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CONTRIBUTIONS TO OUR

# KNOWLEDGE of the FRESHWATER

Algae of Africa

I. Some Freshwater Algae from Madagascar

BY

F.-E. FRITSCH, D. Sc., Ph. D.

Professor of Botany, East London College, University of London.  
(With Plate I)

*Fritsch, Madagascar 1914 p. ....*

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# Contributions to our Knowledge of the Freshwater Algae of Africa

## I. Some Freshwater Algae from Madagascar

BY

F. E. FRITSCH, D. Sc., Ph. D.

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[With Plate I].



In 1912 I received from Prof. Pearson of the South African College a small collection of nine tubes of Freshwater Algae, gathered by the Hon. P. A. Methuen in Madagascar, and my thanks are due both to the collector and to Prof. Pearson for placing the material at my disposal. Messrs. W. and G. S. West in 1895 published a considerable contribution (1) to our knowledge of the Algae of Madagascar, the collections there reported upon containing a large number of new and interesting forms, especially Desmids. In the subsequent enumeration of species, those already recorded by Messrs. West from Madagascar are indicated by an asterisk.

The material in six of the tubes had been collected in July of 1911 at Analamagotra near Périnet, apparently largely from forest streams (tubes 1, 3, 5, 6, 7, 8); the contents of tube 4, collected in October of the same year, were from a locality Lolie Totzy, whilst tube 9 was collected in the same month from hot spings (112° F) at Andranomay. Tube 2 was without a label. In the following, only the numbers of the tubes are quoted, in each case after the appropriate form.

The sixth tube was very rich in Desmids, the bulk of the species recorded in the present paper being obtained from this sample. Apart from this, very few Desmids were observed. None of the samples contained many Diatoms, but these have,

(1) Trans. Linn. Soc. London, Vol. V, Part 2, 1895.

as far as possible, been determined, since up to the present nothing is known of the Diatoms of Madagascar. The discovery of *Batrachospermum huillense* is of considerable interest, since this species has only been once before recorded.

The present paper adds 58 species and 20 genera to the list of Madagascar Freshwater Algae; these include 3 new species, 4 new varieties and a number of new forms. The figures illustrating the paper are the work of my wife.

## ISOKONTAE.

## VOLVOACEAE.

*Volvox*.

1. *Volvox aureus*, Ehrenb., forma *madagascariensis* n. f. Familiis filialibus præmature liberatis, sæpe ovalibus (No. 4).

The colonies, which were purely asexual, showed the normal cell-structure of *V. aureus*, viz. rounded protoplasts from which numerous delicate processes could be seen radiating after staining with Kleinenberg's hæmatoxylin. The mature colonies exhibited from 4-8 gonidia in various stages of subdivision to form daughter-colonies. Only in very rare cases, however, were fully developed daughter-colonies observed lying loose within the mother-colony; on the other hand numerous young individuals were intermingled with the maturer colonies. One peculiarity of this form is therefore a very early liberation of the daughter-individuals, which is already known to occur in *V. aureus* (cf. L. Klein, Morph. u. biol. Studien über die Gattung *Volvox*, Pringsheim's Jahrb., XX, 1889, p. 144).

The liberated daughter-colonies exhibit a very dense aggregation of the cells, amongst which occasional larger ones can be recognised as the incipient gonidia; the daughter-colonies evidently escape a very considerable time before these reach their full size and commence to divide. A considerable number of the young colonies are oval in shape (two measured being  $210 \times 180 \mu$  and  $330 \times 280 \mu$  respectively) and a similar tendency towards an oval form is apparent in many of the mature individuals (e. g. one colony measured  $768 \times 678 \mu$ ).

G. S. West has recently described (Journ. Quekett Microscopical Club, Ser. 2, Vol. XI, 1910, p. 102) a *Volvox* from Africa (cf. also Journ. of Botany, 1909, p. 9), under the name of *V. africanus*, which is characterised by the ovoid shape of

the colonies and by their very late liberation from the mother-individual. The form here described however has oval colonies, with equal rounding of each pole, and appears to liberate its daughter-individuals very prematurely. It is possible that these characteristics mark a distinct species, but I prefer to await further material before coming to a conclusion on this point.

## CELASTRACEÆ.

*Raphidium*.

1. *Raphidium falcatum*, Corda.

var. *mirabile*, W. & G. S. West (*R. polymorphum*, Fresen. var. *mirabile*, W. & G. S. West, Journ. Roy. Microscop. Soc., 1897, p. 501) (No. 3).

Long. cell.  $89 \mu$ ; lat. cell.  $3 \mu$ .

## EDOGONIACEÆ.

*Edogonium*.

1. *Edogonium acrosporium*, De Bary; Hirn, Monogr. u. Iconograph. der Edogoniaceen, Act. Soc. Scient. Fennicæ, XXVII, 1900, p. 244, Tab. XII, fig. 254 (No. 4).

Crass. cell. veget.  $21 \mu$ ; altit.  $78-84 \mu$ .

Crass. oogon.  $51 \mu$ ; altit.  $59 \mu$ .

Growing on *Pithophora* sp.

A second smaller species of *Edogonium* (lat. cell.  $14 \mu$ ; long. cell.  $27 \mu$ ; lat. oogon. oboviform.  $25 \mu$ ; long. oogon.  $33 \mu$ ) was also growing on the *Pithophora*, but the material was inadequate for its determination.

## CONJUGATÆ.

## MESOCARPACEÆ.

*Mougeotia*.

1. *Mougeotia quadrangulata*, Hass. (No. 6).

Lat. cell.  $12 \mu$ ; lat. zygosp.  $30 \mu$ . The zygospores were perfectly square.

## ZYGNEFACEÆ.

*Spirogyra*.

1. *Spirogyra nitida* (Dillw.), Link (No. 4).

Lat. cell.  $63-83 \mu$ ; lat. zygosp.  $63-90 \mu$ ; long. zygosp.  $84-135 \mu$ .

Apart from this, several sterile species of *Spirogyra* and one of *Zyguema* were observed.

## DESMIDIACEÆ.

*Gonatozygon.*

1. *Gonatozygon Kinahani* (Arch.), Rabenh.; W. & G. S. West, Monogr. Brit. Desm., I, 1904, p. 35, Pl. II, fig. 1-3. (No. 6). Diam. 9-10  $\mu$ . Forming long filaments.

*Netrium.*

1. *Netrium Digitus* (Ehrenb.), Itzigs. & Rothe; W. & G. S. West, op. cit., I, p. 64, Pl. VI, figs. 14-16 (No. 6). Long. cell. 144-145  $\mu$ ; lat. cell. med. 45-46  $\mu$ ; lat. cell. apic. 18-20  $\mu$ .

*Penium.*

1. *Penium Navicula*, Bréb.; W. & G. S. West, op. cit., I, p. 75, Pl. VII, figs. 12-15, 19.
  - f. *major* apicibus truncatis, Borge, Süßwasser-Chlorophyteen von Feuerland und Isla Desolacion, Botan. Stud. tilläg. F. R. Kjellmann, 1906, p. 29, fig. 5 (No. 6). Long. cell. 90-93  $\mu$ ; lat. cell. med. 21  $\mu$ ; lat. apic. 9  $\mu$ .
2. *Penium margaritaceum* (Ehrenb.), Bréb.; W. & G. S. West, op. cit., I, p. 83, Pl. VIII, figs. 32-35 (No. 6). Long. cell. 62-129  $\mu$ ; lat. cell. 10-17  $\mu$ ; lat. apic. 7-12  $\mu$ .

*Closterium.*

1. \**Closterium Pseudodianæ*, Roy.
 

*forma* brevior et minus attenuata, W. & G. S. West, Freshw. Alg. Madagascar, loc. cit., p. 46, Pl. V, fig. 39 (No. 3). Long. 109-138  $\mu$ ; lat. 9-11  $\mu$ . The specimens were rather larger than those recorded by Messrs. West.
2. *Closterium Jenneri*, Ralfs; W. & G. S. West, op. cit., I, p. 134, Pl. XV, figs. 23-25 (No. 6). Long. 99  $\mu$ ; lat. 16  $\mu$ .
3. \**Closterium Leibleinii*, Kütz.; W. & G. S. West, op. cit., I, p. 141, Pl. XVI, figs. 9-14 (No. 3). Long. 132-135  $\mu$ ; lat. 15-17  $\mu$ . Messrs. West record a form with thickened apices, but this was not observed.
4. \**Closterium lanceolatum*, Kütz.; W. & G. S. West, op. cit., I, p. 149, Pl. XVII, figs. 9-10 (Nos. 3, 5). Long. 270-285  $\mu$ ; lat. 30-32  $\mu$ .

5. *Closterium peracerosum*, Gay.

var. *aethiopicum* W. & G. S. West, Journ. of Bot., 1897, p. 78, Pl. 365, fig. 9.

*forma* cellulis longioribus quam in forma typica, ventre vix tumido. Long. 277-312  $\mu$ ; lat. med. 15-15.4  $\mu$ . (Pl. I, fig. 13) (No. 6).

This variety of *C. peracerosum*, Gay comes rather close to *C. idiosporum*, W. and G. S. West and *C. substrigosum*, W. & G. S. West, both of which are however relatively much narrower.

*forma curvata*, cellulis subrectis in media parte, apicibus valde curvatis vel uno apice fere recto. Long. ab uno fine ad alterum 330-345  $\mu$ ; lat. 13-15  $\mu$  (Pl. I, figs. 11-12) (No. 6).

The cells of this form are practically straight in their middle portion, the ventral margin being flat, the dorsal one slightly convex, and the chloroplasts are confined to this part of the cell. The curved ends are occupied by colourless protoplasm, and each takes up about one-fifth of the length of the cell. The curvature is frequently even more pronounced than in the figures, the end portion being then almost at right angles to the middle part. Some individuals exhibit an equal curvature of both ends (fig. 11), whilst in others only one end is curved (fig. 12). Occasional cells were observed in which the two ends were curved in opposite directions, much as in some specimens of *Closterium Cornu*, Ehrenb. (cf. W. & G. S. West, op. cit., Pl. 20, fig. 3)

In shape these different forms are very much like those of *C. pseudospivotænium*, Lemm. (Plönc. Forschungsber., IV, 1895, p. 118-119, figs. 11-14), but the apices are not rounded, nor did I ever see any indications of a spiral torsion of the chloroplast.

6. *Closterium Methueni* n. sp. (Pl. I, fig. 7) (No. 6).

*C. parvum*, diam. circ. 6-7- $\mu$  longius, vix curvatum, dorso valde convexo, ventre recto vel in media parte exigue tumido, gradatim attenuatum apices obtusos truncatos et paullo porrectos versus; membrana modice incrassata, non striata, sed perumque rubescens; pyrenoidibus parvis in utraque semicellula in complures series longitudinales ordinatis.

Long. 127-180  $\mu$ ; lat. med. 19-30  $\mu$ ; lat. apic. 6-7  $\mu$ .

The characteristic features of this species are its practically flat ventral surface, the bluntly truncated ends which are often slightly produced, and the numerous small pyrenoids arranged in several longitudinal series. It would appear that the pyrenoids are situated in the longitudinal ridges, but since most of the individuals were crowded with starch, I am not certain of this point.

It differs from *C. lanceolatum*, Kütz. in the nature of the apices, the usually red coloured wall and in the arrangement of the pyrenoids; moreover the ventral surface in *C. lanceolatum* is commonly somewhat convex. From *C. Luoula* (Müll.), Nitzsch it differs in the same respects, as well as in its much smaller size. It bears some resemblance to *C. gibbum*, Borge, but this species is smaller and the ventral surface is slightly concave, nor are the apices produced as in *C. Methueni*. Another similar species is *C. spetsbergense*, Borge, which is however proportionately wider and differs in other respects. Compare also *C. Siliqua*, W. & G. S. West.

var. *ventricosa* nov. var. (Pl. I, fig. 8) (No. 6).

Differt ab forma typica margine ventrali plus minusve convexa, apicibus vix porrectis. Dimensiones ut in forma typica.

Some specimens of this variety are almost equally convex on the two surfaces, so that they strongly resemble individuals of a *Penium*; in most cases however the convexity is more marked on the dorsal than on the ventral surface (fig. 8). The form is a parallel one to West's *f. recta* of *C. striolatum*, Ehrenb. Apart from the truncate ends and the disposition of the pyrenoids, there is considerable resemblance to some forms of *C. lanceolatum*.

7. *Closterium Pritchardianum*, Arch.; W. & G. S. West, op. cit., I, p. 172, Pl. XXII, figs. 6-14.

var. *madagascariense* nov. var. (Pl. I, figs. 10, 19) (No. 5).

*C. permagnum*, diam. circ. 19-plo longius, vix curvatum, dorso leniter convexo, ventre leniter concavo non tumido; marginibus fere parallelis in majore parte cellule, apices versus subito convergentibus; apicibus angustis truncatis paullo recurvis; membrana modice incrassata, fusco rubra, striis punctatis subspiraliter ordinatis ut in forma typica, prope apices irregulariter dispositis; pyrenoidibus in utraque semi-

cellula 14-20, in seriem unicum axilem distributis. Long. 720-780  $\mu$ ; lat. med. 35-42  $\mu$ ; lat. apic. 7-8  $\mu$ .

This differs from the type: in being much longer, without a proportional increase in breadth; in the subparallel margins throughout the greater part of the cell, the attenuation to the apices only commencing about one-eighth of the length of the cell from each end; in the more marked concavity of the ventral margin; and in the large number of pyrenoids in each chloroplast. Nordstedt (Alg. Brasil., Öfvers. K. Vet.-Akad. Förh., 1877, No. 3, p. 16) has described a *f. maxima* of *C. Pritchardianum* which is almost as elongated (viz. 720  $\mu$ ) as var. *madagascariense*, but is much broader than the latter (viz. up to 65  $\mu$ ).

8. \**Closterium Kützingeri*, Bréb.; W. & G. S. West, op. cit., I, p. 186, Pl. XXV, figs. 6-11 (No. 6).  
Diam. 18-20  $\mu$ . With zygospores.

9. *Closterium rostratum*, Ehrenb.; W. & G. S. West, op. cit., I, p. 188, Pl. XXVI, figs. 1-5 (No. 6).  
Diam. 19-21  $\mu$ ; long. 300-350  $\mu$ .

10. \**Closterium setaceum*, Ehrenb.; W. & G. S. West; op. cit., I, p. 190, Pl. XXVI, figs. 9-13 (No. 6).  
Diam. 10-12  $\mu$ .

#### *Tetmemorus*.

1. *Tetmemorus granulatus* (Bréb.), Ralfs; W. & G. S. West, op. cit., I, p. 219, Pl. XXXII, figs. 7-9 (No. 6).  
Long. 127-143  $\mu$ ; lat. 30  $\mu$ ; lat. isthm. 25-27  $\mu$ .

#### *Euastrum*.

1. \**Euastrum ansatum*, Ralfs; W. & G. S. West, op. cit., II, p. 27, Pl. XXXVI, figs. 10-13 (No. 6).  
Long. 93  $\mu$ ; lat. med. 42  $\mu$ ; lat. apic. 24  $\mu$ ; lat. isthm. 15  $\mu$ .

2. \**Euastrum binale* (Turp.) Ehrenb.; W. & G. S. West, op. cit., II, p. 51, Pl. XXXVIII, figs. 28, 29.  
*f. Gutwinski* Schmidle; W. & G. S. West, loc. cit., p. 53, Pl. XXXVIII, figs. 31, 32 (No. 6).

Long. 18-19  $\mu$ ; lat. 12-15  $\mu$ ; lat. isthm. 5  $\mu$ . Crenations of basal angles distinct.

*Micrasterias*.

1. *Micrasterias truncata* (Corda), Bréb.; W. & G. S. West, op. cit., II, p. 82, Pl. XLII, figs. 1-8; Pl. XLV, figs. 5-6.

*Forma incisuris* inter lobum polarem et lobos laterales anguste linearibus, incisuris inter lobos laterales late apertis. Long. 120  $\mu$ ; lat. 105  $\mu$ ; lat. max. lob. polar. 65  $\mu$ ; lat. isthm. 24  $\mu$  (No. 6).

Each lateral lobe was provided with two bidentate processes with small knob-like thickenings, as in Messrs. West's fig. 7 (Pl. XLII).

2. *Micrasterias rotata* (Grev.), Ralfs; W. & G. S. West, op. cit., II, p. 102, Pl. XLVIII, figs. 1-6.

var. *ornata* nov. var. (Pl. I, figs. 17, 18) (No. 6).

*M. mediocris*, circ. 1  $\frac{1}{4}$  plo long. quam lat., late elliptica, profundissime constricta, sinu anguste lineari; semicellulae quinquelobae, incisuris inter lobum polarem et lobos laterales profundis linearibusque, iis inter lobos laterales minus profundis et leviter apertis; lobo polari ut in forma typica, vix prominente et angulis non bidentatis, sed apiculis duobus superpositis munitis, in utroque latere cum processibus binis bidentatis; lobis lateralibus subaequalibus, cum incisura primaria fere mediana et incisuris parvis secundis duobus, lobulis integerrimis vel plus minusve irregulariter bidentatis; uterque lobe lateralis cum processibus duobus bi-vel tri-dentatis in utroque latere, processibus cum iis lobi polaris seriem continuam intra marginem constituentibus; utraque semicellula in utroque latere supra isthmum spinis crassis conicis duabus munita. Membrana minutissime punctata.

Long. 255  $\mu$ ; lat. max. 195  $\mu$ ; lat. isthm. 30  $\mu$ ; lat. max. lob. polar. 63  $\mu$ .

It is possible that this should rather be described as a distinct species, but the general dimensions, shape of polar and lateral lobes, as well as the relative depth of incisions are very similar to the features of a typical *M. rotata*. The most striking characteristic of the new variety lies in the ten sub-marginal processes arising from each surface of the semicell, and in the prominent spinous outgrowths in the neighbourhood of the isthmus. The processes vary a good deal in different individuals; in some they are quite regularly bidentate

(fig. 18), in others the dentation is irregular as in the individual figured in fig. 17, a statement which also applies to the teeth on the margin of the semicell. The processes on the polar lobes are distinctly larger than those on the lateral lobes and extend somewhat beyond the margin. The spines near the isthmus are stout structures, circular in cross-section, and tapering to a sharp point.

The only specimens of *M. rotata* hitherto recorded as bearing surface-ornamentation are comprised in *f. evoluta*, Turn. (cf. W. & G. S. West, loc. cit., p. 104).

*Cosmarium*.

1. *Cosmarium Lundellii*, Delp.; W. & G. S. West, op. cit., II, p. 138.

var. *corruptum* (Turn.), W. & G. S. West, loc. cit., p. 139, Pl. LVII, figs. 5-6 (No. 6).

Long. 43  $\mu$ ; lat. 40  $\mu$ ; lat. isthm. 20  $\mu$ . A slightly smaller form than that recorded by Messrs. West and by Turner.

2. *Cosmarium pyramidatum*, Bréb.; W. & G. S. West, op. cit., II, p. 199.

*forma* lateribus non evidenter convexis, apicibus latoribus quam in forma typica Long. 74-78  $\mu$ ; lat. semicell. ad bas. 45-48  $\mu$ ; lat. apic. 24  $\mu$ ; lat. isthm. 15  $\mu$  (No. 6).

cf. *forma*, Borge (Alg. Regnell. Exped., Arkiv för Bot., I, 1903, p. 94, tab. 3, fig. 8).

3. *Cosmarium pseudopyramidatum*, Lund.; W. & G. S. West, op. cit., II, p. 201, Pl. LXIV, figs. 9-12 (No. 6).  
Long. 48  $\mu$ ; lat. 30  $\mu$ ; lat. isthm. 9  $\mu$ ; crass. 18  $\mu$ .

4. *Cosmarium pseudoconnatum*, Nordst.; W. & G. S. West, op. cit., III, p. 26, Pl. LXVII, figs. 19-21 (No. 6).  
Long. 53-54  $\mu$ ; lat. 41-42  $\mu$ ; lat. isthm. 34-38  $\mu$ ; 4 pyrenoids in each semicell.

var. *truncatum* nov. var. (Pl. I, figs. 2-4) (No. 6).

Differt ab forma typica apicibus evidenter truncatis membrana illic plus minusve incrassata, punctis membranae regularius dispositis; semicellulae a vertice visae circulares cum pyrenoidibus 4. Long. 57  $\mu$ ; lat. 45  $\mu$ ; lat. isthm. 39  $\mu$ .

The most characteristic features of this variety are its truncate slightly thickened ends and the more regular arrangement of the punctæ on the membrane, these latter appearing to be placed in radiating series near the margin of the semicell (cf. figs. 3-4). In var. *ellipsoideum*, W. & G. S. West the apices of the semicells are similarly flattened, but in this form the vertical view is broadly elliptic. Of *C. conicatum*, Bréb., West has described a var. *truncatum*, but this has a much more marked constriction and possesses two, not four pyrenoids in each semicell. In var. *truncatum* of *C. pseudoconicatum* the area in the middle of the cell in which punctæ are lacking is rather wider than in the type.

5. *Cosmarium arctoum*, Nordst.; W. & G. S. West, op. cit., III, p. 41.  
f. *minor*, West, loc. cit., p. 42, Pl. LXIX, figs. 3, 4 (No. 6).  
Long. 12  $\mu$ ; lat. 10  $\mu$ ; lat. isthm. 8  $\mu$ .
6. *Cosmarium Cucurbita*, Bréb.; W. & G. S. West, op. cit., III, p. 106, Pl. LXXIII, figs. 31-33, Pl. LXXIV, fig. 3 (No. 6).  
Long. 40  $\mu$ ; lat. med. 24  $\mu$ ; lat. isthm. 20  $\mu$ .  
var. *attenuatum*, G. S. West; W. & G. S. West, loc. cit., p. 108, Pl. LXXIII, figs. 34-36 (No. 3).  
Long. 45  $\mu$ ; lat. med. 23  $\mu$ ; lat. apic. 12  $\mu$ ; lat. isthm. 20  $\mu$ .
7. \**Cosmarium conicum*, W. & G. S. West, Trans. Linn. Soc., V, Part 2, 1895, p. 71, Pl. VIII, fig. 12 (No. 6).  
Long. 36-37  $\mu$ ; lat. med. 21  $\mu$ ; lat. isthm. 18-19  $\mu$ .  
This species comes very close to var. *attenuatum* of *C. Cucurbita*, especially if one compares fig. 12 a of Messrs. W. & G. S. West with figs. 34 and 36 on Pl. LXXIII of the British Desmids, Vol. III. The only important differences lie in the shape of the sinus and the transverse arrangement of the punctæ near the isthmus. I am not sure that *C. conicum* would not better be made a var. *conicum* of *C. Cucurbita*.
8. \**Cosmarium subspeciosum*, Nordst.; W. & G. S. West, op. cit., III, p. 252, Pl. LXXXIX, fig. 11 (No. 6).  
Long. 36-44  $\mu$ ; lat. 30-33  $\mu$ ; lat. isthm. 10  $\mu$ . Pyrenoide singulo in utraque semicellula.
9. *Cosmarium ochthodes*, Nordst.; W. & G. S. West, op. cit., IV, p. 10, Pl. XCVIII, figs. 1-3 (No. 6).

Long. 78-93  $\mu$ ; lat. 54-66  $\mu$ ; lat. isthm. 24  $\mu$ ; lat. apic. 21  $\mu$ ; crass. 36  $\mu$ .

10. \**Cosmarium decoratum*, W. & G. S. West, Trans. Linn. Soc., V, 1895, p. 61, Pl. VII, fig. 21 (No. 6).  
Long. 78  $\mu$ ; lat. 57  $\mu$ ; lat. isthm. 27  $\mu$ .
11. \**Cosmarium Pseudobroomei*, Wolle; W. & G. S. West, op. cit., IV, p. 22, Pl. C, figs. 7, 8 (No. 6).  
Long. 24  $\mu$ ; lat. med. 21  $\mu$ ; lat. apic. 12-14  $\mu$ ; lat. isthm. 10  $\mu$ .  
A rather small form.
12. *Cosmarium pseudamœnum*, Wille; W. & G. S. West, op. cit., IV, p. 31, Pl. CII, figs. 7-9 (Pl. I, fig. 1) (No. 6).  
Long. 37  $\mu$ ; lat. 20  $\mu$ ; lat. isthm. 13-16  $\mu$ . A rather small form with very small granules, appearing more like undulations of the membrane. Two pyrenoids in each semicell.

#### *Staurastrum.*

1. *Staurastrum trihedrale*, Wolle; Desm. United States, p. 123, Pl. XI, figs. 12, 13; W. & G. S. West, Trans. Linn. Soc., V, 1896, p. 260, Pl. XVI, fig. 29 (Pl. I, fig. 6) (No. 6).  
Long. 43-51  $\mu$ ; lat. med. 33  $\mu$ ; lat. apic. 11  $\mu$ ; lat. isthm. 11  $\mu$ . The specimens were slightly larger than those recorded by Messrs. West and differed from them in two other respects, viz. a somewhat wider sinus and far fewer and smaller scrobiculations which moreover were arranged in vertical series. Possibly these characters mark a distinct form of the species, but the material was too scanty to admit of a satisfactory decision as to the constancy of these features.
2. *Staurastrum alternans*, Bréb.; W. & G. S. West, op. cit., IV, p. 170, Pl. CXXVI, figs. 8, 9 (Nos. 3, 6).  
Long. 27  $\mu$ ; lat. 24  $\mu$ ; lat. isthm. 8  $\mu$ .
3. *Staurastrum claviferum*, W. & G. S. West, Trans. Linn. Soc., V, 1896, p. 259, Pl. XVI, fig. 25.  
f. *minor*, semicellulis dorso minus convexis, spinis plus æqualibus quam in forma typica (Pl. I, figs. 14-16) (No. 6).  
Long. sine spin. 27-30  $\mu$ ; lat. sine spin. 26-27  $\mu$ ; lat. isthm. 10-12  $\mu$ .  
The specimens agreed with those figured by Messrs. West except in the smaller dimensions, the slightly smaller spines and the less marked convexity of the dorsal surfaces of the



semicells. Both in side- and end-views the middle of each semicell was either free of spines (cf. however fig. 14) or bore very minute ones (figs. 15, 16), but there was not always so marked a difference between the size of the spines at the angles and those found at other points, as in the specimens from the United States (fig. 14). Moreover the larger spines at the angles often appeared to grade over into the others. Each semicell contains a three-lobed chloroplast with a single pyrenoid.

In 1897 Messrs. W. and G. S. West (cf. Freshw. Algæ of the South of England, Journ. Roy. Microscop. Soc., 1897, p. 493, Pl. VI, fig. 18) described a var. *erostellum* of *S. rostellum*, Roy et Biss., a species which has since been regarded as synonymous with *S. cosmospinosum* (Börg.), W. and G. S. West. This variety appears to be very near to *S. claviferum* and is probably a still smaller form of this species than the one described in the present paper. The principal differences lie in the somewhat flattened ends of the semicells, in the distribution of the spines, and in the sides appearing rather more concave in end-view. I certainly do not think it belongs to *S. rostellum*, Roy et Biss. (= *S. cosmospinosum*).

Another rather similar form is var. *minimum*, G. S. West of *S. pilosum* (Näg.), Arch. (cf. Journ. Linn. Soc., XXXVIII, 1907, p. 125, Pl. VI, fig. 5), but here the spines are all of the same size and uniformly distributed.

#### *Hyalotheca.*

1. *Hyalotheca dissiliens* (Sm.), Bréb.; Ralfs, Brit. Desm., 1848, p. 51, Pl. I, fig. 1.

Lat. cell. 18-21  $\mu$ ; long. cell. 12-15  $\mu$ ; diam. vag. 30  $\mu$  (No. 6).

This is probably a form of var. *minima*, Schmidle (Bih. K. Sv. Vet.-Ak. Handl., XXIV, 1898, p. 11, tab. I, fig. 5).

#### *Desmidium.*

1. *Desmidium Swartzii*, Ag.; Ralfs, loc. cit., p. 61, tab. IV (No. 6).

Long. 20  $\mu$ ; lat. 35  $\mu$ ; lat. isthm. 25  $\mu$ . No sheath. The material also included specimens of var. *quadrangulatum* (Ralfs), Roy.

2. *Desmidium coarctatum*, Nordst., K. Sv. Vet.-Ak. Handl., XXII, 1888, No. 8, p. 25, Pl. II, fig. 3 (No. 6).

Long. 24-27  $\mu$ ; lat. 38-42  $\mu$ ; lat. apic. 18-20  $\mu$ ; lat. isthm. 30  $\mu$ .

The specimens differed from those originally described by Nordstedt in having rather broader apices and in somewhat larger dimensions. A mucilage-sheath (diam 50-55  $\mu$ ) was present in many specimens. There appeared to be but a single pyrenoid in each semicell.

#### *Gymnozyga.*

1. *Gymnozyga moniliformis*, Ehrenb.; Ralfs, loc. cit., p. 58, tab. III (*Didymoprium Borreri*, Ralfs) (No. 6).  
Small specimens. Diam. 15  $\mu$ ; long. 22-25  $\mu$ .

#### CYANOPHYCEÆ (MYXOPHYCEÆ).

##### CHROOCOCCACEÆ.

#### *Clathrocystis.*

1. *Clathrocystis æruginosa* (Kütz.), Henfrey; Hansgirg, Prodr. dromus, II, 1892, p. 146 (No. 4).

#### *Oscillatoria.*

1. *Oscillatoria simplicissima*, Gomont, Monogr. d. Oscill., Ann. Sci. nat., 7 sér., XVI, 1892, p. 219, pl. VII, fig. 1 (No. 3).

Diam. fil. 6-7  $\mu$ .

2. *Oscillatoria tenuis*, Ag.; Gomont, loc. cit., p. 220, Pl. VII, figs. 2-3 (Nos. 5, 6).

Diam. fil. 5-6  $\mu$ .

3. *Oscillatoria amphibia*, Ag.; Gomont, loc. cit., p. 221, Pl. VII, figs. 4-5 (No. 9).

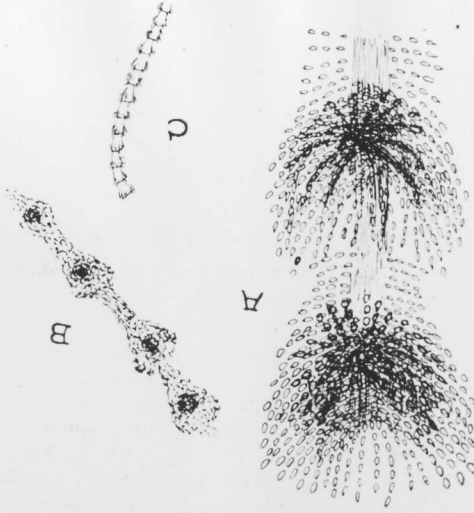
Diam. fil. 2-5  $\mu$ . Filaments much curved; cells several times as long as broad; cell-contents almost without granules.

##### FLORIDEÆ.

#### *Batrachospermum.*

1. *Batrachospermum moniliforme* (L.), Roth, Flor. germ., III, 1800, p. 450; Rabenhorst, Flor. Europ. Alg., III, 1868, p. 405 (No. 1).

2. *Batrachospermum hullense*, Westw. M. S.: W. and G. S. West, Weitsch's Afr. Freshw. Algae, Journ. Bot., 1897, p. 3 (text-figure A-C) (Nos. 1, 7).



As far as I am aware, this species has hitherto only been recorded from Huilla in Angola. The richly branched threads show a very characteristic appearance, when examined with a lens; each segment of a thread (i. e. internode + superjacent node) appears more or less wedge-shaped (fig. C), much as in *B. atrum*, Harvey, but *B. hullense* is at once distinguished from this species by the hairy tuft of rather long nodal branches. At a somewhat higher magnification the threads appear as in fig. B. Under the low power of the microscope (fig. A) the nodal branches are seen to be much more densely crowded and rather longer than the interstitial ones; the latter thin out more and more towards the base of the internode, so that at this point the cortical cells enveloping the main thread become conspicuous. Under lower powers consequently the base of the internode appears a good deal more transparent

than the upper part. The features just described are best seen on the more robust threads, the finer branches often showing more the beaded character of a *B. montiforme*. Both the nodal and the interstitial branches are considerably longer than the short papillose ones of a *B. atrum*, whilst the characteristic wedge-shape of the segments at once distinguishes *B. hullense* from forms like *B. vagum*. The maximum dimensions were as follows: — Diam. fil. prim. (c. ramul. lat.), 210  $\mu$ ; ad nod. 350  $\mu$ ; diam. ax. fil. prim. 120  $\mu$ . On the primary branches the internodes were frequently of considerable length, five or six times as long as those on the finer branches.

BACILLARIACEÆ

FRAGILARIACEÆ

*Synedra*

1. *Synedra Uta* (Nitzsch), Ehrbg.; Van Heurck, Synopsis d. Diatomées de Belgique, 1885, p. 150.

var. *splendens* (Kütz., Van Heurck, op. cit., p. 150, Pl. XXXVIII, fig. 2 (Nos. 3, 8).

Diam. 9  $\mu$ . In the one locality on *Pithophora* sp.

2. *Synedra capitata*, Ehrbg.; Van Heurck, op. cit., p. 152, Pl. XXXVIII, fig. 1 (No. 3).

Long. 460  $\mu$ ; lat. 10  $\mu$

3. *Synedra rotunda*, Kütz.; Van Heurck, op. cit., p. 151, Pl. XXXIX, fig. 11 (No. 1).

Long. 39  $\mu$ . Numerous individuals amongst *Batrachospermum*.

EUNOTIACEÆ

*Eunotia*

4. *Eunotia (Himmantidium) pectinatis* (Kütz.), Rabenh.; Van Heurck, op. cit., p. 142, Pl. XXXIII, figs. 15-16 (No. 8).

Long. 39  $\mu$ ; lat. 5  $\mu$ . Forming short bands on the surface of *Pithophora* sp. Shape of valve view rather like fig. 20 on Pl. XXXIII in Van Heurck.

## NAVICULACEÆ.

*Navicula.*

1. *Navicula affinis*, Ehrenb.; Schönfeldt, Bacillariales, in Süsswasserflora Deutschlands, Österreichs u. d. Schweiz, X<sup>o</sup>, 1913, p. 74, fig. 137 (No. 6).  
Long. 34  $\mu$ ; lat. 9  $\mu$ .
2. *Navicula gibba*, Kütz., Van Heurck, op. cit., p. 78, Atl. Suppl., fig. 12; Schönfeldt, op. cit., p. 109, fig. 235 (No. 6).  
Long. 51-70  $\mu$ ; lat. med. 10-12  $\mu$ .
3. *Navicula interrupta*, Kütz.; Van Heurck, op. cit., p. 89, Pl. IX, fig. 7-8; Schönfeldt, op. cit., p. 104, fig. 214 (No. 6).  
Long. 60  $\mu$ ; lat. med. 12  $\mu$ . In valve-view the sides were very slightly curved.
4. *Navicula Iridis*, Ehrenb., Van Heurck, op. cit., p. 103, Pl. XIII, fig. 1, Schönfeldt, op. cit., p. 74, fig. 138 (No. 6).  
Long. 72  $\mu$ ; lat. 22  $\mu$ . With very delicate oblique striæ.
5. *Navicula radiosa*, Kütz., Van Heurck, op. cit., p. 83, Pl. VII, fig. 20 (No. 3).  
Long. 78  $\mu$ , lat. 12  $\mu$ .
6. *Navicula rhomboides*, Ehrenb.; Schönfeldt, op. cit., p. 77, fig. 143 (No. 6).  
Long. 84-87  $\mu$ ; lat. 18-19  $\mu$ .
7. *Navicula acrosphæria*, Bréb.; Schönfeldt, op. cit., p. 106, fig. 228 (No. 3).  
Long. 87  $\mu$ ; lat. med. 12  $\mu$ .
8. *Navicula Tabellaria*, Ehrenb.; Van Heurck, op. cit., p. 78, Pl. VI, fig. 8 (Nos. 3, 5, 6).  
Long. 87-135  $\mu$ ; lat. med. 11-16  $\mu$ ; lat. apic. 12  $\mu$ . On the whole rather small specimens.
9. *Navicula (Pinnularia) madagascariensis* n. sp. (Pl. I, fig. 9) (No. 6).

*N. mediocris*, valvis in aspectu valvulari lanceolatis, marginibus subparallelis apices versus subito convergentibus, polis acutis rotundatis, area centrali parva ovali; striis robustis, 8-9 in 10  $\mu$ , in parte mediana (adversus plateam centralem) paullo brevioribus et radiatis, inde aream centralem versus curvatis;

in quarta autem parte longitudinis cellulæ vicina polis fiunt rectæ, denique polos versus convergunt; platea axiali angusta, ca. sexta parte diam. cellulæ, ante polos contrahente et angustissima; raphide curvata, paullo sigmoidea.

Long. 117-135  $\mu$ ; lat. 18-20  $\mu$ .

This species is characterised by (I) its shape, the pointed ends which are however a little rounded at the extreme tip being a very marked feature; (II) the shape of the median line which narrows down *before* the poles are reached, so that the striæ almost meet some little distance in front of the polar nodules; (III) the S-shaped curvature of the raphe; (IV) the arrangement of the striæ. Opposite the central area only one or two striæ are placed perpendicular to the margin of the valve, the remainder being prominently radiate. This radiate arrangement is continued beyond the central area, but in this region the striæ become curved, as shown in fig. 9. At about one quarter the length of the valve from each pole the striæ again become straight and perpendicular to the margin, this arrangement continuing until near the poles, where the striæ become convergent.

From *N. viridis*, Kütz. this species differs in the shape of the ends of the valves<sup>(1)</sup>, in the curved raphe, in the more numerous striæ, and in their different arrangement. From *N. dactylus*, Ehrenb. in the same features (apart from the character of the raphe), as well as in the much narrower median line and in the absence of the swelling in the middle of the valves.

10. *Navicula (Pinnularia) viridis*, Kütz.; Van Heurck, op. cit., p. 73, Pl. V, fig. 5 (No. 5).

Long. 165  $\mu$ ; lat. 25  $\mu$ .

11. *Navicula (Pinnularia) Dactylus*, Ehrbg.; Van Heurck, op. cit., p. 73, Pl. V, fig. 4 (No. 3).

Long. 202-220  $\mu$ ; lat. 31-33  $\mu$ .

12. *Navicula (Pinnularia) major*, Kütz.; Van Heurck, op. cit., p. 73, Pl. V, figs. 3-4 (No. 3).

Long. 270  $\mu$ ; lat. 32  $\mu$ .

(1) Although some of the specimens of *N. viridis* figured by W. Smith (Brit. Diat., Pl. XVIII, fig. 163) have rather pointed ends.

*Stauroneis.*

1. *Stauroneis acuta*, W. Smith, Brit. Diat., I, 1853, p. 59, Pl. XIX, fig. 187; Van Heurck, op. cit., p. 68, Pl. IV, fig. 3 (No. 8).  
Long. 117  $\mu$ ; lat. 21  $\mu$ .
2. *Stauroneis Phaeniceron*, Ehrbg.; Van Heurck, op. cit., p. 67, Pl. IV, fig. 2 (Nos. 3, 5).  
Long. 120-175  $\mu$ ; lat. 30-40  $\mu$ .

*Gyrosigma.*

1. *Gyrosigma acuminatum*, Kütz. (*Pleurosigma acuminatum* (Kütz.), Grun.; Van Heurck, op. cit., p. 117, Pl. XXI, fig. 12) (No. 4).

## GOMPHONEMACEÆ.

*Gomphonema.*

1. *Gomphonema intricatum*, Kütz.; Van Heurck, op. cit., p. 126, Pl. XXIV, figs. 28, 29 (No. 8).  
Long. 36-60  $\mu$ ; lat. med. 6  $\mu$ . On *Pithophora* sp.

## COCCONEMACEÆ.

*Amphora.*

1. *Amphora ovalis*, Kütz.; Van Heurck, op. cit., p. 59, Pl. I, fig. 1 (No. 3).  
Very small specimens. Long. 27  $\mu$ ; lat. 15  $\mu$ .

## SURIRELLACEÆ.

*Surirella.*

1. *Surirella robusta*, Ehrenb.  
var. *splendida*, Kütz.; Van Heurck, op. cit., p. 187, Pl. LXXII, fig. 4 (No. 3).  
Long. 150  $\mu$ ; lat. 52  $\mu$ . I am not sure of this determination as the specimens were very poor.

## FLAGELLATÆ.

## EUGLENACEÆ.

*Euglena.*

1. *Euglena granulata* (Klebs), Lemm. Süßwasserfl. Deutschlands, Osterreichs und d. Schweiz, II, 1913, p. 131 fig. 211 (No. 6).  
Long. 90  $\mu$ ; lat. 24  $\mu$ . Cilium about as long as the body.

*Trachelomonas.*

1. *Trachelomonas hispida* (Perty), Stein; Lemmermann, op. cit., p. 149, fig. 272 (No. 6).  
Long. 35  $\mu$ ; lat. 22  $\mu$ .
2. *Trachelomonas africana* n. sp. (Pl. I, fig. 5) (No. 6)  
Testa ovale concinna utroque fine truncata, 2-3 plo long. quam lat., brunnea. Porus flagelli parvus, collari elongato et valde prominenti, 5  $\mu$  alto circumdatus. Membrana glabra paullo incrassata. Contentus flagellumque ignoti  
Long. 27-33  $\mu$ ; lat. 12  $\mu$ .

The shape of the cell in this species is quite different to that of any hitherto published, and this leads me to describe it as a new form, although I was unable to make out the nature of the cell contents or the flagellum.

East London College,  
March 24<sup>th</sup>, 1914.

## DESCRIPTION OF PLATE

- Fig. 1. *Cosmarium pseudamœnum*, Wille, forma ( $\times 840$ ).
- » 2-4. *Cosmarium pseudocommatum*, Nordst var. *truncatum* n. var. ( $\times 400$ ).  
Figs. 2 and 4, front view; fig. 3, end-view showing the four pyrenoids in the semicell and the arrangement of the punctæ at the margin of the semicell.
- » 5. *Trachelomonas africana* n. sp. ( $\times 840$ ).
- » 6. *Staurastrum trihedrale*, Wille, forma ( $\times 400$ ).
- » 7. *Closterium Methueni* n. sp. ( $\times 620$ ).
- » 8. » » var. *ventricosa* n. var. ( $\times 620$ ).
- » 9. *Navicula madagascariensis* n. sp. ( $\times 620$ ). The striae are only shown on the upper half of the valve.
- » 10. *Closterium Pritchardianum*, Arch. var. *madagascariense* n. var. ( $\times 160$ ).
- » 11-13. *Closterium peracerosum*, Gay var. *æthiopicum*, W. & G. S. West, formæ ( $\times 400$ ).
- » 14-16. *Staurastrum claviferum*, W. & G. S. West ( $\times 840$ ).  
14, seen obliquely from the front; 15, front-view; 16, end-view.
- » 17-18. *Microsterias rotata* (Grev.), Ralfs var. *ornata* n. var. ( $\times 400$ ). 18, small part of the margin of a more regular specimen than that shown in fig. 17.
- » 19. *Closterium Pritchardianum*, Arch. var. *madagascariense* n. var., apex of cell ( $\times 400$ ).

