

TRANSLATIONS.

ALGARUM UNICELLULARIUM GENERA nova et minus cognita,
præmissis OBSERVATIONIBUS de ALGIS UNICELLULARIBUS
in genere.

*New and less known Genera of UNICELLULAR ALGÆ, preceded
 by OBSERVATIONS respecting UNICELLULAR ALGÆ in general.*
 By ALEX. BRAUN. (Lipsiæ, 1855; with six Plates.)

Continued from No. XVII, p. 16.

IN one respect only does the question appear to require more strict definition, a careful distinction should be made between *Algæ* which are unicellular only in the looser sense of the term, and those which have a more direct title to the name; for several genera of *Algæ* (among the *Palmellaceæ*, *Desmidiaceæ*, and *Diatomaceæ*), though formed indeed of isolated cells, or of cells loosely connected merely by a gelatinous matter, nevertheless exhibit a vegetative division of the cells, by means of which they are multiplied through a more or less extended series of generations, until the cycle of vegetation terminates in the production of *gonidia* or of spores. In these genera, therefore, as in the multicellular *Algæ*, divers generations of cells are to be distinguished:— 1, *ordinal*,* which by their conjunction constitute the vegetating individual, either continuous, or broken up and dissected into parts (individuals of a lower order); and 2, *cardinal*,† by which fructification is accomplished, and the transition to a new series of ordinal cells effected. It is obvious, therefore, that *Algæ* of this kind, since they really pass through a multicellular vital cycle, and are unicellular only in appearance (pseudo-unicellular), must, in a biological sense, be regarded as multicellular; whence it is readily seen that they cannot be separated from other multicellular *Algæ* formed of contiguous cells, by any strict line of demarcation either morphological‡ or systematic.§ Unicellular *Algæ*, in

* 'Reihengenerationen,' Näg. einz. Algen, p. 25.

† 'Uebergangsgeneration,' *ibid.* (Schlussgeneration).

‡ Compare the *Diatomaceæ* and solitary *Desmidiaceæ* with the catenated forms: *Tetraspora* with the *Ulvæ*, through *T. bullosa*, which is referred by Thuret to the *Ulvaceæ*, under the name of *Monotrema*; compare also *Hormospora* with *Ulotriche*, *Stichococcus* with *Hormidium*, *Synechococcus* with *Oscillaria*, &c.

§ The *Diatomaceæ* and *Desmidiaceæ*, placed, according to Nägeli's classi-

the wider sense of the term, would be distinguished by a more essential character, if with them were conjoined all those which exhibit similar generations of cells, so that a specific idea is equally represented* in each cell, either free or united with others. But such a character, if the matter be more closely scrutinised, is scarcely anywhere really exhibited among *Algæ* endowed with the property of vegetative division, since, at any rate, the cells of the cardinal generation differ from the rest physiologically and sometimes also morphologically; and in the cells themselves of the ordinal generations some differences, which can hardly be regarded as fortuitous, and chiefly relating to magnitude,† may be observed. It is obvious, therefore, that in all these instances a specific idea can only be really completed by a certain cycle of cells.

The more strictly unicellular *Algæ*, however, present conditions altogether different, their entire and undivided vital cycle being completed by the continuous evolution of a single cell. In them there is no division of the cell throughout the whole course of vegetation, nor any multiplication and diversity of generations, since the same cell successively assumes the functions of *thallus* and of organ of fructification (of gonio-cyst or sporo-cyst, *vulg.* "sporangium"). But among these also some diversity is presented, by which the forms, in the strictest sense of the term, unicellular, are separated from those which, in a certain sense, hold an ambiguous place; for the unicellular *Algæ* differ with respect to the generation of the *gonidia*, which in some is effected by the direct separation and transformation of the cell-contents,‡ and in others is preceded by a previous repeated act of division.§ That the former are unicellular, in the strictest sense of the term, no one will doubt, since they exhibit no series of generations within the vital cycle; but the latter, which, after the unicellular state of vegetation, pass through intermediate *quasi* multicellular states, in order to complete their fructification, might be regarded as multicellular *Algæ*, if indeed the term cells could properly be applied to those transitory generations, composed merely of portions of the plasma of the primary

fructification, among the unicellular *Algæ*, are very closely allied to the *Zygnemacæ* among the multicellular *Algæ*; and in the same way the *Chroococcacæ* are intimately related to the *Nostochineæ* (in the wider sense).

* Nägeli, *inz. Alg.*, pp. 2 and 3.

† Compare the *Diatomacæ* and *Desmidiacæ* (especially the *Closteria*), as well as the *Gleocapsæ*, *Tetrasporæ*, &c.

‡ As in *Hydrocytium*, *Codium*, *Chytridium*, *Bryopsis*, *Botrydium*, and *Hydrodictyon*.

§ In *Cystococcus*, *Characium*, and *Pediastrum*.

cell (primordial or naked cells as they are termed), scarcely separated by any proper membranes, and presenting no indication of vegetative evolution. However this may be, it is clear that these transitory generations perform the functions of imperfect *gonidia*, destined to undergo a second division, on which account, and from their close similarity in habit* and other characters, this ambiguous section should perhaps be referred to the unicellular type, though it cannot be denied that a connecting link with the multicellular *Algæ* (pseudo-unicellular) is presented in it.

From the *unicellular Algæ*, besides the *pseudo-unicellular*, are also to be distinguished those which are typically *bicellular*, producing two heterogeneous cells, one of which constitutes a *thallus*, the other a *goniocytium* or a *sporocytium*. These plants have, it is true, a unicellular thallus, but have also *gonocytia* or *sporocytia* distinct from and exclusive of the *thallus*. The simplest state, such as is exhibited in extremely depauperate specimens of *Vaucheria*, represents a simple vegetating cell, terminated above in a single *goniocytium*. But generally a more complex bicellular type is exhibited in those forms, the vegetating cell branching in various ways, and consequently supporting several fructification-cells, which differ in different cases, according as they constitute *gonidia* and *spores*. In *Codium* but one mode of fructification (that of *gonidia*, within a *goniocytium*) is known, whilst in *Vaucheria*, *Achlya*, and *Saprolegnia*, a double, or even threefold kind of fructification may be observed.†

The author is not acquainted with a *tricellular* type of evolution among the true *Algæ*; but in the mycetoid plants analogous to *Algæ*,‡ this mode of evolution is manifested very distinctly in *Pilobolus*,§ which is truly a tricellular *fungillus* whose thallus is divided into two cells—a root, as it were, and a stem, which supports a third cell (*sporocytium*).

* Compare, for instance, *Characium* with *Hydrocytium*, *Pediastrum* with *Hydrodictyon*.

† The corniculate ramules of *Vaucheria* which accompany the lateral sporocytia containing hypnospores, from the observations of Karsten (Bot. Zeit., 1852, p. 86), which, however, should be received with caution, the author scarcely doubts to be *gonocytia*, emitting lesser zoogonidia (microgonidia). [On this point *vide* Pringsheim's observations, given in the 'Quarterly Journal of Microscopical Science,' vol. iv.] Hence it will be perceived that *Vaucheria* presents a triple apparatus of fructification.

‡ The mucorine *Fungi*, amongst which *Pilobolus* belongs, together with the closely allied *Saprolegnia* (including *Leptomitium lacteus*), wholly agree with the *Vaucheriaceæ* (and with the *Codiææ*) in their usually unicellular *thallus*, and the endogenous formation of their spores.

§ Cohn, in Nov. Acta Nat. Curios., 23, 1, p. 492, tab. 51.

But to return to the true unicellular *Algæ*. The number of genera belonging to this class at present known is small, but amongst them great diversity exists. The greatest care is requisite in their determination as independent organisms; nor should this be decided, unless every stage of their evolution from beginning to end is known. Especially must we be careful not to regard the young state of *Algæ* of a higher order, or depauperate generations (*paupercula*), as unicellular genera.* Nor, on the other hand, should less caution be observed not to confound associations of unicellular *Algæ* with the multicellular. For in several genera of the latter class the closest and most regular associations of distinct individuals, which at first are sometimes freely motile, are met with. These forms are in the highest degree fallacious, presenting as they do a false resemblance to a cellular texture. They are well worthy of more particular attention, and a comparison of them with the families or colonies of the pseudo-unicellular *Algæ* may not be considered superfluous. These compound bodies, however, in *Algæ*, more or less properly speaking unicellular, formed by the association of cells, are so well treated of by Nägeli ('Einz. Algen.,' p. 24), as regards their origin, composition, and diversity of form, that the author has scarcely anything to add beyond certain distinctions, belonging more especially to unicellular *Algæ* in the stricter sense of the term. For the associations of *Algæ*, less properly so termed, or of the pseudo-unicellular class, are always formed by the vegetative multiplication of cells; and those of the really unicellular by true propagation: the former, therefore, merely represent individuals divided into more or less independent and loosely coherent parts, and cannot be distinguished by any strict definition from a continuous thallus; whilst the latter are really constituted of several individuals distinct from the first. The associations of pseudo-unicellular *Algæ* are evolved from a single cell (spore or *gonidium*) by successive multiplication, the number of cells gradually increasing through a more or less determinate series of generations; whilst the associations of the more strictly unicellular *Algæ*, on the contrary, are constituted of several cells (*gonidia*), distinct *ab origine*, the number of cells never increasing, owing to the absence of any vegetative division; the former, in fact, constitute *families* of cells, pro-

* *Paupercula* of this kind, that is to say, individuals normally depauperate, and curiously simulating 1-2 cellular parasitic plants, are produced in some species of *Ustilogonium*, as well as in *Bulbochete*, from microgonidia. Vide Braun, 'Rejuvenescence,' p. 151; Aut. de Bary, in 'Mus. Sekenb.,' 1854, pp. 63, 87, t. iii and iv.

ducing, from a single mother-cell, secondary, tertiary, and quaternary, &c., cells up to a certain stage; whilst the latter, formed, as it were, from sister-cells, and never producing any offspring admitted into the society, might rather be termed *cænobia*. One exception to this rule only is known to the author, presented in *Sciadium*, a strictly unicellular plant, but which is nevertheless evolved into a true family, formed, however, not by vegetative multiplication, but by way of propagation.

The author, therefore, from the foregoing considerations, would classify the associations of the lower *Algæ*, according to their principal differences, in the following manner:

- A. An association evolved by successive generations of cells from a single mother-cell (spore, *gonidium*): **FAMILIA**;
- a. Cells arising by vegetative division (more or less distinct, but retained in connection by means of the parent membrane): the family representing an individual biologically single (a thallus broken up):
 - α. Order of cells immutable: *Hormospora!* *Palmodactylon!* *Merismopædia!* *Tetraspora*, *Glæocapsa*, *Glæocystis*;
 - β. Order mutable: *Nephrocytium*, *Glæothece*, *Aphanothece*, *Apiocystis*.
 - b. Cells arising by true propagation: **FAMILIA CÆNORIOTICA**, composed of individuals really distinct: *Sciadium*.
- B. Association constituted of several cells (*gonidia*) originally distinct: **CÆNOBIUM**;
- a. Constituted of zoogonidia, which become united after a motile stage, and grow into immotile cells;
 - α. Order immutable: *Hydrodictyon*;
 - β. Order mutable: *Pediastrum*.
 - b. Of immotile gonidia, which grow into immotile cells;
 - α. Order immutable: *Scenedesmus*, *Sorastrum*;
 - β. Order mutable: *Celestrum?*
 - c. Of immotile gonidia, which change into vibratory cells;
 - α. Order immutable: *Gonium*, *Stephanosphaera*, *Synaphia*;
 - β. Order mutable: *Pandorina*.

To this arrangement another is subjoined, in which a synoptical comparative view is given of the differences exhibited in the lower *Algæ*, derived from the *simple* or *multiple* generation of cells described above:

- A. **MONOCYTIDEÆ**, or Unicellulares, exhibiting a unicellular vital cycle:
- a. True, or unicellular in the strictest sense of the term; no transitional generations of *gonidia*;
 - α. *Eremobia*, growing with a solitary cell: *Protococcus*, Næg., *Hydrocytium*, *Codiolum*, *Ophiocytium*, *Polyedrium?* (*Chytridium*);

- β. *Cænobia*, the unicellular individuals associated into a *cænobium* (pseudo-multicellular): *Hydrodictyon* ;
- γ. *Synöcobia*, associated into families (pseudo-multicellular): *Scidium* :
- β. Ambiguous, *i. e.* forming *gonidia* by means of transitional generations, and indicating the transition to the multicellular *Algæ* :
- α. *Eremobia*, as above : *Cystococcus*, *Charucium* ;
- β. *Cænobia*, as above : *Pediastrum*, *Scenedesmus*, *Gonium*, *Pandorina*, *Stephanosphaera*, *Synaphia*.
- B. OLIGOCYTIDEÆ, the vital cycle limited to few cells ; cells, two or three, heterogamous.
- α. Bicellular : *Codium*, *Faucheria* (*Saprolegnia*, *Achlya*) ;
- β. Tricellular : *Pilobolus*.
- C. POLYCYTIDEÆ, or multicellular, the vital cycle including many cells :
- α. *Homöocytideæ*, cells (the vegetative at any rate) subsimilar :
- α. *Schizocytideæ*, cells more or less separate from each other (pseudo-unicellular) :
- * *Choristobia*, cells quite separate : *Navicula*, *Closterium*, *Pleurococcus*, *Chroococcus*.
- ** *Synöcobia*, cells loosely connected by gelatinous envelopes, associated into families : *Schizoneua*, *Hormospora*, *Palmodactylon*, *Palmella*, *Hydrurus*.
- β. *Synechocytideæ*, cells contiguous (the family of cells becoming a continuous *thallus*) : *Himantidium*, *Desmidiium*, *Spirogyra*, *Oscillaria*.
- β. *Neterocytideæ*, cells obviously differing in nature : *Nostoc*, *Cylindrosporum*, *Rizularia*, *Citogonium*, *Bulbochete*, &c.

In this classification, the first section (A) alone contains *Algæ*, in the author's opinion, truly unicellular, although *Algæ*, unicellular according to Nägeli's definition, are included in sections A, B, and C, α, α and β (in part). It need scarcely be remarked, however, that all the sections in this classification taken from single characters are merely artificial, and do not correspond with families founded upon a real and intimate affinity. Nor, indeed, would it seem that all unicellular *Algæ*, in the stricter sense of the term, are of necessity so closely allied as to be included in a single and peculiar tribe ; points, the discussion of which is reserved till the description of each genus is given.

Some observations remain to be made respecting the terminology of the *Algæ*. The vegetative substance of the *Algæ*, as regards the varieties of forms, has received various appellations, but by Kützing it has been termed in general *phycoma*, for which the author would substitute *phytoma*, a

term extending to the vegetative substance of all plants. Were the term *phycoma* to be admitted, the *phytomata* of other classes of plants would also require to be designated by special names, *e. g.*, for the Fungi *mycoma*, for the Mosses *bryoma*, for the Ferns *pteridoma*, would have to be adopted, which the author regards as superfluous, since only two kinds of *phytomata* need be distinguished on morphological grounds, *viz.*, *phytoma cormodes* for the phanerogamous and higher cryptogamous plants, and *phytoma thalodes* for the lower cryptogams. The author, therefore, thinks it would be right to employ the term *thallus* to designate the vegetative body of both the Lichens and Fungi.

The cell is by him expressed by the Greek term *cytis*, which is also employed by others, whence the derivatives *cytioblastus*, *cytioplasma*, *cytioderma*.

(To be continued.)

Remarks on DR. STEIN'S DOCTRINE respecting the ACINETA-FORMS. By DR. H. CIENKOWSKI.

(From the 'Bulletin de la Classe Physico-Mathematique de l'Academie Imperiale des Sciences de St. Pétersbourg,' January, 1855.)

STEIN'S observations respecting the Infusoria have justly excited great astonishment among the micrographers. The wonderful phenomena of "Alternation of Generations" have been represented by this observer as occurring more extensively among the Protozoa than perhaps in any other class of animals. The *Vorticellina*, in consequence of a process of "encysting," are transformed into *Acinetæ*, and these again into *Vorticellæ*, by means of internal motile embryos, which are emitted from them.

In order to arrive at an independent judgment with respect to these *Acineta*-forms, I have examined the following species: *Podophrya fixa*, Ehr., the *Acineta* connected with it, and *Vorticella microstoma*, Ehr. Now, if the doctrine be substantial and not merely hypothetical, two important statements should be borne out by facts; *viz.*, the transition of the *Vorticellæ* into *Podophryæ*, and, secondly, the transformation of the offspring of the *Podophryæ* into *Vorticellæ*.

Stein arrived at the former conclusion by comparing *Podophryæ* remaining at an early stage of development with metamorphosed *Vorticella*-cysts. Among *Podophryæ* of the