rupture of the cell wall from the mother cell.

Known only from cultures; isolated as a contaminant of a *Chlorella*-strain, USA (Texas).

Key for the determination of species

1a Mother cell walls never widened, always tightly enveloping the daughter cells; cells mainly ovoid, rarely ± spindle-like or ellipsoid, a little asymmetrical or symmetrical, often only with one apical cell wall thickening 2

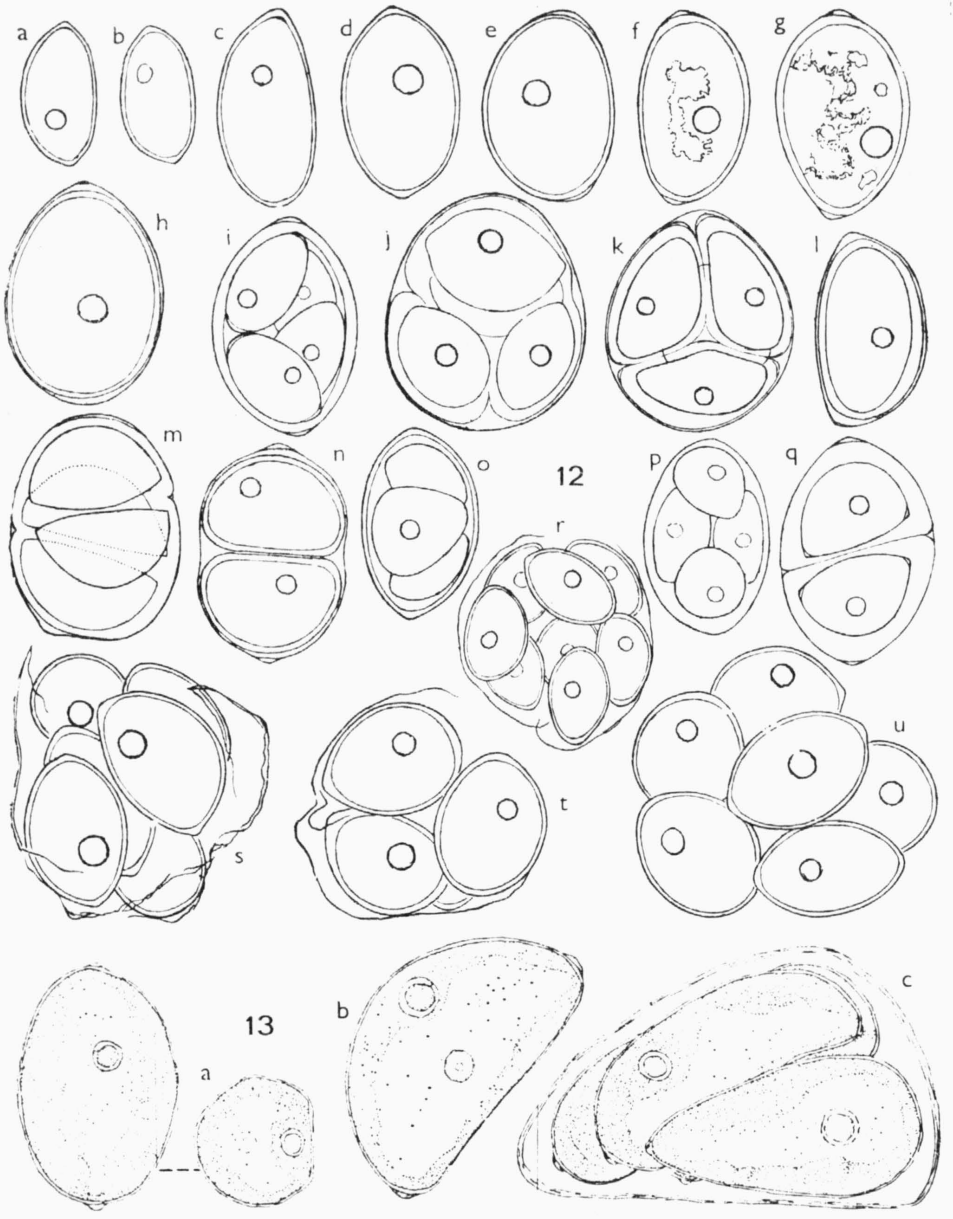

Fig. 12. — *Ecdysichlamys obliqua* G. S. West; **a**—**h** = variability of cells, **i**—**p** = formation, **r**—**t** = liberation of autospores from mother cells, **u** = group of young cells (according to Komárek 1983).
Fig. 13. — *Ecdysichlamys* cf. *obliqua* G. S. West; **a**—**b** = cells, **c** = autospore formation (according to L. Moewus 1953).

1b Mother cell walls joined to or slightly distant from the inside daughter cells; cells ± ellipsoid or oval, clearly asymmetrical with one more convex side; two apical thickenings are most common, one thickening occurs rarely 3
2a Two autospores, cells ± 12 × 7 μm; grows in soils in high mountains (Alps) . . 1. *E. alpina*
2b Two, four or eight autospores, cells 9—15.5 × 4—12 μm; grows in periphyton of water reservoirs in tropical areas (Cuba) . . . . . 3. *E. periphytica*
3a Cells up to 14(—16) μm long and up to 10 μm wide; up to 8 autospores 4
3b Cells 12—28 × 5.5—22 μm, 2—8—(16) autospores . . . . . 5. *E. polymorpha*
4a Vegetative cells ± ellipsoid, poles obtuse pointed, but mainly without visible thickenings; oblique position of autospores is very rare; the lamellation of cell walls not visible in the optical microscope 5
4b Vegetative cells ± oval with distinct apical thickenings; two autospores, situated obliquely inside of the mother cell are common; the lamellation of cell walls visible in high magnification in the optical microscope . . . . . 4. *E. obliqua*
5a Protoplast of cells without vacuoles . . . . . 2a. *E. minuta* var. *minuta*
5b Protoplast of cells vacuolised . . . . . 2b. *E. minuta* var. *vacuolata*

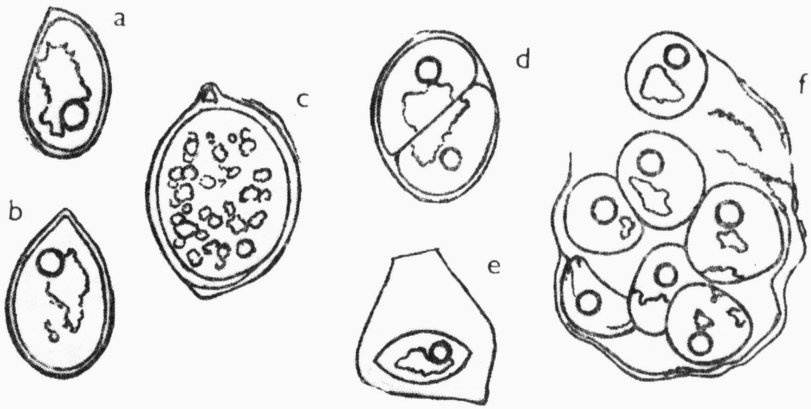

Fig. 14. — *Ecdysichlamys polymorpha* (Groover et Bold) comb. nova; **a**—**b** = cells, **c** = old cell, **d**—**f** = autospore formation (redrawn from the photos in Groover & Bold 1968).

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SOUHRN

Rod *Ecdysichlamys* G. S. West s jedním druhem *E. obliqua* byl popsán jako půdní řasa z Angoly v r. 1912. Byl řazen do čeledi *Oocystaceae*, od příbuzného r. *Oocystis* (se kterým byl někdy slučován) se však liší mírně asymetrickými buňkami, nerozšířenými mateřskými buněčnými stěnami kolem autospor a dceřiných buněk, vnitřní strukturou buněk a pravděpodobně i strukturou buněčných stěn. Podle našeho mínění je od r. *Oocystis* jednoznačně odlišitelný.

Podle uvedených kriterií patří do r. *Ecdysichlamys* ještě některé další řasy (většinou z půdních nebo aerických stanovišť), určované dosud jako různé druhy r. *Oocystis* (zejm. „*O. asymmetrica*"), nebo popisované jako nové druhy (*Oocystis alpina*, *O. minuta*, *O. polymorpha*). Autoři měli možnost prostudovat 1 přírodní populaci a 2 kmeny různých druhů tohoto rodu. K taxonomickému vyhodnocení použili numerickou metodu s odstupňovanou hodnotou znaků podle frekvence

jejich výskytu v populaci. Vedle 3 vlastních vzorků hodnotili ještě 6 dalších populací, popsaných pod různými jmény v literatuře a odpovídajících svými morfologickými znaky diagnose r. *Ecdysichlamys*.

Podle výsledků byla doplněna rodová diagnosa a diskutovány diferenční znaky od habituelně podobných rodů *Oocystis* a *Scotiellopsis*. Numerické vyhodnocení umožnilo přesněji definovat 5 druhů a jednu varietu, jmenovitě *E. alpina* (Reisigl) comb. nova, *E. minuta* (Guill. et al.) comb. nova (s var. *vacuolata*), *E. periphytica* spec. nova, *E. obliqua* G. S. West (typus) a *E. polymorpha* (Groover et Bold) comb. nova.

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See also plates I—II in the Appendix.

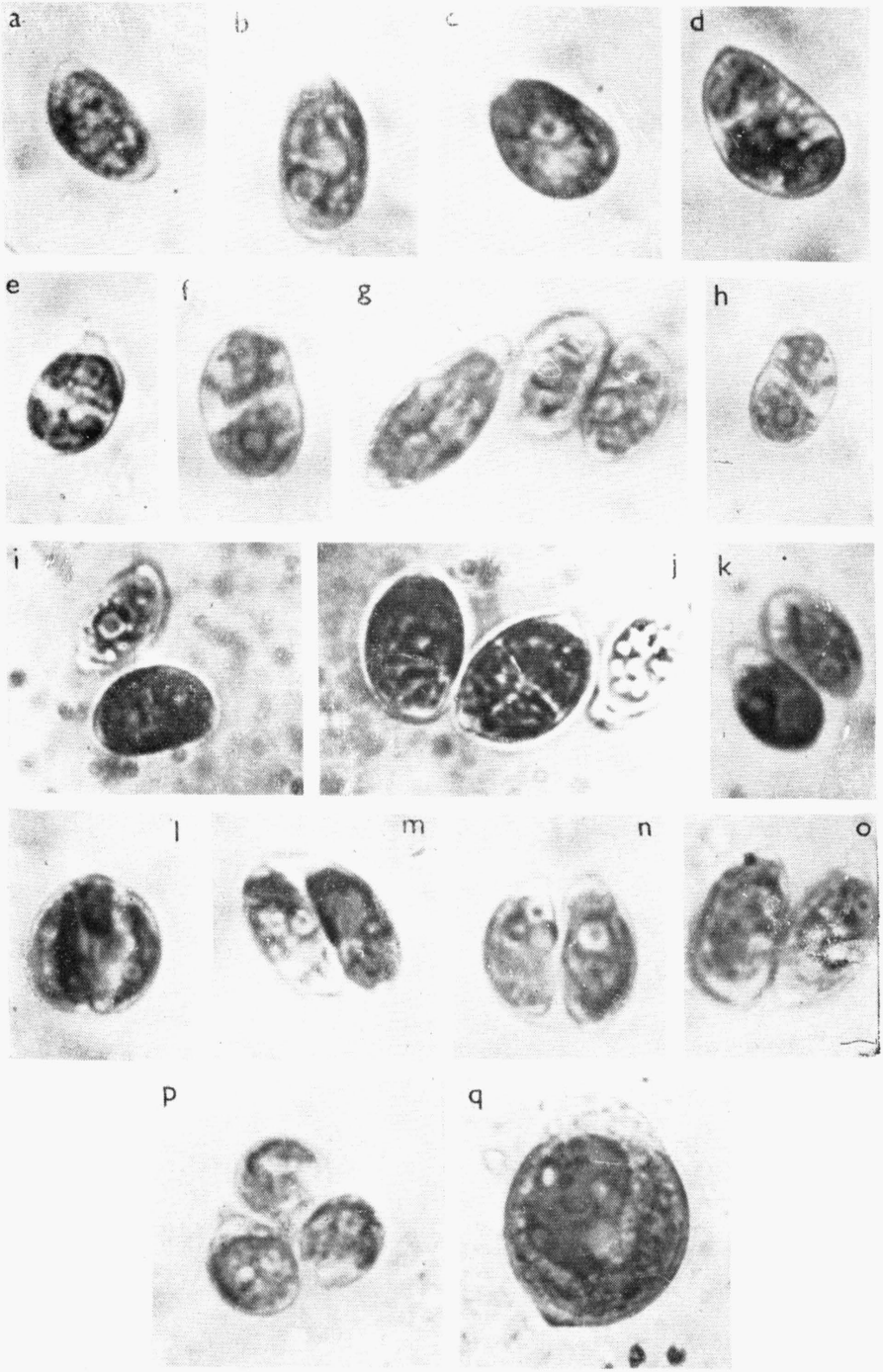

Fig. 16. — *Ecdysichlamys periphytica* spec. nova; specimens from cultures (photo Comas).

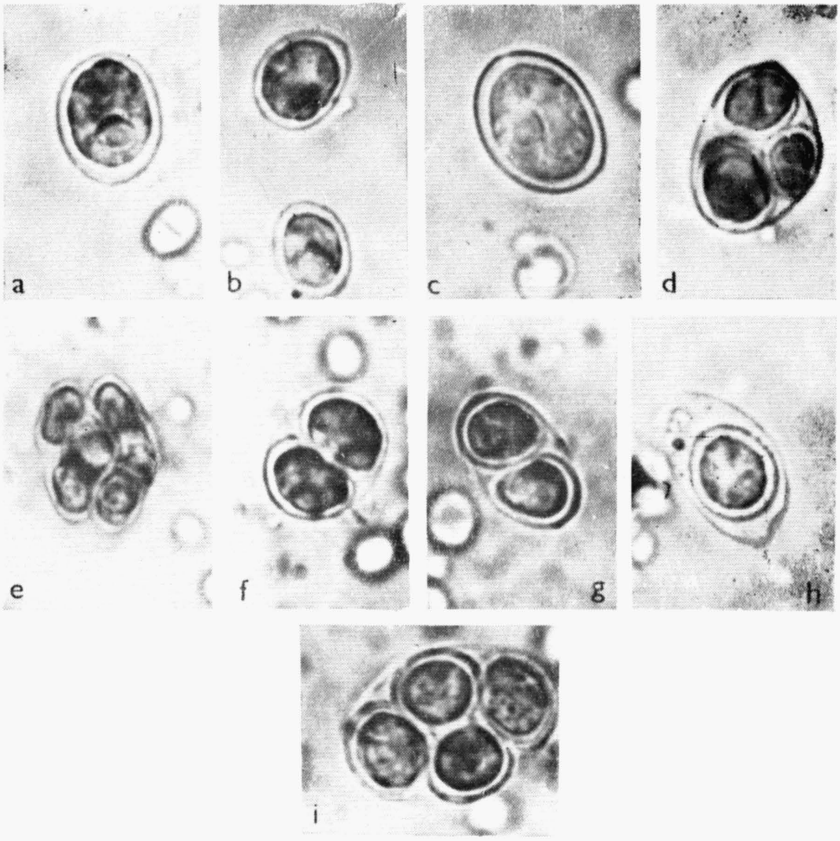

Fig. 15. — *Ecdysichlamys obliqua* G. S. WEST; natural material from San Diego de los Baños (photo COMAS).