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# DIAGNOSES OF NEW LICMOPHORAE

BY

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For over 3 years I have made of the genus *Licmophora* as well as of some allied genera, such as *Climacosphenia* and a very interesting new genus intermediate between *Licmophora* and *Climacosphenia*, the subject of a special study and it is my intention to publish a Monography of the family *Licmophoreae*, as soon as I shall find some Magazine or Academy which will accord the hospitality to my somewhat voluminous work.

The genus *Licmophora* has been hitherto very much neglected by the diatomists, as it can be seen from the fact that even with the comparatively little material in my possession I have been able to find over 40 new species and varieties, thus more than doubling the number of those already known. My rather long experience on this subject has brought me to the conviction that the genus *Licmophora* is probably a very large one; I have but little doubt that when it will be studied in all countries, especially in the tropical seas, as thoroughly as I have been able to do it in regard to the Mediterranean, the Black sea and the Californian coast, the species and varieties of this genus will by far exceed 100.

In the following pages I will give a short description or diagnosis of only 41 new forms, leaving some others, which require a further examination, to another occasion. At the end of this note the reader

will find an attempt at a natural classification of the Lilmophorae intended to replace the artificial system established by Grunow.

I take this opportunity to ask persons who are in possession of material containing Lilmophora or Climacosphenia to assist me in my Monography by sending slides or better even raw material, the latter, as far as possible, not dried up. I shall be glad to give in exchange slides or material from the Mediterranean, the Black sea, the sea of Azof, the Caspian sea, the Pacific ocean (California, recent as well as fossil), the Philippine Islands etc. Material containing Lilmophorae from the tropical and the arctic regions would be the most desirable, although especially favourable one from the North Sea and the Mediterranean (in fact from any locality) will be also wellcomed.

I have found and studied most of the known species, still there are some which I did not happen to meet with or which I would like to have from some new locality, as for instance: *L. anglica* (Kz.) Grun., *L. hyalina* (Kz.) Grun., *L. borealis* Kütz., *L. communis* (Heib.?) Grun., *L. cristallina* (Kz.) Grun., *L. Australis* (Kz.) Grun., *L. longissima* Leud. Fortm., *L. nubecula* (Kz.) Grun., *L. tincta* (Ag.) Grun., *L. Jurgensii* var. *finmarchica* Grun. and var. *chersonensis* Grun., *L. Kamtschatica* Grun. and the different varieties of *L. Lyngbyei*.

If any one possesses slides containing these (or any other) species I would kindly ask them to exchange their slides for other ones, or to lend me them for a short time: I engage to return them in a safe condition.

Material as well as slides should be sent to M.<sup>r</sup> Ed. Thum, 3, Johannisallee, Leipzig, Germany, who will forward them to me.

### 1. *L. adriatica* Mer. [fig. 1].

Valve broad, clavate, inflated at the upper third, abruptly attenuated in its middle part, with strongly concave margins, upper end slightly attenuated, with apex rounded or truncate, lower part narrow, inferior apex usually not inflated. Pseudoraphe indefinite, striae fine. Girdle face cuneate, moderately broad, walls of the frustule somewhat thick, upper angles rather acute. Septa superficial, strong,

straight, somewhat divergent near the upper margin, septal puncta quite marginal, secondary puncta <sup>(1)</sup> absent. Length 0.0256-0.074 mm., breadth of the girdle face 0.0143-0.0266 mm., breadth of the valve 0.0086-0.0119 mm. (average 0.0105 mm.).

Locality: Adriatic sea (Fiume), common.

Differs from *L. anglica*, which it resembles in its girdle face, by the strongly clavate form of the valves and their greater breadth. It is also nearly allied to *L. ovulum* Mer. wich, however, is smaller and has ovoid valves.

### 2. *L. araphidiea* Mer.

Valve narrow, cuneate, gradually tapering from the summit to the lower end, maximal breadth near the very upper end, which terminates in a short rostrum, lower end rounded. Pseudoraphe absent. Striae delicate but distinct, 12-14 in 0.01 mm. at the lower end, 13-15 in the middle, 15-17 near the upper end, parallel, strongly radiate at the summit. Septa not deep (about 0.014 mm.). Length 0.290-0.345 mm., breadth of the valve 0.020-0.030 mm., at the lower end 0.0086-0.0114 mm.

Locality: Sumatra! New Guinea (Tami Islands), rare.

Remarkable for the absence of a pseudoraphe, of which there is not the slightest trace.

### 3. *L. biplacata* Mer. [fig. 2].

Valve moderately broad, elongated ovoid, gradually attenuated towards the inferior end, with straight margins, superior apex rounded, inferior acute. Pseudoraphe and striae very fine. Girdle face cuneate, narrow, with inferior apex broad and superior angles acute. Septa superficial (?). Endochrome composed of two elongated plates resting on each of the valves, with a large elaeoplast belonging

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<sup>(1)</sup> I call «secondary puncta» the (usually two) puncta situated between the septa at the upper margin of the frustule.

to each of them. Stipes very short, flattened, structurless. Individuals isolated, rarely united in pairs. Length 0.0041-0.0076 mm., breadth of the girdle face 0.0019 mm., breadth of the valve about 0.00152 mm.

Locality: Mediterranean (Villefranche), common (occasionally).

This is the smallest of all species, the largest being *L. Crozierii* Grun., which attains, according to Grunow, 0.8 mm., a difference between both of 1 to 100!

#### 4. *L. capitata* Mer.

Valve clavate, with the upper portion strongly inflated, abruptly attenuated near the upper quarter, terminating in a long and very narrow lower part; upper end attenuated and somewhat rostrate. Striae very fine. Girdle face very delicate, outlines thin, very narrowly cuneate, upper angles slightly rounded. Septa very thin, straight, superficial, septal puncta very small, quite marginal. Forming small colonies of 2 to 4 individuals on short, dichotomously divided stipes; stipes composed of a central darker axial part and a thick hyaline outer layer. Length 0.037-0.040 mm., breadth of the girdle face 0.0062-0.00665 mm., breadth of the valve 0.0057 mm.

Locality: Adriatic (Pola), rare.

This species resembles *L. hastata* var. *clavata* Mer., differing mainly by the quite marginal septa, it is also smaller and much more delicate.

#### 5. *L. dalmatica* var. *parva* Mer.

Valve of medium breadth, very gently attenuated towards the lower end, which is more or less acute, not protracted, margins straight, upper end broadly rounded, usually somewhat attenuated. Striae very fine. Girdle face rather broad, cuneate, upper angles broadly rounded, upper margin convex. Septa shallow, their length 0.0019-0.00427 mm., gently arcuate, thin, becoming stronger near the septal puncta; the latter small but very distinct, round, secondary puncta large. Forming numerous colonies on long stipes of the type of *L. paradoxa*, i. e., composed of two layers, the outer thick

and more tender, the inner thin and compact. Ramification consists of alternately very short and long branches bent in opposite directions. Length 0.034-0.048 mm., breadth of the girdle face 0.023-0.035 mm., breadth of the valve about 0.0095 mm.

Locality: Adriatic (Pola), not rare.

The valve has the same shape as in *L. dalmatica*, being relatively broader, but the girdle face is somewhat different: the septal puncta are distinct and round while in the type species they are indistinct and elongated; the size is much smaller and the mode of ramification is not regular and symmetric as it always is in *L. dalmatica*. Varietas *tenella* has much more delicate outlines, the septa are less profound (0.00114-0.00143 mm.), the valve and girdle face narrower and the former with somewhat concave margins.

#### 6. *L. dubia* var. *adriatica* Mer.

Valve narrow, very slightly and gradually attenuated from the summit to the lower end, sometimes somewhat abruptly attenuated in the middle part, superior apex broadly rounded, inferior slightly inflated. Pseudoraphe distinct, striae very fine, 24-25 (or more) in 0.01 mm. Girdle face narrow or very narrow, cuneate, often linear at the upper part, with coarse outlines, upper angles slightly rounded. Septa thin, straight, quite superficial, septal puncta small, strongly marginal. Endochrome granular. Forming small, tufted colonies on short irregularly branched stipes, sometimes more elongated, with ramification irregularly dichotomic; stipes structurless. Length 0.056-0.128 mm., breadth of the girdle face 0.0095-0.020 mm., breadth of the valve 0.0057-0.0105 mm.

Locality: Adriatic (Pola), common.

Much larger than the type species, which varies between 0.036 and 0.0665 mm.

#### 7. *L. dubia* var. *latior* Mer. [fig. 3].

Valve rather broad, cuneate or elongated ovoid, slightly and gradually attenuated from the summit to the inferior apex, which is

broad and rounded, superior apex broadly rounded, margins straight. Pseudoraphe indefinite, striae very fine, not less than 24-25 in 0.01 mm. Girdle face narrow, cuneate, with rather delicate margins, upper angles rounded. Septa superficial, very thin, straight, septal puncta small, strongly marginal. Endochrome granular. Length 0.0295-0.039 mm., breadth of the girdle face 0.0073-0.0119 mm., breadth of the valve 0.0095-0.0105 mm.

Locality: California (Catalina Island near San Pedro), on *Macrocystis*, rather common.

Differs from the type species, into which it gradually passes, by the broader valves and the more delicate appearance of the frustule. Some of the valves are of the same form as in *L. pontica*, but the latter is much more robust and the girdle face is quite different.

#### 8. *L. Ehrenbergii* var. **fungoides** Mer. [fig. 5].

Valve very broad, of the shape of a mushroom, composed of two parts: the upper, very broad, conical, with rounded apex, very abruptly and sharply attenuated, passing into the lower part corresponding to the stalk of the mushroom, this latter broadly linear, becoming conical near the inferior end, which is slightly produced and somewhat acute. Pseudoraphe broad, striae very robust, radiate near the superior apex, 7 in 0.01 mm. at the lower end, 7-8 in the middle and 8-9 at the summit. Septa very shallow. Length 0.110-0.124 mm., breadth of the upper part of the valve 0.039-0.0427 mm., of the lower part 0.020-0.0256 mm.

Locality: Kertsch (Crimea), fossil (Sarmatische Stufe), not rare.

This curious form gradually passes on one side into var. *subconstricta* Mer., and on the other into var. *ovata* (f. *rhombica*).

The same fossil material from Kertsch contains a peculiar form of var. *ovata* characterised by a more rhombical form of the valves, with 7-8 striae in the middle which can be distinguished as var. *ovata* forma *rhombica*.

#### 9. *L. Ehrenbergii* var. **subconstricta** Mer. [fig. 6].

Valve broadly elongated, more or less constricted at the lower end, more rarely in the middle, gradually broadening from this point



towards the upper end which is slightly rostrate, then again slightly inflated at the lower part, inferior apex acute, often rostrate. Pseudoraphe broad, striae robust, usually 8 (8-10) in 0.01 mm. throughout. Septa not deep, 0.0057-0.0067 in length. Length 0.126-0.229 mm., breadth of the valve 0.013-0.038 mm., at the constriction 0.0095-0.022 mm., at the lower inflated part 0.0105-0.024 mm.

Locality: Adriatic (Triest, Fiume, Quarnero, Ancona), not very common! fossil: Kertsch, Crimea (Sarmatische Stufe), not very common.

This beautiful form is very variable in its outlines and gradually passes into var. *fungoides* and var. *ovata* on the one hand and into *L. angustata* Grun. on the other.

#### 10. *L. Ehrenbergii* var. *tenuistriata* Mer.

Valve of the same form as in the type species but the striae much finer and a little closer, 10 in 0.01 mm. throughout, puncta very indistinct. Septa not profound, c. 0.00665 mm. deep. Length about 0.119, breadth of the valve 0.024-0.0256 mm.

Locality: Samoa, rather rare! Hawaii, rare.

From New Guinea I know a form with still finer striae (10-11 in 0.01 mm.) and with valves resembling more those of forma *barbadensis* than of the genuine *L. Ehrenbergii*. Whether this is the same as var. *tenuistriata* of Samoa or a separate variety cannot be decided without further observations.

#### 11. *L. elegans* Mer. [fig. 4].

Valve broad, clavate, very gracefully shaped, abruptly attenuated in the middle or towards the lower  $\frac{1}{3}$ , gradually tapering from this point toward the inferior apex which is narrow, upper end slightly attenuated, with rounded summit. Pseudoraphe broad, striae very distinct but fine, with rather distinct puncta, 10 to 11.5 in 0.01 mm. in the middle part, radiant at the summit. Septa shallow, their length 0.0024-0.0038 mm. Length 0.0855-0.123 mm., breadth of the valve 0.020-0.0266 mm.

Locality: Adriatic (Quarnero)! Mediterranean (Genua), not very rare.

Differs from *L. Ehrenbergii* by the form of the valve and the finer striae. In this latter respect resembles the var. *tenuistriata* of *L. Ehrenbergii* which however has the same shape of valves as *L. Ehrenbergii*. *L. mediterranea* is smaller and has cuneate valves.

12. ***L. flabellata*** var. ***parva*** Mer.

Differs from the type species by its smaller size and the girdle face which is broader and cuneate.

					Length					0.061
					Breadth of the girdle face					0.019
0.065	0.065	0.068	0.078	0.079	0.0855	0.089	0.093	0.095	0.121	0.139
0.024	0.0295	X	0.018	0.023	0.0256	0.020	0.019	0.0295	X	0.019

breadth of the valve 0.00665-0.0076 mm.

Locality: California (San Pedro, Monterey), common! Sumatra, not rare.

It is not on single occasional small specimens that I have established this variety, but on whole gatherings where it predominates or where, as in one gathering from Monterey, it is to be found in an almost pure condition. The size of the type species varies from 0.111 to 0.415 mm. The largest forms (from Adria, Pola) surpassing 0.3 mm. can be distinguished as forma *major*.

13. ***L. gigantea*** Mer.

Valve slightly clavate, gradually attenuated from the summit to the lower end, with only slightly concave margins; superior apex rather broad, rounded, not attenuated, lower end narrow, with apex inflated (as in *L. flabellata*). Pseudoraphe distinct, striae fine, invisible with an ordinary magnifying power. Girdle face very narrow, with the upper part abruptly broadened and limited by parallel margins, lower part very narrowly cuneate, upper angles slightly rounded. Septa superficial, straight, septal puncta small, quite marginal, secondary puncta little developed. Endochrome granular. Length 0.277-0.323 mm., breadth of the girdle face 0.020-0.027 mm, breadth of the valve 0.024-0.0256 mm.

Locality: Adriatic (Pola), rare.

This species resembles at first sight *L. flabellata* but differs by the much broader valves, the peculiar form of the girdle face (in which respect *L. gigantea* resembles *L. remulus* Gr.) and the granular endochrome (*L. flabellata* has 4 plates).

14. **L. Grunowii** Mer. [fig. 7].

Valve rather narrow, gradually attenuated towards the lower end, with straight margins, upper end attenuated, with apex subrounded or acute, lower end somewhat acute. Pseudoraphe broad, striae very robust, parallel throughout, 8 in 0.01 mm. near the lower end, 8-9 in the middle. Girdle face rather broad with very thick robust outlines, upper angles acute; septa rather deep (0.0088 mm.), straight, very thick. Endochrome granular. Forming colonies sessil or on very short structurless stipes. Length 0.060-0.100 mm. (usually 0.075-0.085 mm), breadth of the girdle face 0.0266-0.050 mm., breadth of the valve 0.0114-0.0143 mm.

Locality: Black sea (Ialta, Sebastopol), very common! Mediterranean (Villefranche, Genua), rare! Sicily (Catania), common! Adriatic (Pola, Fiume), rare.

I do not find in the Synopsis of Van Heurck or elsewhere any species to which the above described could be referred. It is nearly allied to *L. Ehrenbergii* but the valves are quite different.

15. **L. Grunowii** var. **elongata** Mer. [fig. 8].

Differs from the type species by its larger size and comparatively narrower valves, with superior apex acute, sometimes somewhat rostrate. The girdle face is also narrower and the septa a little deeper (0.0114 mm.). Length 0.086-0.195 mm. (usually 0.124-0.143 mm.), breadth of the girdle face 0.042-0.0665 mm., breadth of the valve 0.0143-0.0166.

Locality: Black sea, Crimea (Goursouf, Theodosia), very common! Mediterranean (Neapel), rare! Hawaii, common.

In one of the gatherings from the Black sea (Goursouf) and in

Hawaii I have found this variety in a very pure condition, not mixed with the type, while in two others (Ialta, Crimea and Catania, Sicily) the type species is to be found almost pure (in Catania even quite pure), thus showing that both forms are distinct. This variety is connected by intermediate forms with *L. Ehrenbergii*.

In the specimens from Hawaii the striae are a little closer (9-10 in 0.01 mm. in the middle) than in those of the Black sea (8-9 in the middle). This fact as well as the above described var. *tenuistriata* of *L. Ehrenbergii* shows that the influence of climate (temperature) on the number of striae is not always in conformity with the theory advanced by Schumann and some others.

16. ***L. hastata*** Mer. [fig. 10].

Valve narrow, clavate, upper part rather abruptly broadened affecting the shape of the head of a spear, the summit conical, with acute apex, the lower part, corresponding to the spear-staff, very long and narrow, gradually tapering towards the inferior end which is acute. Pseudoraphe indefinite, striae very fine. Girdle face narrow, cuneate, with angles subacute. Septa not deep, 0.0024-0.0033 mm., very slightly arcuate, septal puncta small but very distinct, round. Endochrome granular. Forming small colonies, usually of 2 (to 4) individuals, often solitary, sessil or on very short stipes showing a darker axial part. Length 0.031-0.121 mm. (usually 0.057-0.067 mm.), breadth of the girdle face 0.0095-0.022 mm., breadth of the valve 0.0076-0.0114 mm. (average 0.00855 mm.).

Locality: Black sea! Mediterranean (Villefranche)! Adriatic (Pola)! California (San Pedro), rare. Frequent but scarce everywhere.

This species differs from *L. debilis* (Kütz.) Grun. only by the more or less rhombic, angular shape of the upper part of the valve which in *L. debilis* is rather lanceolate, limited by more rounded (not angular) outlines. This difference might appear to be a trifling one, still a very careful study of both forms has shown me that they are two distinct species, or at least varieties.

17. **L. hastata** var. **clavata** Mer. [fig. 11].

Valve strongly clavate, with upper part very inflated, in other respects not differing from the type species. Length 0.035-0.129 mm., breadth of the valve 0.0095-0.012 mm. (average 0.0114 mm.).

Locality: Black sea (Ialta, Crimea), common, mixed with the type.

This variety shows the characteristics of *L. hastata* developed in its extreme; it is connected with the latter by all intermediate forms. The strong inflation of the upper part of the valve gives to this *Licmophora* a very peculiar appearance.

18. **L. inflata** Mer. [fig. 12].

Valve narrow, clavate, with the upper half inflated, abruptly attenuated in the middle, becoming gradually very narrow, inferior apex acute, upper end attenuated, usually slightly produced, superior apex broad, truncate. Pseudoraphe and striae very fine. Girdle face very narrow, linear cuneate, sometimes cuneate, upper angles slightly rounded. Septa not profound (0.00256 mm.), thin, rather strongly bent near the superior apex of the frustule (as in *L. tenuis*), septal puncta small but distinct, round. Length 0.067-0.085 mm., breadth of the frustule 0.0076-0.013 mm., breadth of the valve 0.0065-0.0067 mm.

Locality: Black sea (Sebastopol), rare! Adriatic (Pola), rare.

This species is nearly allied to *L. debilis* from which it mainly differs by the broad truncate upper end of the valve which in *L. debilis* is narrow and acute; the girdle face is also narrower and the size larger and more uniform.

19. **L. inflata** var. **intermedia** Mer.

Valve variable as to the form, more or less attenuated towards the summit, superior apex truncate, rounded, rarely acute, becoming considerably but gradually narrower towards the lower end, which is very narrow, acute, margins straight. Pseudoraphe and striae very

fine. Girdle face cuneate, moderately broad, with rather rounded angles; septa not profound (0.00225 mm.), septal puncta small, distinct, round. Length 0.033-0.0427 mm., breadth of the frustule 0.0095-0.0162 mm., breadth of the valve 0.00427-0.0065 mm.

Locality: Sea of Azof (Guenitschesk), rather common! Black sea (Sebastopol), rare.

It is difficult, without entering in details and without figures, to explain the differences existing between this variety and its type. It is an intermediate form between *L. debilis* and *L. inflata*.

20. ***L. lata*** Mer. [fig. 13].

Valve broad, bottleshaped, upper part somewhat linear, or slightly attenuated to the summit, with parallel, sometimes convex margins, abruptly attenuated towards the lower third or fourth, becoming conical, lower apex narrow, rounded, upper broadly rounded.

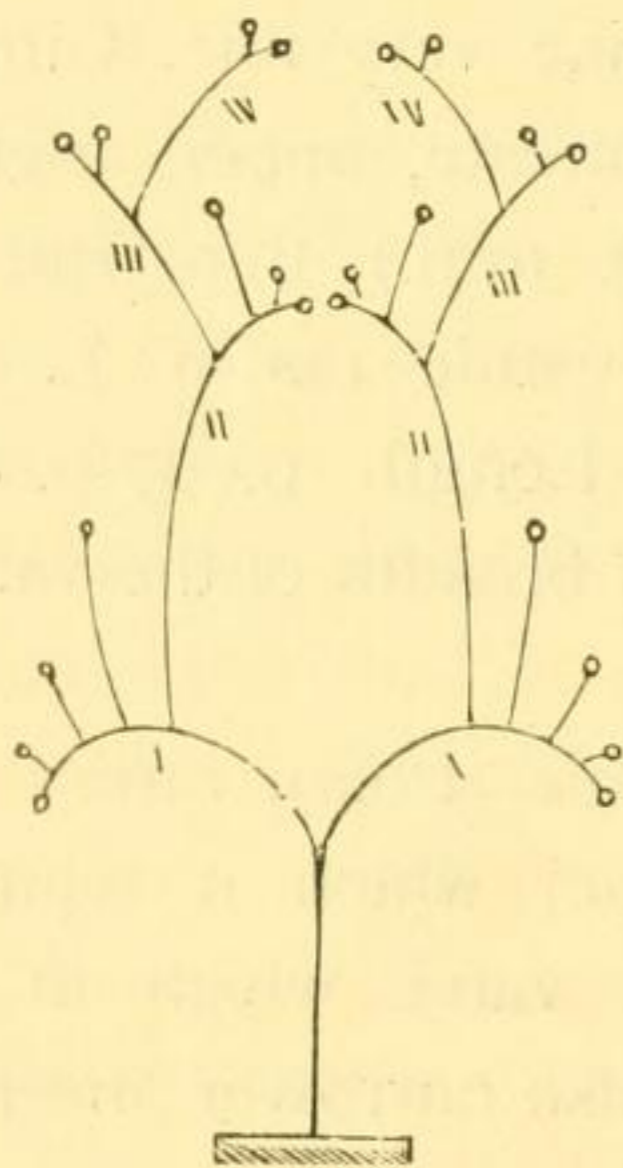


Diagram illustrating the low of ramification of the stalks in the groupe: *Paradoxae*.

Pseudoraphe rather broad, very distinct, striae very fine. Girdle face moderately broad, cuneate, upper angles subrounded, upper margin convex; septa very deep (0.0114 mm.), arcuate, septal puncta distinct, round. Endochrome granular. Forming numerous colonies on long stipes, composed of two layers an external and a thinner but denser inner one; mode of ramification the same as in *L. dalmatica*, *L. gracilis*, *L. paradoxa* (see diagram.). Length 0.052-0.073 mm., breadth of the frustule 0.0266-0.039 mm., breadth of the valve 0.013-0.019 mm.

Locality: California (San Pedro, very common, Monterey, common).

The structure of the stipes is the same as in the whole groupe to which this species belongs (*L. dalmatica*, *L. gracilis*, *L. paradoxa*, *L. communis*); the mode of ramification is a very peculiar and constant one.

21. *L. mediterranea* Mer. [fig. 14].

Valve broad, cuneate, with its maximal breadth near the upper end, gradually attenuated towards the inferior apex. Pseudoraphe rather broad, very distinct; striae distinct, not very coarse, composed of rather distinct elongated puncta, number of striae 11 in 0.01 mm. in the middle, 14 at the upper part, slightly radiate near the summit. Girdle face moderately broad, with upper angles rounded. Septa moderately deep (0.0057 mm.), strong, arcuate, septal puncta rather indistinct, secondary puncta large. Length 0.0635-0.073 mm., breadth of the girdle face 0.022-0.035 mm., breadth of the valve 0.014-0.017 mm.

Locality: Mediterranean (Villefranche), not rare.

The form of the valves differs but little from that of *L. Ehrenbergii*, but the size is smaller and the striae much finer and by far not so robust. The girdle face is quite different. The size is remarkably constant (compare the extremes in the size as shown by 17 measurements with those of *L. hastata* or *L. subundulata*).

22. *L. mediterranea* var. *adriatica* Mer. [fig. 15].

Differs from the type species by its somewhat larger and more variable size, by the greater breadth of the valves and their more rounded superior apex; the striae are a little coarser and more distant, being 10 in the middle, 10-12 at the summit; the septa are a little deeper (0.00665-0.00855 mm.) and less arcuate. Length 0.0655-0.108 mm., breadth of the girdle face 0.0275-0.032 mm., breadth of the valve 0.016-0.024 mm.

Locality: Adriatic (Ancona), rather common.

This form greatly resembles *L. mediterranea*, differing however by quite a number of particularities, which taken separately are insignificant but as a whole make it necessary to separate this form from the type species.

(Contin.)



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23. *L. membranacea* Mer.

Valve very narrow, gradually attenuated towards the lower end which is very narrow and rather acute, attenuated towards the upper end which is more or less rostrate. Pseudoraphe indefinite, striae very fine. Girdle face extremely delicate, narrow or very narrow, cuneate, sometimes linear in its upper part, with almost acute angles. Septa very shallow (0.0021-0.00226 mm.), very delicate, slightly arcuate, septal puncta very small. Endochrome composed of 4-6 irregularly lacinated transverse bands. Individuals solitary or forming small colonies of 2-4 (rarely more) frustules on very short structurless stipes. Length 0.021-0.055 mm. (usually 0.033-0.043 mm.), breadth of the frustule 0.0038-0.0012 mm., (usually 0.0057-0.0076 mm.) breadth of the valve 0.0033-0.0038 mm.

Locality: Black sea, Crimea (Ialta), common in certain places! Mediterranean (Villefranche), rare! Adriatic (Pola), rare.

The frustule is membranaceous and so delicate that with a somewhat low magnifying power it can scarcely be seen. This is the most delicate species of Licmophorae. The endochrome has a very peculiar appearance.

24. *L. Monksiaë* Mer. [fig. 16].

Valve broad in the middle, slightly attenuated towards the superior apex which is truncate, sometimes broadly rounded, more considerably attenuated towards the lower end, which is narrow; lower part forming an elongated cone, with usually straight margins. Striae fine, except at the lower end where they are distinct with an ordinary magnifying power, about 12-13 in 0.01 mm. Girdle face cup-shaped with more or less convex margins, upper angles rounded. Septa very deep (0.00665 mm.), very fine, almost straight and parallel, sometimes divergent above the septal puncta, the latter small, round, very distinct, secondary punta large, adjoining the septa. Endochrome granular. Forming small colonies on short structurless stipes or solitary Length 0.0162-0.041 mm. (usually 0.024-0.033 mm.), breadth

of the girdle face 0.0114-0.020 mm., breadth of the valve 0.00665-0.0076 mm.

Locality: California (San Pedro), common.

It is to Miss S. P. Monks of Los Angeles, who has assisted me in many ways in my work, that I dedicate this species. The girdle face has a very peculiar appearance not to be found in any other species; the position of the large secondary puncta is also a very peculiar character. It resembles in many respects *L. profundeseptata*.

25. **L. montereyana** Mer. [fig. 17].

Valve narrow, linear in its upper  $\frac{1}{2}$ , abruptly attenuated in the middle, becoming again linear and very narrow in the lower  $\frac{1}{4}$ , superior apex broadly rounded, inferior inflated. Pseudoraphe invisible, striae very fine, about 23 or more in 0.01 mm. Septa deep (0.0166 mm.). Length 0.113 mm. breadth of the valve 0.0076 mm.

Locality: California (Monterey), very rare.

The valve of this species has a form similar to that of *L. remuloides* Mer., but it is a very distinct species, the septa being deep and the lower apex of the valve inflated. It differs from *L. grandis* by the indefinite pseudoraphe which is very distinct in the latter, the valve is also different. It has no close relation to any other species.

26. **L. ovulum** Mer. [fig. 18].

Valve broad or very broad, ovoide, more or less abruptly attenuated at the lower end, superior apex broadly rounded, not attenuated (except in very large specimens), inferior apex narrow, rounded and somewhat produced. Pseudoraphe indefinite, striae very fine; about 24-25 in 0.01 mm. Girdle face rather broad, sometimes very broad, cuneate, upper angles rounded, inferior apex sometimes very broad and concave; frustule robust. Septa superficial, straight, septal puncta very large, somewhat deepened inwards, secondary puncta usually absent. Endochrome granular. Forming more or less numerous colonies on short, scanty and irregularly ramified stipes, with a con-

densed outer layer. Length 0.0143-0.058 mm. (usually 0.002-0.003 mm.), breadth of the girdle face 0.0114-0.023 mm., breadth of the valve 0.007-0.009 mm. (usually 0.008 mm.).

Locality: Atlantic coast of N. America (Atlantic City, New Jersey) <sup>(1)</sup>, very common! Black sea (Sebastopol), very rare.

Small but very robust and characteristic species. In small individuals the breadth of the frustule sometimes surpasses its length, and the lower end is in such cases very broad and sometimes (especially in specimens from the Black sea) excavated or concave—quite the opposite of *L. pontica*, where the inferior apex of the frustule is rounded.

### 27. *L. pacifica* Mer.

Valve broad, cuneate, ovoide in small individuals, gradually tapering from the summit which is broadly rounded towards the narrow and subacute inferior apex, margins straight. Pseudoraphe and striae distinct, the latter about 11-12 in 0.01 mm. Girdle face broadly cuneate, with upper angles rounded, outlines strong, inferior apex broad. Septa comparatively deep (0.005 mm.), moderately arcuate, septal puncta round, very distinct. Endochrome granular. Sessil form. Length 0.0266-0.0437 mm., breadth of the frustule 0.0266-0.034 mm., breadth of the valve 0.0081-0.0095 mm.

Locality: California (San Pedro), not rare.

This species has a certain resemblance to *L. Lyngbyei*, to which it seems to be allied. The valves of large specimens resemble somewhat those of *L. Jürgensii* var. *capensis* Grun., but the septa are much deeper, than in the latter.

### 28. *L. parasitica* Mer. [fig. 19].

Valve rather narrow, somewhat abruptly attenuated towards the lower end which is narrow, produced and with acute apex, upper

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<sup>(1)</sup> It is through the kindness of M.r Ch. Boyer of Philadelphia that I am in possession of a pure gathering of this species from Atlantic City (New Jersey),

part more or less linear, superior apex broad, truncate. Pseudoraphe indefinite, striae very fine. Girdle face narrowly cuneate, with upper angles slightly rounded, outlines very delicate. Septa shallow (0.0014-0.0019 mm.), gently arcuate, septal puncta very small. Endochrome granular. Sessile or on short, slightly ramified stalks, usually parasitic on frustules of *L. grandis*. Length 0.016-0.0285 mm., breadth of the frustule 0.00665-0.0095 mm., breadth of the valve 0.0029-0.0033 mm.

Locality: Mediterranean (Villefranche), rather common.

Differs from small individuals of *L. debilis* by the broad, truncate superior apex of the valves which in *L. debilis* is always attenuated and more or less acute; the frustules are also more delicate.

### 29. *L. permagna* Mer. [fig. 20].

Valve of medium breadth, bacilliform, very slightly and gradually attenuated from the summit to the lower end, with straight margins; superior apex strongly attenuated, with summit acute, inferior apex broad, rounded, not inflated. Pseudoraphe rather broad, very distinct, striae not very delicate, about 18-19 in 0.01 mm., parallel throughout, crossed by straight longitudinal lines. Septa very shallow, 0.0033-0.00665 mm. (average of 11 cases: 0.00453 mm.). Length 0.125-0.266 mm., breadth of the valve 0.0143-0.018 mm.

Locality: New Guinea (German possessions), rather common.

But for the acute superior apex and the longitudinal lines this species could be considered as nearly allied to *L. Jürgensii*. By the longitudinal lines it reminds *L. Jürgensii* var. *capensis* Grun.

### 30. *L. pontica* Mer. [fig. 21].

Valve of medium breadth, cuneate, very slightly attenuated from the summit to the base, with straight margins, lower end somewhat broad, rounded, sometimes slightly produced, superior apex broadly rounded. Striae very fine. Girdle face moderately broad, cuneate, with very thick margins, upper angles very rounded, lower apex somewhat broad, rounded; septa superficial, straight, septal puncta very

large, strongly marginal, secondary puncta absent. Endochrome granular (6-12 granules). Length 0.0214-0.0466 mm. (usually 0.033 mm.), breadth of the girdle face 0.013-0.019 mm., breadth of the valve 0.0072-0.0082 mm.

Locality: Black sea (Ialta, Theodosia in Crimea), rare.

This is the only species with rounded inferior apex of the frustule; it is intermediate between *L. ovulum* and *L. dubia* as the latter is intermediate between *L. pontica* and *L. Jürgensii*, these four species thus forming a continuous genealogical line without interruption.

### 31. *L. proboscidea* Mer. [fig. 22].

Valve narrow, clavate, abruptly attenuated in its superior part, terminating in a long, narrow proboscis or rostrum, gradually attenuated towards the very narrow and acute end lower margins straight or slightly concave. Striae very fine, 24 or more in 0.01 mm. Girdle face cuneate, rather narrow, with upper angles acute or subacute, margins thin; septa deep (0.0056 mm.), strongly arcuate and divergent towards the upper apex, septal puncta very small, round, distinct. Forming small colonies on short dichotomously ramified stipes which are composed of a darker axial part and a lighter external layer. Length 0.038-0.056 mm, breadth of the girdle face 0.0086-0.020 mm., breadth of the valve 0.00285-0.0048 mm.

Locality: Adriatic (Pola), not rare.

This species is rather variable in its characteristics; the rostrum is more or less narrow and more or less distinctly separated from the rest of the valve; the breadth of the frustule and the depth of the septa are also subject to variations. The shape of the valves is almost the same as in *L. rostrata* Mer., although both are very distinct species, their size, girdle face and striae being quite different. Has a great affinity with *L. semiasymmetrica* Mer.

32. *L. profundeseptata* Mer. [fig. 23].

Valve moderately broad, elongated ovoid, with somewhat convex margins, abruptly attenuated in the lower  $\frac{1}{4}$  which is produced, inferior apex narrow, superior broadly rounded. Pseudoraphe rather delicate, striae distinct with an ordinary magnifying power at the inferior  $\frac{1}{4}$  only, about 13-14 in 0.01 mm., becoming farther on invisible. Girdle face cuneate, moderately broad, with upper angles well rounded, margins moderately strong. Septa excessively deep (0.0105 mm.), almost straight and very thin below the septal puncta, divergent and stronger above them; septal puncta small, round, very distinct. Endochrome granular. Length 0.038-0.0475 mm., breadth of the girdle face 0.018-0.025 mm., breadth of the valve 0.00855 mm.

Locality: Mediterranean (Villefranche), very rare.

This species has the deepest septa known; in this respect as in many others it resembles *L. Monksiae* and can be considered as a mediterranean representative of a peculiar small groupe of Licmophorae-Profundeseptatae. The secondary septal puncta are not adjoining the septa as in *L. Monksiae*.

33. *L. quadriplacata* Mer. [fig. 24].

Valve very narrow, bacilliform or narrowly cuneate, rarely clavate, gradually attenuated towards the lower end, with straight or nearly straight margins, inferior apex very narrow, acute, superior part very slightly attenuated, superior apex broadly rounded or somewhat truncate. Pseudoraphe indefinite, striae very fine. Girdle face narrowly cuneate, with angles subacute; septa superficial, straight, very fine, septal puncta small, strongly marginal. Endochrome composed of four elongated plates resting by pairs on each of the valves, separated transversally, with margins extending on the girdle face. Forming small colonies of 1-4 not exceeding 14 individuals on moderately elongated, structurless stipes, with dichotomic ramification. Length 0.021-0.054 mm., breadth of the girdle face 0.0076-0.012 mm., breadth of the valve 0.00285-0.0048 mm.

Locality: Mediterranean (Villefranche), very common! Adriatic (Pola), common.

*L. flabellata* is also provided with four chromatophores but the plates are resting not on the valves, as here, but on the zonal face; they are also more rounded. In all other respects both species are very different.

#### 34. *L. redondina* Mer.

Valve very broad, elongated ovoid, upper part with convex, lower part with straight margins, slightly attenuated towards the summit, which is broad, rounded, slightly produced, gradually attenuated towards the lower end, which is almost acute. Pseudoraphe very broad (0.002 mm.), lanceolate, striae very robust,  $7\frac{1}{4}$  in 0.01 mm., with indistinct puncta, parallel, slightly radiate at the upper end. Length 0.135 mm., breadth of the valve 0.0475 mm.

Locality: Redondo (California), fossil, rare.

I have seen a single valve of this species, which is nearly akin to *L. Ehrenbergii* var. *ovata*; differs from the latter by the form of the valve, the somewhat more distant striae, and the broader and lanceolate pseudoraphe. Could be regarded as a variety of *Licm. Ehrenbergii*.

#### 35. *L. remuloides* Mer. [fig. 25].

Valve very narrow, composed of two distinct parts of almost equal length, upper part linear, with superior apex rounded, abruptly passing into the inferior part, which is much narrower, gradually tapering to the lower apex, the latter not inflated. Pseudoraphe fine, striae very fine. Girdle face very narrow, linear in its upper part, with angles subacute. Septa very shallow (0.0048 mm.) but not marginal, straight, very thin, septal puncta small, round, distinct. Length 0.126 mm., breadth of the upper linear part of the valve 0.007 mm.

Locality: Black sea (near Ialta, Crimea), very rare.

The valve has some resemblance with that of *L. montereyana*



Mer., but the girdle face is very different; the septa of the latter species are very deep, and the lower apex of the valve is inflated. They are not related to one another.

36. **L. rostrata** Mer. [fig. 26].

Valve narrow, cuneate, gradually attenuated towards the lower end, with usually straight margins, abruptly attenuated at the upper end forming a long narrow rostrum, inferior apex narrow, acute. Pseudoraphe distinct, striae usually distinct at an ordinary magnifying power, 13-14 in 0.01 mm. in the middle part. Girdle face narrow, linear in its upper  $\frac{1}{3}$  or  $\frac{1}{2}$  (sometimes even more), with angles subacute, margins rather strong, becoming thin at the upper part. Septa very deep (0.012 mm.), thin, moderately arcuate, parallel above the septal puncta, the latter round, very distinct. Endochrome granular. Length 0.073-0.116 mm., breadth of the girdle face 0.0105-0.019 mm., breadth of the valve 0.0048-0.0072 mm.

Locality: Black sea (Ialta, Sebastopol), common! Mediterranean (Villefranche), not rare! Adriatic (Pola, Ancona), rather rare! California (San Pedro), rare (type?).

The form of the valve is nearly the same as in *L. proboscidea* Mer., but the latter is much more delicate, its size smaller, the striae much finer, the girdle face cuneate. Nevertheless there can be but little doubt that this species has originated directly from *L. rostrata*.

37. **L. semiasymmetrica** Mer. [fig. 27].

Valve narrow, clavate, partly symmetrical, partly more or less asymmetrical, inflated in the upper third, somewhat abruptly attenuated in the middle or below, slightly attenuated towards the superior end which is broader than the inferior and more or less produced with apex rounded, lower end narrow; in the asymmetrical type the valve is more or less arcuate, abruptly attenuated in its middle part on one side (the concave one) only. Pseudoraphe indefinite, striae very fine. Girdle face narrow, cuneate, with upper an-

gles slightly rounded, outlines delicate; septa deep (0.0033 mm.), thin, faintly arcuate, septal puncta small, round, very distinct. Endochrome granular. Length 0.025-0.053 mm., breadth of the girdle face 0.0076-0.017 mm., breadth of the valve 0.0043-0.0055 mm.

Locality: Black sea (Goursouf, Crimea, rather common)! Mediterranean (Villefranche), rare.

This curious species has valves partly symmetrical, partly asymmetrical, both types being about of the same frequency. It is certainly nearly related to *L. proboscidea* Mer., but the valves of the latter are never asymmetrical, the proboscis or rostrum is usually much more distinct, the septa in the average are deeper.

### 38. *L. spicula* Mer. [fig. 28].

Valve extremely narrow, spicula like, slightly attenuated from the upper third to the summit which is rounded, upper part somewhat produced; gradually attenuated towards the inferior apex, the latter acute. Striae very fine. Girdle face narrow, cuneate, with upper angles subacute, outlines delicate; septa deep (0.052 mm.), very thin, becoming stronger above the septal puncta, where they are but very slightly divergent, septal puncta very small. Forming small colonies of from 2 to 8 individuals on short dichotomously divided stipes, composed of two layers, the inner being thinner but denser than the outer. Length 0.038-0.0466 mm., breadth of the girdle face 0.0067-0.0076 mm., breadth of the valve 0.0024-0.0029 mm.

Locality: Adriatic (Pola), rather common.

This species has the most narrow valves known, the other extreme being represented by *L. Baileyi* Lewis. The somewhat rostrate upper end of the valve reminds *L. proboscidea*; further examination might prove it to be a variety of the latter. As it stands now I see however no sufficient reason to consider it as such.

### 39. *L. subundulata* Mer. [fig. 29].

Valve very narrow, bacilliform, with one or two usually faint constrictions, very slightly attenuated towards the inferior apex with al-

most parallel margin, becoming more strongly attenuated near the lower end, which is conical, terminating in a point, upper end somewhat attenuated, with apex rounded. Pseudoraphe fine, striae very variable, from 12 to 17 in 0.01 in the middle. Girdle face very narrow, linear, becoming suddenly conical at the lower end, upper angles slightly rounded; septa very shallow (0.0014 mm.), sometimes quite superficial, straight, thin, septal puncta very distinct, elongated. Endochrome granular. Length 0.0665-0.048 mm. (average of 25 cases 0.121 mm.), breadth of the girdle face 0.0067-0.0114 mm., breadth of the valve 0.0038-0.0072 mm.

Locality: Adriatic (Pola), common! Black sea (Sebastopol), very rare.

The girdle face of this very peculiar species reminds much more a *Synedra* than a *Licmophora*. The variation in size is unusually great.

40. **L. subundulata** var. **tenella** Mer.

Differs from the type species by its smaller size and more delicate appearance, the constrictions of the valve are fainter, usually indistinct, the girdle face broader, the septa almost always superficial, with very small marginal puncta, the striae finer, 18-22 in 0.01 mm. Length 0.0475-0.0655 mm., breadth of the girdle face 0.0057-0.0095 mm., breadth of the valve 0.0029-0.0033 mm.

Locality: Adriatic (Pola), rather rare, mixed with the type.

41. **L. Thumii** Mer. [fig. 30].

Valve of medium breadth, strongly clavate, slightly arcuate and asymmetrical, rarely symmetrical, upper part inflated, attenuated towards the superior apex which is broad, truncate; abruptly attenuated at the superior  $\frac{1}{4}$ , becoming narrow and almost linear, inferior apex slightly inflated. Pseudoraphe broad, very distinct, terminating at the summit of the valve in a pseudonodule, striae 16-17 in 0.01 mm. at the lower end as well as in the middle. Girdle face cuneate, with upper angles subacute; frustule rather strong. Septa deep

(0.0152 mm.), slightly arcuate, thin below the septal puncta, thick above them. Length 0.093-0.179 mm, breadth of the valve 0.011-0.017 mm.

Locality: California (Monterey), common.

*L. Thumii* has no close relation to any other species. I need not to explain in whose honour I have named this species, every diatomist knowing M.r E. THUM, of LEIPZIG.

# ESSAY

OF A NATURAL CLASSIFICATION OF THE LICMOPHORAE

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The genus *Licmophora* from a comparatively small one, as it has been heretofore, having now grown up to a large one, it has become necessary to distribute the numerous species and varieties in natural groupes according to their affinities. The system of GRUNOW based on a single character — the depth of the septa is by this very reason an artificial one, and in fact both of his groupes, the *Subseptatae* and *Profundeseptatae* contain the most heterogeneous forms, and at the same time separate species, which are closely allied, as for instance *L. Ehrenbergii* from *L. Grunowii*, or *L. dalmatica* from *L. paradoxa*. A natural system must take in consideration not one characteristic only, but all of the characteristics.

In my Monography, if I ever succeed to publish it, I will deal with this question more in detail, at the present time I will only give a short characteristic of the different groupes which can be established with a list of species belonging to each of them.

**I. Placatae.** — Valve narrow, striae very fine, *septa quite superficial*, frustule delicate, *endochrome composed of 2-4 plates*, stipes structureless (compound and striate in *L. flabellata*).

1. *L. biplacata* Mer.
2. *L. quadriplacata* Mer.
3. *L. flabellata* (Carmichael) C. Agardh.
4. — var. *parva* Mer.

**II. Dubiae.** — Valve usually more or less bacilliform, slightly attenuated from the very *summit* which is *broadly rounded*, striae very

variable, *septa shallow, usually superficial* and straight, frustule usually with *thick walls*, stipes short.

1. *L. dubia* Grun.
2. — var. *adriatica* Mer.
3. — var. *finmarchica* Grun.
4. — var. *laticor* Mer.
5. *L. pontica* Mer.
6. *L. ovulum* Mer.
7. *L. adriatica* Mer.
8. *L. anglica* (Kütz.) Grun.
9. *L. Oedipus* (Kütz.) Grun.
10. *L. Jürgensii* Ag.
11. — var. *intermedia* Grun.
12. — var. *chersonensis* Grun.
13. — var. *capensis* Grun.
14. *L. constricta* Grun.
15. *L. Reichardti* Grun.
- ? 16. *L. permagna* Mer.

**III. Debiles.** — *Valve* usually *clavate*, abruptly attenuated, with lower part very narrow, *superior apex* usually *acute*, pseudoraphe fine, *septa shallow*, with septal puncta distinct, round. Usually delicate forms, with thin walls. Endochrome with granules more or less irregular or elongated. Sessil or on short stipes with differentiated axial part.

1. *L. debilis* (Kütz.) Grun.
2. *L. hastata* Mer.
3. — var. *clavata* Mer.
4. *L. capitata* Mer.
5. *L. inflata* Mer.
6. — var. *intermedia* Mer.
7. *L. parasitica* Mer.
8. *L. membranacea* Mer.
9. *L. remuloides* Mer.
10. *L. remulus* Grun.

11. *L. gigantea* Mer.
- ? 12. *L. subundulata* Mer.
- ? 13. — var. *tenella* Mer.

**IV. Paradoxae.** — Valve with upper apex rounded, lower end more or less produced, *pseudoraphe* usually very *distinct*, striae fine, girdle face with angles rounded, *septa* usually *deep*, *stipes elongated*, composed of two layers (except in *L. grandis*), *ramification very peculiar*, not dichotomic (see diagram on p. 152 of La Nuova Notarisa 1901).

1. *L. paradoxa* C. Agardh.
2. *L. gracilis* (Kütz.) Grun.
3. *L. dalmatica* (Kütz.) Grun.
4. — var. *parva* Mer.
5. — var. *tenella* Grun.
6. *L. communis* (Heiberg?) Grun.
7. *L. lata* Mer.
8. *L. hyalina* (Kütz.) Grun.
9. *L. tincta* (Ag.) Grun.
- ? 10. *L. grandis* (Kütz.) Grun.

**V. Profundeseptatae.** — Valve similar to that of Paradoxae, *striae distinct at the lower end*, *septa very deep*, parallel below the septal puncta. Stipes short, structurless.

1. *L. profundeseptata* Mer.
2. *L. Monksiae* Mer.

**VI. Lyngbyeae.** — Valve narrow, gradually attenuated towards the lower end, *upper part attenuated*, often *rostrate*, *striae* more or less distinct, *not very fine* (usually 12-16 in 0.01 mm.), *septa deep*.

1. *L. Lyngbyei* (Kütz.) Grun.
2. — var. *Pappeana* Grun.
3. *L. pacifica* Mer.
4. *L. tenuis* (Kütz.) Grun.
5. *L. rostrata* Mer.

6. *L. proboscidea* Mer.
7. *L. spicula* Mer.
8. *L. semiasymmetrica* Mer.

**VII. Perstriatae.** -- *Valve* usually *broad*, with upper end more or less *acuminate*, pseudoraphe very *broad*, *striae robust* (6-12 in 0.01 mm.). Robust forms, with thick walls. Usually *sessil*.

1. *L. Ehrenbergii* (Kütz.) Grun.
2. — var. *ovata* (W. Sm.) Grun.
3. — var. *fungoides* Mer.
4. — var. *subconstricta* Mer.
5. — var. *tenuistriata* Mer.
6. *L. Grunowii* Mer.
7. — var. *elongata* Mer.
8. *L. mediterranea* Mer.
9. — var. *adriatica* Mer.
10. *L. elegans* Mer.
11. *L. angustata* Grun.
12. *L. redondina* Mer.
13. *L. californica* Grun.
14. *L. kamtschatica* Grun.

**Incertae sedis.**

1. *L. Thumii* Mer.
2. *L. araphidiea* Mer.
3. *L. Crozieri* Grun.
4. *L. longissima* Leud. Fortm.
5. *L. Baileyi* Lewis.
6. *L. nubecula* (Kütz.) Grun.
7. *L. montereyana* Mer.

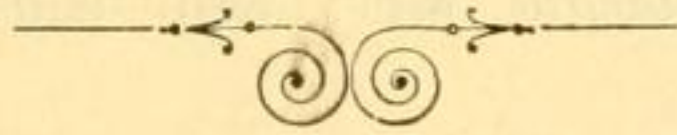


## RELATIVE DEPTH OF THE SEPTA

In my descriptions of Licmophorae I have introduced the direct measurement of the depth of the septa taken from the summit of the valve to the inner margin of the septum or, in the girdle face, from the upper margin of the frustule to the septal puncta. The absolute value of this measure does not however represent the real degree of the deepness of the septa in a given species: they can be absolutely deep, as in *L. araphidiea*, where they have a length of 0.0143 mm., more than those of *L. profundeseptata*, which are only 0.0105 mm. deep and still relatively to the size of the frustule they are shallow in *L. araphidiea* while in *L. profundeseptata* they are very deep. It is therefore necessary to take this character not in its absolute value but in its relation to a uniform size of the frustules. The following table (based on more than two thousands measurements) shows the relative depth of the septa of different species, the size of each species being supposed equal to 0.1 mm. All septa below 0.008 mm. can be regarded as shallow, all above 0.008 (inclusive) – as deep.

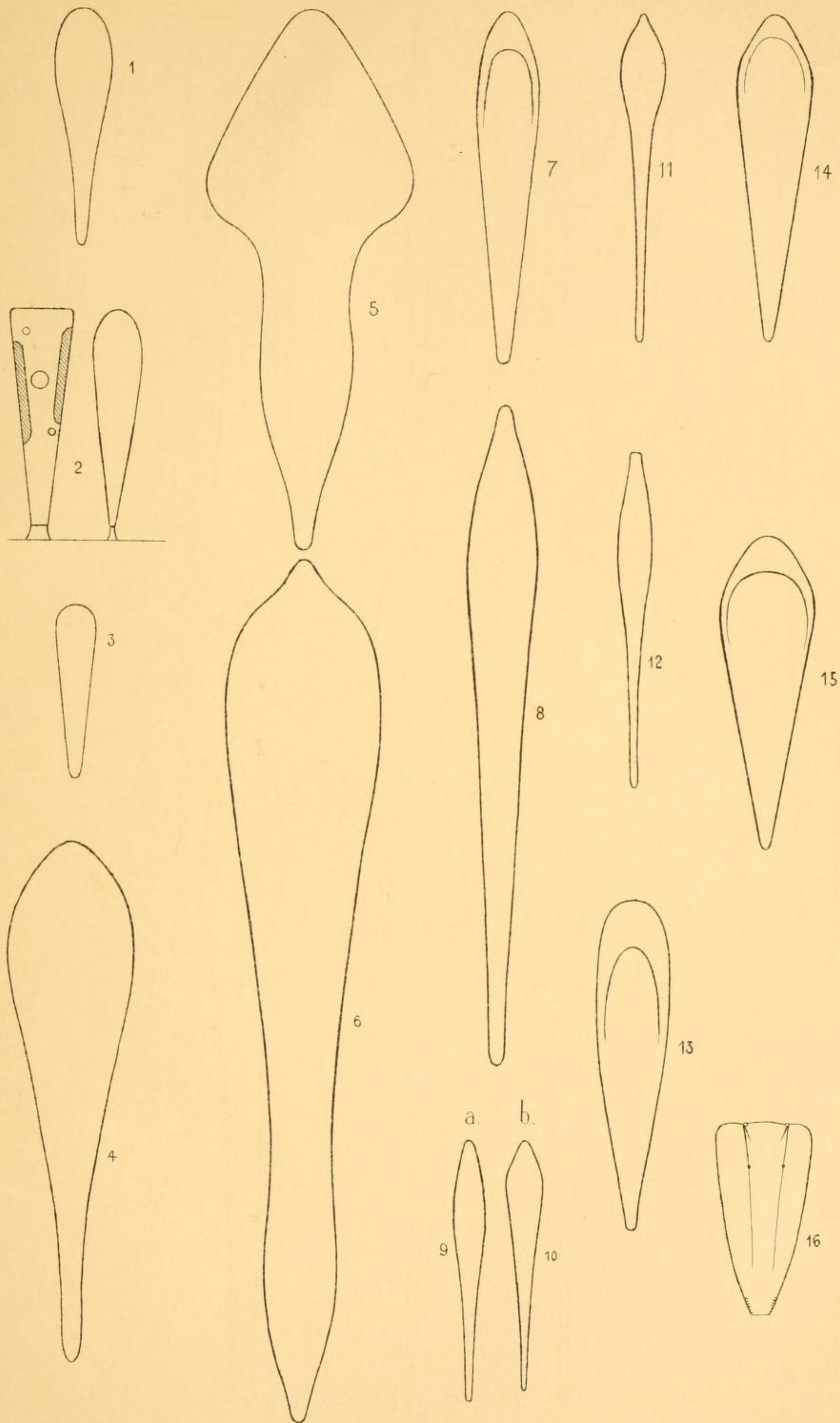
<i>L. subundulata</i> Mer.	.	.	.	0.0015 mm.
<i>L. permagna</i> Mer.	.	.	.	0.0028 »
<i>L. elegans</i> Mer.	.	.	.	0.0033 »
<i>L. Jürgensii</i> Ag.	.	.	.	0.0033 »
<i>L. remuloides</i> Mer.	.	.	.	0.0038 »
<i>L. angustata</i> Gr.	.	.	.	0.0040 »
<i>L. inflata</i> Mer.	.	.	.	0.0042 »
<i>L. hastata</i> Mer.	.	.	.	0.0043 »
<i>L. araphidiea</i> Mer.	.	.	.	0.0044 »
<i>L. dalmatica</i> var. <i>parva</i> Mer.	.	.	.	0.0047 »
<i>L. Reichardtii</i> Gr.	.	.	.	0.0048 »
<i>L. capensis</i> Gr.	.	.	.	0.0049 »
<i>L. Ehrenbergii</i> (Kz.) Gr.	.	.	.	0.0054 »
<i>L. membranacea</i> Mer.	.	.	.	0.0059 »
<i>L. debilis</i> (Kz.) Gr.	.	.	.	0.0062 »

<i>L. gracilis</i> (Kz.) Gr.	. . .	0.0070 mm.
<i>L. parasitica</i> Mer.	. . .	0.0072 »
<i>L. dalmatica</i> (Kz.) Gr.	. . .	0.0077 »
<i>L. tenuis</i> (Kz.) Gr.	. . .	0.0084 »
<i>L. Grunowii</i> Mer.	. . .	0.0085 »
<i>L. semiasymmetrica</i> Mer.	. . .	0.0090 »
<i>L. mediterranea</i> Mer.	. . .	0.0090 »
<i>L. grandis</i> (Kz.) Gr.	. . .	0.0095 »
<i>L. paradoxa</i> Ag.	. . .	0.0103 »
<i>L. Lyngbyei</i> (Kz.) Gr.	. . .	0.0119 »
<i>L. spicula</i> Mer.	. . .	0.0120 »
<i>L. Thumii</i> Mer.	. . .	0.0120 »
<i>L. rostrata</i> Mer.	. . .	0.0129 »
<i>L. proboscidea</i> Mer.	. . .	0.0134 »
<i>L. communis</i> (Heib.?) Gr.	. . .	0.0138 »
<i>L. pacifica</i> Mer.	. . .	0.0140 »
<i>L. lata</i> Mer.	. . .	0.0164 »
<i>L. californica</i> Gr.	. . .	0.0185 »
<i>L. Monksiae</i> Mer.	. . .	0.0233 »
<i>L. profundeseptata</i> Mer.	. . .	0.0273 »



## Explanation of figures.

- Fig. 1. *Licmophora adriatica* Mer. Adriatic (Fiume); magnif. 630.
- » 2. *Licmophora biplacata* Mer. Left figure girdle face with cell-contents. Villefranche; magnif. about 3000.
- » 3. *Licmophora dubia* var. *latior* Mer. California; magnif. 630.
- » 4. *Licmophora elegans* Mer. Genua; magnif. 630.
- » 5. *Licmophora Ehrenbergii* var. *fungoides* Mer. Kertsch (Crimea) fossil; magnif. 630.
- » 6. *Licmophora Ehrenbergii* var. *subconstricta* Mer. Adriatic (Quarnero); magnif. 630.
- » 7. *Licmophora Grunowii* Mer. Ialta (Crimea); magnif. 630.
- » 8. *Licmophora Grunowii* var. *elongata* Mer. Black sea (Crimea); magnif. 630.
- » 9. *Licmophora debilis* (Kütz.) Grun.; magnif. 630.
- » 10. *Licmophora hastata* Mer. (*debilis* var.?) Mediterranean; magnif. 630.
- » 11. *Licmophora hastata* var. *clavata* Mer. Black sea (Crimea); magnif. 630.
- » 12. *Licmophora inflata* Mer. Sebastopole; magnif. 630.
- » 13. *Licmophora lata* Mer. California; magnif. 630.
- » 14. *Licmophora mediterranea* Mer. Villefranche; magnif. 630.
- » 15. *Licmophora mediterranea* var. *adriatica* Mer. Ancona; magnif. 630.
- » 16. *Licmophora Monksiae* Mer. California; magnif. 945.
- » 17. *Licmophora montereyana* Mer. California; magnif. 630.
- » 18. *Licmophora ovulum* Mer. New Jersey U. S. A.; magnif. 630.
- » 19. *Licmophora parasitica* Mer. Villefranche; magnif. 945.
- » 20. *Licmophora permagna* Mer. New Guinea; magnif. 630.
- » 21. *Licmophora pontica* Mer. Black sea (Theodosia); magnif. 630.
- » 22. *Licmophora proboscidea* Mer. Adriatic (Pola); magnif. 630.
- » 23. *Licmophora profundeseptata* Mer. Villefranche; magnif. 630.
- » 24. *Licmophora quadriplacata* Mer. with cell-contents. Villefranche; magnif. 945.
- » 25. *Licmophora remuloides* Mer. Black sea (Crimea); magnif. 630.
- » 26. *Licmophora rostrata* Mer. Sebastopole; magnif. 630.
- » 27. *Licmophora semiasymmetrica* Mer. Black sea (Crimea); magnif. 1260.
- » 28. *Licmophora spicula* Mer. Adriatic (Pola); magnif. 630.
- » 29. *Licmophora subundulata* Mer. Adriatic (Pola); magnif. 630.
- » 30. *Licmophora Thumii* Mer. California; magnif. 630.



The following text is generated from uncorrected OCR or manual transcriptions.

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23. *L. membranacea* Mer.

Valve very narrow, gradually attenuated towards the lower end which is very narrow and rather acute, attenuated towards the upper end which is more or less rostrate. Pseudoraphe indefinite, striae very fine. Girdle face extremely delicate, narrow or very narrow, cuneate, sometimes linear in its upper part, with almost acute angles. Septa very shallow (0.0021- 0.0022 mm.), very delicate, slightly arcuate, septal puncta very small, Endochrome composed of 4-6 irregularly lacinated transverse bands. Individuals solitary or forming small colonies of 2-4 (rarely more) frustules on very short structureless stipes. Length 0.021-0.055 mm. (usually 0.033-0.043 mm.), breadth of the frustule 0.0088-0.0012 mm., (usually 0.0057-0.0076 mm.) breadth of the valve 0.0033-0.0038 mm.

Locality: Black sea, Crimea (Ialta), common in certain places!

Mediterranean (Villefranche), rare! Adriatic (Pola), rare.

The frustule is membranaceous and so delicate that with a somewhat low magnifying power it can scarcely be seen. This is the most delicate species of Licmophorae. The endochrome has a very peculiar appearance.

24. *L. Monksiae* Mer. [fig. 16].

Valve broad in the middle, slightly attenuated towards the superior apex which is truncate, sometimes broadly rounded, more considerably attenuated towards the lower end, which is narrow; lower part forming an elongated cone, with usually straight margins. Striae fine, except at the lower end where they are distinct with an ordinary magnifying power, about 12-13 in 0.01 mm. Girdle face cup-shaped with more or less convex margins, upper angles rounded. Septa very deep (0.006-0.005 mm.), very fine, almost straight and parallel, sometimes divergent above the septal puncta, the latter small, round, very distinct, secondary puncta large, adjoining the septa. Endochrome granular. Forming small colonies on short structureless stipes or solitary Length 0.012-0.041 mm. (usually 0.024-0.033 mm.), breadth

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of the girdle face 0.014-0.020 mm., breadth of the valve 0.006-0.007 mm.

Locality: California (San Pedro), common.

It is to Miss S. P. Monks of Los Angeles, who has assisted me in many ways in my work, that I dedicate this species. The girdle face has a very peculiar appearance not to be found in any other species; the position of the large secondary puncta is also a very peculiar character. It resembles in many respects *L. profundosepia*.

25. *L. montereyana* Mer. [fig. 17].

Valve narrow, linear in its upper  $\frac{1}{2}$ , abruptly attenuated in the middle, becoming again linear and very narrow in the lower  $\frac{1}{2}$ , superior apex broadly rounded, inferior inflated. Pseudoraphe invisible, striae very fine, about 23 or more in 0.01 mm. Septa deep (0.0166 mm.). Length 0.003 mm. breadth of the valve 0.0076 mm.

Locality: California (Monterey), very rare.

The valve of this species has a form similar to that of *L. remioides* Mer., but it is a very distinct species, the septa being deep and the lower apex of the valve inflated. It differs from *L. grandis* by the indefinite pseudoraphe which is very distinct in the latter, the valve is also different. It has no close relation to any other species.

26. *L. ovulum* Mer. [fig. 18].

Valve broad or very broad, ovoid, more or less abruptly attenuated at the lower end, superior apex broadly rounded, not attenuated (except in very large specimens), inferior apex narrow, rounded and somewhat produced. Pseudoraphe indefinite, striae very fine; about 24-25 in 0.01 mm. Girdle face rather broad, sometimes very broad, cuneate, upper angles rounded, inferior apex sometimes very broad and concave; frustule robust. Septa superficial, straight, septal puncta very large, somewhat deepened inwards, secondary puncta

usually absent. Endochrome granular. Forming more or less numerous colonies on short, scanty and irregularly ramified stipes, with a con-

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densed outer layer. Length 0.014-0.058 mm. (usually 0.002-0.003 mm.), breadth of the girdle face 0.0114-0.023 mm., breadth of the valve 0.007-0.009 mm. (usually 0.008 mm.).

Locality: Atlantic coast of N. America (Atlantic City, New Jersey C), very common ! Black sea (Sebastopol), very rare.

Small but very robust and characteristic species. In small individuals the breadth of the frustule sometimes surpasses its length, and the lower end is in such cases very broad and sometimes (especially in specimens from the Black sea) excavated or concave—quite the opposite of *L. politica*, where the inferior apex of the frustule is rounded.

27. *L. pacifica* Mer.

Valve broad, cuneate, ovoid in small individuals, gradually tapering from the summit which is broadly rounded towards the narrow and subacute inferior apex, margins straight. Pseudoraphe and striae distinct, the latter about 1-12 in 0.01 mm. Girdle face broadly cuneate, with upper angles rounded, outlines strong, inferior apex broad. Septa comparatively deep (0.005 mm.), moderately arcuate,



septal puncta round, very distinct. Endochrome granular. Sessile form.

Length 0.026-0.0437 mm., breadth of the frustule 0.02-0.034 mm.,  
breadth of the valve 0.0081-0.0095 mm.

Locality: California (San Pedro), not rare.

This species has a certain resemblance to *L. Lyngbyei*, to which it seems to be allied. The valves of large specimens resemble somewhat those of *L. Jurgensii* var. *capensis* Grun., but the septa are much deeper, than in the latter.

28. *L. parasitica* Mer. [fig. 19].

Valve rather narrow, somewhat abruptly attenuated towards the lower end which is narrow, produced and with acute apex, upper

(1) It is through the kindness of Mr Ch. Boyer of Philadelphia that I am in possession of a pure gathering of this species from Atlantic City (New Jersey),

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part more or less linear, superior apex broad, truncate. Pseudoraphe indefinite, striae very fine. Girdle face narrowly cuneate, with upper angles slightly rounded, outlines very delicate. Septa shallow (0.0014-0.0019 mm.), gently arcuate, septal puncta very small. Endochrome granular. Sessile or on short, slightly ramified stalks, usually parasitic on frustules of *L. graiidis*. Length 0.01-0.0285 mm., breadth of the frustule 0.0015-0.003 mm., breadth of the valve 0.0029-

0.0033 mm.

Locality : Mediterranean (Villefranche), rather common.

Differs from small individuals of *L. dehilis* by the broad, truncate superior apex of the valves which in *L. debilis* is always attenuated and more or less acute; the frustules are also more delicate.

29. *L. permagna* Mer. [fig. 20].

Valve of medium breadth, bacilliform, very slightly and gradually attenuated from the summit to the lower end, with straight margins; superior apex strongly attenuated, with summit acute, inferior apex broad, rounded, not inflated. Pseudoraphe rather broad, very distinct, striae not very delicate, about 18-19 in 0.01 mm., parallel throughout, crossed by straight longitudinal lines. Septa very shallow, 0.0033-0.0065 mm. (average of 11 cases: 0.00453 mm.). Length 0.125-0.206 mm., breadth of the valve 0.0143-0.018 mm.

Locality : New Guinea (German possessions), rather common.

But for the acute superior apex and the longitudinal lines this species could be considered as nearly allied to *L. Jiirgensii*. By the longitudinal lines it reminds *L. Jiirgeimi* var. *capensis* Grun.

30. *L. pontica* Mer. [fig. 21].

Valve of medium breadth, cuneate, very slightly attenuated from the summit to the base, with straight margins, lower end somewhat

broad, rounded, sometimes slightly produced, superior apex broadly rounded. Striae very fine. Girdle face moderately broad, cuneate, Avith very thick margins, upper angles very rounded, lower apex somewhat broad, rounded; septa superficial, straight, septal puncta very

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large, strongly marginai, secondary puncta absent. Endochrome granular (6-12 granules). Length 0.0214-0,0460 mm. (usually 0.033 mm.), breadth of the girdle face 0.013-0.019 mm., breadth of the valve 0.0072-0.0082 mm.

Locality : Black sea (Ialta, Theodosia in Crimea), rare.

This is the only species with rounded inferior apex of the frustule; it is intermediate between *L. ovuluni* and *L. duina* as the latter is intermediate between *L. pontica* and *L. Jiirgensii*, these four species thus forming a continuous genealogical line without interruption.

3i. *L. proboscidea* Mer. [fig. 22].

Valve narrow, davate, abruptly attenuated in its superior part, terminating in a long, narrow proboscis or rostrum, gradually attenuated towards the very narrow and acute end lower margins straight or slightly concave. Striae very fine, 24 or more in 0.01 mm. Girdle face cuneate, rather narrow, with upper angles acute or subacute, margins thin; septa deep (0.0056 mm.), strongly ar-

cuate and divergent towards the upper apex, septal puncta very small, round, distinct. Forming small colonies on short dichotomously ramified stipes which are composed of a darker axial part and a lighter external layer. Length 0.038-0.056 mm, breadth of the girdle face 0.0086-0.020 mm., breadth of the valve 0.00285-0.0048 mm.

Locality : Adriatic (Pola), not rare.

This species is rather variable in its characteristics; the rostrum is more or less narrow and more or less distinctly separated from the rest of the valve; the breadth of the frustule and the depth of the septa are also subject to variations. The shape of the valves is almost the same as in *L. rostrata* Mer., although both are very distinct species, their size, girdle face and striae being quite different. Has a great affinity with *L. semiasymmetrica* Mer.

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32. *L. profundeseptata* Mer. [fig. 23].

Valve moderately broad, elongated ovoid, with somewhat convex margins, abruptly attenuated in the lower  $\wedge$  which is produced, inferior apex narrow, superior broadly rounded. Pseudoraphe rather delicate, striae distinct with an ordinary magnifying power at the inferior  $\wedge$  only, about  $i_3$ - $i_4$  in 0.01 mm., becoming farther on invisible. Girdle face cuneate, moderately broad, with upper angles well

rounded, margins moderately strong. Septa excessively deep (0.0105 mm.), almost straight and very thin below the septal puncta, divergent and stronger above them ; septal puncta small, round, very distinct. Endochrome granular. Length 0.038-0.0475 mm., breadth of the girdle face 0.018-0.025 mm., breadth of the valve 0.00855 mm.

Locality: Mediterranean (Villefranche), very rare.

This species has the deepest septa known ; in this respect as in many others it resembles *L. Monksiae* and can be considered as a mediterranean representative of a peculiar small group of Licmophorae-Profundeseptatae. The secondary septal puncta are not adjoining the septa as in *L. Monksiae*.

33. *L. quadriplacata* Mer. [fig. 24].

Valve very narrow, bacilliform or narrowly cuneate, rarely deviate, gradually attenuated towards the lower end, with straight or nearly straight margins, inferior apex very narrow, acute, superior part very slightly attenuated, superior apex broadly rounded or somewhat truncate. Pseudoraphe indefinite, striae very fine. Girdle face narrowly cuneate, with angles subacute; septa superficial, straight, very fine, septal puncta small, strongly marginal, endochrome composed of four elongated plates resting by pairs on each of the valves, separated transversally, with margins extending on the girdle face. Forming small colonies of 1-4 not exceeding 14 individuals on moderately elongated, structureless stipes, with dichotomic ramification. Length 0.021-0.054 mm., breadth of the girdle face 0.007-0.012 mm.,

breadth of the valve 0.00285-0.0048 mm.

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Locality: Mediterranean (Villefranche), very common! Adriatic

(Fola), common.

*L. flabellata* is also provided with four chromatophores but the

plates are resting not on the valves, as here, but on the zonal face;

they are also more rounded. In all other respects both species are

very different.

34. *L. redondina* Mer.

Valve very broad, elongated ovoid, upper part with convex, lower part with straight margins, slightly attenuated towards the summit, which is broad, rounded, slightly produced, gradually attenuated towards the lower end, which is almost acute. Pseudoraphe very broad (0.002 mm.), lanceolate, striae very robust,  $7\frac{1}{2}$  in 0.01 mm., with indistinct puncta, parallel, slightly radiate at the upper end. Length 0.35 mm., breadth of the valve 0.0475 mm.

Locality: Redondo (California), fossil, rare.

I have seen a single valve of this species, which is nearly akin to *L. Ehrenbergii* var. *ovata*; differs from the latter by the form of the valve, the somewhat more distant striae, and the broader and lanceolate pseudoraphe. Could be regarded as a variety of *Licium Ehrenbergii*.

35. *L. remuloides* Mer. [fig. 25].

Valve very narrow, composed of two distinct parts of almost equal length, upper part linear, with superior apcx rounded, abruptly passing into the inferior part, which is much narrower, gradually tapering to the lower apex, the latter not inflated. Pseudoraphe Une, striae very fine. Girdle face very narrow, linear in its upper part, with angles subacute. Septa very shallow (0.0048 mm.) but not marginal, straight, very thin^ septal puncta small, round, distinct. Length 0.126 mm., breadth of the upper linear part of the valve 0.007 mm.

Locality : Black sea (near Ialta, Crimea), very rare.

The valve has some resemblance with that of *L. monterevana*

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Mer., but the girdle face is very different; the septa of the latter

species are very deep, and the lower apex of the valve is inflated.

They are not related to one another.

36. *L. rostrata* Mer. [fig. 26].

Valve narrow, cuneate, gradually attenuated towards the lower end, with usually straight margins, abruptly attenuated at the upper end forming a long narrow rostrum, inferior apex narrow, acute.

Pseudoraphe distinct, striae usually distinct at an ordinary magnifying power, 13-14 in 0.01 mm. in the middle part. Girdle face narrow, linear in its upper  $\frac{1}{2}$ , or  $\frac{2}{3}$ , (sometimes even more), with angles subacute, margins rather strong, becoming thin at the upper part. Septa very deep (0.012 mm.), thin, moderately arcuate, parallel above the septal puncta, the latter round, very distinct. Endochrome granular. Length 0.015-0.02 mm., breadth of the girdle face 0.005-0.019 mm., breadth of the valve 0.0048-0.0072 mm.

Locality: Black sea (Ialta, Sebastopol), common! Mediterranean (Villefranche), not rare! Adriatic (Pola, Ancona), rather rare! California (San Pedro), rare (type. ^).

The form of the valve is nearly the same as in *L. proboscidea* Mer., but the latter is much more delicate, its size smaller, the striae much finer, the girdle face cuneate. Nevertheless there can be but little doubt that this species has originated directly from *L. rostrata*.

37. *L. semiasymmetrica* Mer. [fig. 27].



Valve narrow, davate, partly symmetrical, partly more or less asymmetrical, inflated in the upper third, somewhat abruptly attenuated in the middle or below, slightly attenuated towards the superior end which is broader than the inferior and more or less produced with apex rounded. lower end narrow; in the asymmetrical type the valve is more or less arcuate, abruptly attenuated in its middle part on one side (the concave one) only. f^seudoraphe indefinite, striae very fine. Girdle f^ice narrow, cuneate, with upper an-

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gles sliyhliy rounded, outlines delicate; septa deep (0.0033 mm.), thin, faintly arcuate, septal puncta small, round, very distinct. Endochrome granular. Length 0.025-0.053 mm., breadth of the girdle face 0.0070-0.017 mm., breadth of the valve 0.0043-0.0055 mm. ,

Locality : Black sea (Goursouf, Crimea, rather common) ! Mediterranean (Villefranche), rare.

This curious species has valves partly symmetrical, partly asymmetrical. both lypes being about of the same frequency. It is certainly nearly related to *L. proboscidea* Aler., but the valves of the latter are never asymmetrical, the proboscis or rostrum is usually much more distinct, the septa in the average are deeper.

38. *L. spicula* Aler. [fig. 28].

Valve extremely narrow, spicula like, slightly attenuated from the upper third to the summit which is rounded, upper part somewhat produced; gradually attenuated towards the inferior apex, the latter acute. Striae very fine. Girdle face narrow, cuneate. with upper angles subacute, outlines delicate; septa deep (0.052 mm.), very thin, becoming stronger above the septal puncta, where they are but very slightly divergent, septal puncta very small. Forming small colonies of from 2 to 8 individuals on short dichotomously divided stipes. composed of two layers, the inner being thinner but denser than the outer. Length 0.038-0.046 mm., breadth of the girdle face 0.0067-0.0076 mm., breadth of the valve 0.0024-0.0029 mm.

Locality: Adriatic (Pola), rather common.

This species has the most narrow valves known, the other extreme being represented by *L. Baileyi* Lewis. The somewhat rostrate upper end of the valve reminds *L. proboscidea*; further examination might prove it to be a variety of the latter. As it stands now I see however no sufficient reason to consider it as such.

39. *L. subundulata* Mer. [fig. 2 ].

Valve very narrow, bacilliform, with one or two usually faint constrictions. very slightly attenuated towards the inferior apex with a

most parallel margin, becoming more strongly attenuated near the lower end, which is conical, terminating in a point, upper end somewhat attenuated, with apex rounded. Pseudoraphe fine, striae very variable, from 12 to 17 in 0.01 in the middle. Girdle face very narrow, linear, becoming suddenly conical at the lower end, upper angles slightly rounded; septa very shallow (0.0014 mm.), sometimes quite superficial, straight, thin, septal puncta very distinct, elongated. Endochrome granular. Length 0.0605-0.048 mm. (average of 25 cases 0.121 mm.), breadth of the girdle face 0.007-0.014 mm., breadth of the valve 0.0038-0.0072 mm.

Locality: Adriatic (Pola), common! Black sea (Sebastopol), very rare.

The girdle face of this very peculiar species reminds much more a *Synedra* than a *Licmophora*. The variation in size is unusually great.

40. *L. subundulata* var. *tenella* Mer.

Differs from the type species by its smaller size and more delicate appearance, the constrictions of the valve are fainter, usually indistinct, the girdle face broader, the septa almost always superficial, with very small marginal puncta, the striae finer, 18-22 in 0.01 mm. Length 0.0476-0.0655 mm., breadth of the girdle face 0.0057-0.0095 mm., breadth of the valve 0.0029-0.0033 mm,

Locality: Adriatic (Pola), rather rare, mixed with the type.

41. *L. Thumii* Mer. [fig. 30].

Valve of medium breadth, strongly davate, slightly arcuate and asymmetrical, rarely symmetrical, upper part inflated, attenuated towards the superior apex which is broad, truncate; abruptly attenuated at the superior  $\wedge$  becoming narrow and almost linear, inferior apex slightly inflated. Pseudoraphe broad, very distinct, terminating at the summit of the valve in a pseudonodule, striae 16-17  $\wedge$  O-oi mm. at the lower end as well as in the middle. Girdle face cuneate, with upper angles subacute: frustule rather strong. Septa deep

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(o.oi52 mm.), slightly arcuate, thin below the septal puncta, thick above them. Length 0.093-0.179 mm, breadth of the valve o.oi-0.017 mm.

Locality: California (Monterey), common.

*L. Thumii* has no dose relation to any other species. I need not to explain in whose honour I have named this species, every diatomist knowing M.r E. Thum, of Leipzig.

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## ESSAY

### OF A NATURAL CLASSIFICATION OF THE LICMOPHORAE

The genus *Licmophora* from a comparatively small one, as it has been heretofore, having now grown up to a large one, it has become necessary to distribute the numerous species and varieties in natural groups according to their affinities. The system of Grunow based on a single character — the depth of the septa is by this very reason an artificial one, and in fact both of his groups, the *Subseptatae* and *Profundeseptatae* contain the most heterogeneous forms, and at the same time separate species, which are closely allied, as for instance *L. Ehrenbergii* from *L. Grunowii*, or *L. dahmatica* from *L. paradoxa*. A natural system must take in consideration not one characteristic only, but all of the characteristics.

In my Monography, if I ever succeed to publish it, I will deal with this question more in detail, at the present time I will only give a short characteristic of the different groups which can be established with a list of species belonging to each of them.

I. *Placatae*. — Valve narrow, striae very fine, septa quite superficial, frustule delicate, endoconch composed of 2<sup>+</sup> plates, stipes structureless (compound and striate in *L. Jai'elhila*).

1. *L. biplocata* Mer.

2. *L. quadriplacata* Mer.

3. *L. flabellata* (Carmichael) C. ylgardh.

4. — var. *parva* Mer.

II. *Dublae*. — Valve usually more or less bacilliform, slightly attenuated from the very summit which is broadly rounded, striae very

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variable, sepia shallow, usually sinuately and straight, frustule usually  
with thick wall, stipes short.

1. *L. dubia* Grun.

2. — var. *adriatica* Mer.

3. — var. *finmarchica* Grun.

4. — var. *latior* Mer.

5. *L. politica* Mer.

6. *L. ovulium* Mer,

7. *L. adriatica* Mer,

8. *X. anglica* (Kütz.) Grun.

9. *7v. Oedipus* (Kütz.) Grnn.

10. *L. Jiirgensii* Ag.

11. — var. *intermedia* Grnn.

12. — var. *chersouensis* Grun.

13. — var. *capensis* Grun.

14. *L. cousiriclu* Grun.

15. *L. Reichardti* Grun.

16. *L. penna gna* Mer,

III. *Debiles*. — Valve usually clavate, abruptly attenuated, with lower part very narrow, superior apex usually acute, pseudoraphe fine, septa shallow, with septal puncta distinct, round. Usually delicate forms, with thin walls. Endochrome with granules more or less irregular or elongated. Sessile or on short stipes with differentiated axial part.

1. *L. debilis* (Kütz.) Grun.

2. *L. haslala* Mer,

3. — var. *clavata* Mer.

4. *L. capitata* Mer.

5. *L. infiala* Mer.

6. — var. *intermedia* Mer.

7. *L. parasitica* Mer.

8. *L. membranacea* Mer.

9. *L. remuloides* Mer.

10. *L. remulus* Grun.

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11. *L. gigantca* Mcr.

12. *L. siibuudiilata* Mer.

13. — var. *tendla* Aler.

IV. *Paradoxae*. — Valve with upper apex rounded, lower end more or less produced, pseudoraphe usually very distinct, striae fine, girdle face with angles rounded, septa usually deep, stipes elongated, composed of two layers (except in *L. grandis*), ramification very peculiar, not dichotomic (see diagram on p. 152 of *La Nuova Notarisia* 1901).



1. *L. pamdoxa* C. Agardh.

2. *L. gracilis* (Kütz.) Grun.

3. *L. dalmatica* (Kütz, Grun.

4. — var, *parva* Mer.

5. — var. *tenella* Grun,

6. *L. communis* (Heiberg.^) Grun.

7. *L. lata* Mer.

8. *L. hyalina* (Kütz.) Grun.

9. *L. tincta* (Ag.) Grun.

} 10. *L. grandis* (Kiitz.) Grun.

V. *Profundeseptatae*. — Valve similar to that of *Paradoxae*, striae distinct at the lower end, septa very deep, parallel below the septal puncta, Stipes short, structureless.

1. *L. profundeseptata* Mer,

2. *L. Monksiae* Mer.

VI. Lyngbyeae. — Valve narrow, gradually attenuated towards the lower end, upper pari attenuated, often rostrate, striae more or less distinct, not very fine (usually 12-16 in 0.01 mm.), sepia deep.

1. *L. Lynghyei* (Kütz.) Grun,

2. — var. *Pappeana* Grun,

3. *L. pacifica* Mer.

4. *L. teiiuis* (Kütz.) Grun.

5. *L. rostrata* Mer.

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6. *L. proboscidea* Mei\*.

7. *L. spicula* Mer.

8. *L. semiasymmetrica* Mer.

VII. Perstriatae. — Valve usually broad, with upper end more or less acuminate, pseudoraphe very broad, striae robust (6-12 in 0.01 mm.). Robust forms, with thick walls. Usually sessil.

1. *L. Ehrenbergii* (Kütz.) Grun.

2. — var. *ovata* (W. Sm.) Grun.

3. — var. *fungoides* Mer.

4. ~ var. *subconstricta* Mer.

5. — var. *tenuistriata* Mer.

6. *L. Grunowii* Mer.

7. — var. *longata* Mer.

8. *L. mediterranea* Mer.

9. — var. *adriatica* Mer.

10. *L. elegans* Mer.

11. *i. angustata* Grun.

12. *L. redondina* Mer.

13. *Z. californica* Grun.

14. *Z. Transcaucasica* Grun.

Incertae sedis.

1. *L. Thimii* Mer.

2. *Z. araphidiea* Mer.

3. *Z. Crozierii* Grun.

4. *L. longissima* Leud. Fortm.

5. *Z. Baileyi* Lewis.

6. *Z. niibecida* (Kütz.) Grun.

7. *Z. monterovana* Mer.

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#### RELATIVE DEPTII OF TUE SEPTy\

In my descriptions of Lichophorae I have introduced the direct measurement of the depth of the septa taken from the summit of the valve to the inner margin of the septum or, in the girdle face, from the upper margin of the frustule to the septal puncta. The absolute value of this measure does not however represent the real degree of the deepness of the septa in a given species : they can be absolutely deep, as in *L. araphidiea*, where they have a length of 0.0143 mm., more than those of *L. profundosepiata*, which are only 0.0105 mm. deep and still relatively to the size of the frustule they are

shallow in *L. araphidiea* while in *L. profundeseptata* they are very deep. It is therefore necessary to take this character not in its absolute value but in its relation to a uniform size of the frustules.

The following table (based on more than two thousands measurements) shows the relative depth of the septa of different species, the size of each species being supposed equal to 0.1 mm. All septa below 0.008 mm. can be regarded as shallow, all above 0.008 (inclusive) - as deep.

*L. siihundii* Mer.

*L. per magna* Mer. .

*L. elegans* Mer.

*L. Jiirgensii* Ag.

*L. remnoides* Mer. .

*L. angli si aia* Gr.

*L. infiala* Mer.

*L. bastata* Mer.

*L. araphidiea* Mer. .

*L. dalmatica* var. *parva* A

L. Reichardti Gr.

L. capensis Gr.

L. Ehrenbergii (Kz.) Gr

L. membranacea Mer.

L. debilis (Kz.) Gr. .

0.00 1:) mm.

0.0028 »

o.oo33 »

o.oo33 »

o.oo38 ji

0.0040 »

0.0042 »

0.0043 i>

0.0044 ' >

0.0047 »

0.0048 j)

0.0049 "

0.0064 \*

0.0059 »

0.0002 »

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L. graci/is (Kz.) Gr.

L. parasi/tea Mer. .

L. dalmatica (Kz.) Gr.

L. tenuis (Kz.) Gr.

L. Grunozvii Mer.

L. semiasymmetrica Mer.

L. mediterranea Mer

L. grandis (Kz.) Gr

L. paradoxa Ag.

L. Lyngbyei (Kz ) G

L. spicula Mer.

L. Thumii Mer.

Z. rostrata Mer.

Z. proboscidea Mer

Z. commiinis (Heib..?) Gr

X. pacifica Mer.

Z. /a/a Mer. .

Z. cali fornica Gr.

Z. Monhsiae Mer.

Z. profiindeseplala Mer



0.0070 mm.

0.0072 »

0.0077 »

0.0084 »

0.0085 »

0.0090 »

0.0090 »

0.0095 »

0.0103 »

0.0119 »

0.0120 »

0.0120 B

0.0129 »

0.0134 "

0.0138 »

0.0140 »

0.0164 »

o.oiSS B

0.0233 »

0.0273 >

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Explanation of figures.

Fig. 1. *Liciniophora adriatica* Mer. Adriatic (Fiume); magnif. 630.

» 2. *Licmoplwra biplacata* Mer. Left figure girdle face with cell-contents.

Villefranche ; magnif. about 3000.

» 3. *Liciniophora dubia* var. *latior* Mer. California; magnif. 630.

» 4. *Licmophora elegans* Mer. Genua; magnif. 630.

» 5. *Licmophora Ehrenbergii* var. *fungoides* Mer. Kertsch (Crimea) fossi 1 ;  
magnif. 630.

- » 6. *Licmophora Ehrenbergii* Lx. *subconstricta* Mer. Adriatic (Ouarnero); magnif. 630.
- » 7. *Licmophora Grunowii* Mer. Italia (Crimea); magnif. 630.
- » 8. *Licmophora Cruxentii* var. *^/? «^rt/rt* Mer. Black sea (Crimea) ; magnif. 630.
- » 9. *Licmophora debilis* (Kiitz.) Grun. ; magnif 630.
- » 10. *Licmophora hastata* Mer. (*debilis* var.?) Mediterranean ; magnif. 630.
- » 11. *Licmophora hastata* var. *clavata* Mer. Black sea (Crimea); magnif. 630.
- » 12. *Licmophora itiflata* Mer. Sebastopole ; magnif. 630
- » 13. *Licmophora lata* Mer. California; magnif. 630.
- » 14. *Licmophora mediterranea* Lx. Villefranche; magnif 630.
- » 15. *Licmophora mediterranea* var. *adriatica* Mer. Ancona; magnif. 630.
- » 16. *Licmophora Moitksiae* Mer. California; magnif. 945.
- » 17. *Licmophora moitksyana* Mer. California; magnif. 630.
- » 18. *Licmophora ovulum* Mer. New Jersey U. S. A. ; magnif. 630.

- » 19. *Licmophora parasitica* Mer. Villefranche; magnif. 945.
  
- » 20. *Licmophora peilinagna* Mer. New Guinea; magnif. 630.
  
- » 21. *Licmophora pontica* Mer. Black sea (Theodosia); magnif. 630.
  
- » 22. *Licmophora proboscidea* Mer. Adriatic (Pola); magnif. 630.
  
- » 23. *Licmophora pifoiindeseptata* Mer. Villefranche; magnif. 630.
  
- » 24. *Licmophora quadriplacata* Mer. with cell-contents. Villefranche; magnif- 945-
  
- » 25. *Licmophora reiuiloides* Mer. Black sea (Crimea); magnif. 630.
  
- » 26. *Licmophora rostrata* Mer. Sebastopole ; magnif. 630.
  
- » 27. *Licmophora semiasymmctrica* Mer. Black sea (Crimea); magnif. 1260.
  
- » 28. *Licmophora spicula* Mer. Adriatic (Pola); magnif. 630.
  
- » 29. *Licmophora sabundulata* Mer. Adriatic (Pola); magnif. 630.
  
- » 30. *Licmophora Thumii* Mer. California; magnif. 630.

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