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ORIGINAL COMMUNICATIONS.

On the Marine Diatomaceæ *of* Northumberland, *with a* Description *of* Several New Species. By Arthur Scott Donkin, M.D., L.R.C.S. Edin., Lecturer on Medical Jurisprudence in the Newcastle-on-Tyne College of Medicine, in connection with the University of Durham.

In my previous communication* on this subject, I believe I was the first to point out to observers, that in many localities on the sands of the open shore, marine Diatomaceæ, in a living state, can be collected in great abundance; and several to whom I have sent slides, or gatherings, have had opportunities of judging of their richness and purity; amongst whom I may mention my friends, Dr. Greville, Mr. Roper, and Mr. Okeden. Since the publication of my former contribution, the ample experience of three consecutive summers has led me to arrive at the conclusion, that the presence of Diatomaceæ on the sandy beach of still bays is not an accidental occurrence, or the result of peculiarities of season; but, on the contrary, that such localities are the natural habitat of the *free species* belonging to this highly interesting class of microscopic organisms, and that, in such localities, these species are annually, during the spring and summer months, generated in surprising abundance. But my observations have led me to infer that certain conditions are essential to their propagation on the open shore. These are—1, a clean sandy beach; 2, a still or calm condition of the water by which this beach is washed; 3, a certain degree of warmth in the sand.

On the first of these conditions I may remark, that mud seems to be inimical to the propagation of free marine species; for in muddy localities, otherwise favorable to their propagation, they are either entirely absent or very thinly scattered over the surface. As to the second condition, they are never found on such portions of the beach as are subject

* 'Trans. Micr. Soc. London,' vol. vi, p. 34, new series.

in ordinary weather to the influence of breakers, but only in sheltered quiet *nooks,* where the tide creeps up and retires again without producing waves, which, beating against the surface of the sand, soon dissipate its tiny occupants. For this reason, the collector may traverse miles of the shore otherwise suitable, without observing a single specimen, until he arrives at some sheltered cove, such, for example, as serves to protect the boats of the fishermen from the violence of the storm. In such favoured spots, the furrows left on the sand by the receding tide will be found to be covered by a chesnut or olive coloured stratum of Diatomaceæ, which may be collected in the manner described in my former paper. It is necessary to add, that these habitats should not be visited by the collector, except during the continuance of calm weather, as immediately after a storm all traces of Diatomaceæ will have disappeared. The third condition, however, seems to be as necessary as the other two; consequently, Diatomaceæ are only observed on the beach between the latter part of April to the beginning of September, as a general rule, when not only the stillness of the sea, but the warmth which the sands acquire from the direct rays of the sun during ebb-tide, favours their propagation. From September to April, the low temperature and the waves of winter prevent their development and aggregation.

I will only here remark, on the propagation of the Diatomaceæ, that although it has not been shown that they form *gonidia,* yet I have reason to believe that gonidia, in the form of *still* or *resting spores,* are the sources from which the new *crop* originates on the beach each successive spring. This opinion I have formed from the following facts. First, amongst the myriads of specimens of marine Diatomaceæ I have examined in the living state, I have never observed the process of conjugation. Secondly, I have, as a general rule, found the same species luxuriating in the same circumscribed locality (extending, in many cases, over only a few square yards) which yielded it in the previous summer. The presence of a particular form, year after year, in the same spot, would therefore appear to be due to the propagating cause, remaining buried in the sand during the winter, through the course of which not a diatom is to be found. Were the crop of each succeeding spring due to the subdivision of a single frustule, or of a few, accidently left by the tides, the same locality would produce, in all probability, widely different forms each returning season.

I may mention as a fact of some importance, that I have generally found the species most commonly met with on the beach, arranged in distinct zones, in the lower of which (that near the low water margin) the *Toxonideæ, Pl. lanceolatum, Pl. falcatum, N. lyra, N. forcipata,* &c., occur abundantly. In the upper zone, or that near high-water mark, the predominant forms are *Cocconeis excentrica, N. palpebralis, Amphiprora pusilla, Ep. marina, Nitz. virgata, Nitz. spathulata,* &c.; in the middle zone, *A. arenaria, N. granulata, N. humerosa, N. Clepsydra, N. Northumbrica, N. truncata,* &c., are abundant.

Before proceeding to describe the new species which I am about to introduce, I consider it necessary to make a few observations in defence of some of those already published in my previous contribution. Professor Walker Arnott has asserted that the two species forming my new genus *Toxonidea, T. Gregoriana* and *T. insignis,* are mere twisted or distorted conditions of *Pleurosigmata,* the former of *Pl. angulatum,* the latter of *Pl. æstuarii* or *Pl. lanceolatum,* Dr. Arnott observes,* "In Pleurosigma I have seen no instance in which the living frustule is twisted" * * * "the S. V. is sigmoid with the median line nearly equidistant from the two sides; but after the valves are detached from the connecting zone, they often become slightly twisted, and as they cannot then present a flat surface to the eye, the median line appears to approach nearer to the one margin than the other.* This is a confession and explanation of views, on the part of Dr. Arnott, in itself fatal to his hypothesis; for it shows that the twisting or distortion, which he avers the *Toxonideæ* have been subjected to, is not a vital change found in the living frustule, but is the result of boiling in acid, and of drying the valve on glass slides. To prove the inaccuracy of this assertion, I have only to observe, that I have examined numberless specimens of both *Tox. Gregoriana* and *insignis* in a living state, moving in their native element; and that the shape of the valve, and the relative position of all its parts, in each species, is exactly that represented by me in my description† and figures of them. To my own testimony I may be allowed to add that of my friend, Dr. Greville, to whom I sent a living gathering, abounding in these species. In nearly all the very numerous gatherings I have, from time to time, made on the Northumbrian shore during the last four summers, I have found the Toxonideæ in some localities in great abundance, and in all they preserve a remarkable uniformity of contour and markings. *Pl. angulatum,* on the contrary, is not a shore

* 'Micr. Journal,' vol. vi, p. 199.

† 'Trans. Micr. Soc. Lond.,' vol. vi, p. 19, new series.

diatom, as I have ascertained by ample experience in searching after living forms. It is not even a marine species, its habitat being the brackish water of the tidal estuaries, where it occurs abundantly. On the open shore, free from the influence of streams, its occurrence is very rare and accidental.

Pl. lanceolatum Dr. Arnott considers to be "a form of *Pl. æstuarii,* Sm., peculiar to clean sand."—'Micr. Jour.,' vol. vi, p. 197). "These two forms," he says, "have not been sufficiently isolated to permit any positive deduction to be drawn." This reads somewhat paradoxical; but I must reply, *first,* that *Pl. lanceolatum* is a very much larger form than *Pl. æstuarii,* and has not apiculate extremities; the colour of the valve is rich salmon, while that of the latter is bluish inclining to purple; secondly, that both are found in the typical state developed under the same conditions in the same localities, on the surface of the *clean sandy beach;* and thirdly, that I have gathered each form singly in separate localities. Dr. Arnott seems to found his opinion of the identity of these two species on the assertion of Professor Smith, that *Pl. æstuarii* is frequently "*direct.*" It is possible, however, that Professor Smith has confounded the two forms together.

Some observers have objected to *Epithemia marina,* that it is a *Nitzschia;* but with this opinion I cannot agree: it has neither the compressed frustule nor the *keeled* valve of that genus; on the contrary, its valve is *inflated,* and I have been able to detect on it a *median line* with central and terminal nodules, which is best seen in dry specimens, when the ventral surface of the F. V. is carefully brought into focus under a high power and good illumination. These characters of the valve, taken in connection with the ornamented appearance of the hoop, would prove the species in question to belong either to the genus *Amphora* or to be a member of a new genus; to the one or the other of which, it and the following closely allied forms, *Nitzschia virgata,* Roper, *Nitz. Amphioxys,* Sm., and *Nitz. vivax,* Sm., ought to be referred. In all of these the striæ are punctate.

In the first two sections of the following list, I have included all the species enumerated under Sections I and II of my former paper.

SECTION I.—*Species described in Professor Smith's Synopsis.*

a. Brackish Water Species.

Epithemia Musculus, Kütz.
" *Westermanii,* Kütz.
Epithemia Constricta, De Bréb.
Amphora affinis, Kütz.

Campylodiscus parvulus, Sm.
Surirella lata, Sm.
,, *Gemma*, Sm.
,, *fastuosa*. Ehr.
,, *Brightwelli*, Sm.
,, *ovata*, Sm.
,, *solina*, Sm.
Tryblionella marginata, Sm.
,, *punctata*, Sm.
,, *acuminata*, Sm.
Nitzschia sigma, Sm.
,, *bilobata*, Sm.
Navicula convexa, Sm.
,, *Jennerii*, Sm.
,, *Westii*, Sm.
,, *punctulata*, Sm.
,, *pusilla*, Sm.
,, *Amphisbœna*, *var.*, Sm.
Navicula elegans, Sm.
Pinnularia peregrina, Ehr.
Stauroneis crucicula, Sm.
Pleurosigma distortum, Sm.
,, *fasciola*, Sm.
,, *litorale*, Sm.
,, *Hippocampus*, Sm.
,, *Balticum*, Sm.
,, *quadratum*, Sm.
,, *angulatum*, Sm.
Synedra tabulata, Sm.
,, *gracilis*, Sm.
Amphiprora alata, Kütz.
,, *constricta*, Ehr.
,, *vitrea*, Sm.
Amphipleura sigmoidea, Sm.

b. Salt-water Species.

Cocconeis scutellum, Ehr.
,, *diaphana*, Sm.
Eupodiscus crassus, Sm.
,, *fulvus*, Ehr.
Actinocyclus undulatus, Kütz.
Coscinodiscus radiatus, Ehr.
,, *excentricus*, Ehr.
,, *concinnus*, Sm.
Triceratium favus, Ehr.
Campylodiscus Hodgsonii, Sm.
,, *Ralfsii*, Sm.
,, *clypeus*, Ehr. *rare*.
Nitzschia spathula, De Bréb.
,, *reversa*, Sm.
,, *closterium*, Sm.
Synedra superba, Kütz.
Navicula liber, Sm.
,, *pygmæa*, Sm.
,, *Smithii*, De Bréb.
,, *humerosa*, De Bréb.
,, *Crabro*, Ehr.
Navicula didyma, Kütz.
,, *palpebralis*, De Bréb.
,, *Lyra*. Ehr.
,, *Kennedyii*, Sm.
,, *retusa*. De Bréb.
Pinnularia Cyprinus, Ehr.
,, *distans*, Sm.
,, *directa*, Sm.
Stauroneis pulchella, Sm. *var*. pl. 19, fig. 1948.
Pleurosigma transversale, De Bréb.
,, *Nubecula*, Sm., *rare*.
,, *formosum*, Sm.
,, *elongatum*, Sm.
,, *delicatulum*, Sm.
,, *strigosum*, Sm.
,, *æstuarii*, Sm.
Doryphora Boeckii, Sm.
Amphitetras antediluvianum, Ehr.
Biddulphia aurita, De Bréb.
,, *Baileyii*, Sm.

Biddulphia rhombus, Sm.
,, *turgida*, Sm.
Gomphonema marina, Sm.
Achnanthes brevipes, Ag.
,, *subsessilis*, Kütz.
Rhabdonema arcuatum, Kütz.
,, *minutum*, Kütz.
Grammatophora marina, Kütz.
,, *serpentina*, Kütz.
Melosira nummuloides, Kütz.
Orthosira marina, Sm.
Isthmia enervis, Ehr.
Schizonema cruciger, Sm.

SECTION II.—*Species discovered since the publication of Professor Smith's Synopsis.*

Eupodiscus sparsus, Greg. Trans. Micr. Soc. vol. v, pl. 1, fig. 47).

Eupodiscus tesselatus, Roper. (Micr. Journal, vol. vi, pl. iii, fig. 1).

Coscinodiscus concavus, Ehr. (Greg. in Trans. Royal Soc. Edin. vol. xxi, part iv, pl. 2, fig. 47).

Coscinodiscus nitidus, Greg. (Trans. Royal Soc. Edin. vol. xxi, part iv, pl. 2, fig. 45).

Coscinodiscus ovalis, Roper. (Micr. Journal, vol. vi, pl. 3, fig. 4).

Amphiprora plicata, Greg. (Trans. Royal Soc. Edin. vol. xxi, part iv, pl. 4, fig. 57).

Amphiprora complexa, Greg. (Trans. Royal Soc. Edin. vol. xxi, part iv, pl. 4, fig. 62.)

Amphiprora maxima, Greg. (Trans. Royal Soc. Edin. vol. xxi, part iv, pl. 4, fig. 61).

Amphiprora pusilla, Greg. (Trans. Royal Soc. Edin. vol. xxi, part iv, pl. 4, fig. 56).

Amphora Grevilliana, Greg. (Trans. Royal Soc. Edin. vol. xxi, part iv, pl. 5, fig. 90).

Amphora cymbifera, Greg. (Trans. Royal Soc. Edin. vol. xxi, part iv, pl. 6, fig. 97).

Amphora robusta, Greg. (Trans. Royal Soc. Edin. vol. xxi, part iv, pl. 4, fig. 79).

Amphora lævis, Greg. (Trans. Royal Soc. Edin. vol. xxi, part iv, pl. 4, fig. 74).

Amphora lævissima, Greg. (Trans. Royal Soc. Edin. vol. xxi, part iv, pl. 4, fig. 72).

Navicula granulata, De Bréb. (Trans. Micr. Soc. Lond. vol. vi, pl. 3, fig. 19.

Navicula clavata, Greg. (Trans. Micr. Soc. Lond. vol. iv, pl. 5, fig. 17).

Navicula angulosa, Greg. (Trans. Micr. Soc. vol. iv, pl. 5, fig. 8).

Navicula rectangulata, Greg. (Trans. Royal Soc. Edin. vol. xxi, pl. i, fig. 7).

Navicula nitescens, Greg. (Trans. Royal Soc. Edin. vol. xxi, part iv, pl. 1, fig. 16).

Navicula formosa, Greg. (Trans. Micr. Soc. Lond. vol. iv, pl. 5, fig. 6).

Navicula rhombica, Greg. Trans. Micr. Soc. Lond. vol. iv, pl. 5, fig. 1). *N. libellus*, of the same author, is obviously a variety of this form (see Trans. Royal Soc. Edin. vol. xxi, part iv, pl. 6, fig. 101).

Navicula forcipata, Grev. (Micr. Jour. vol. vii, pl. 6, figs. 10 and 11).

Nitzschia virgata, Roper. (Micr. Jour. vol. vi, pl. 3, fig. 6).

Attheya decora, West. (Trans. Micr. Soc. vol. viii, pl. 7, fig. 15). This form I gathered in abundance at Cresswell, so long ago as June, 1857. That is long before Mr. West or Mr. Atthey were aware that Diatomaceæ were to be found on the beach there. It is horny, and not siliceous in its structure, and will therefore not bear boiling in acid.

From the above list I have excluded the following forms contained in the corresponding section of my former paper: *Navicula latissima*, Greg., a variety of *N. granulata*; *N. Maxima*, Greg. identical with *N. liber*; *N. Barclayana*, Greg. a large form of *N. palpebralis*; *Amphiprora lepidoptera*, Greg., which I inserted erroneously; and *Cocconeis distans*, Greg., of which I have only seen an imperfect specimen.

Section III.—*Species new to Britain.*

1. *Eupodiscus tenellus*, De Bréb. (Fig. 16). ("Diatom. Marin. du Littoral de Cherbourg," memoires de la Société Impériale des Sciences Naturelles de Cherbourg, tome ii, 1854).

Disc colourless, slightly convex, granular; granules moniliform, arranged in convergent lines; surface of disc divided into eight compartments by eight equidistant lines of coarser granules, reaching near to the centre; lines on either side of these interrupted a short distance from the margin; pseudonodule marginal.

Of this form De Brébisson justly remarks:

"L'ouverture marginale de cette espèce délicate est si peu distincte, et se confond tellement avec les granules, qu'il serait permis de douter qu'elle appartînt à ce genre, si la structure non celluleuse et la disposition de ses granules n'obligeaient à l'y rapporter."

Section IV.—*New Species.*

1. *Pleurosigma falcatum*, n. sp. (Pl. I, fig. 1).—Form of frus-

tule linear on S. V.; on F. V. falcate, or gently arcuate. V. pale straw colour, on S. V., narrow, linear, slightly sigmoid; extremities rounded; median line strongly sigmoid; on F. V. twisted laterally and falcate. Length from ·0060″ to ·0070″, breadth of S. V. about ·0006″; striæ oblique, fine.

The peculiar form of this singular species is owing to the entire frustule being *twisted laterally* on its *long axis*, and to its being curved in the form of an arc. The frustule has, therefore, one valve curved forward, and convex on its outer surface; the other bent backwards, and concave in its outer surface. The peculiar lateral twisting of the valve is well seen in its F. V. (fig. 1, c).

When examined in the living state, this species has all the appearance of a *Toxonidea*, between which genus and the *Pleurosigmata* it forms a connecting link; it is, however, a genuine *Pleurosigma*, in which the twisting and curvature of the frustule are natural and not accidental conditions. To examine the entire frustule in a prepared state, the material must be macerated in alcohol and ether, and afterwards roasted on a thin glass cover.

Hab. Cresswell and Boulmar Bay; plentiful, June to September, 1858 and 1859.

2. *Navicula Trevelyana*,* n. sp. (fig. 2).—Form on F. V. elongated quadrangular, constricted laterally; on S. V. linear, extremities rounded, margins slightly bulging out near the extremities and middle; valve exceedingly convex, inflated, with large *orbicular unstriated* space around central nodule; median line curved; striæ coarse, costate, strongly convergent around central nodule, strongly divergent near extremities. Length, from ·0040″ to ·0050″; breadth of S. V. about ·0008″.

This beautiful species I have found in gatherings with *N. rectangulata*, Greg., to which it is closely allied, but twice as large, and widely different in specific characters.

Hab. Cresswell and Duridge Bay. May, June, and July, 1857, 1858, and 1859. (fig 3)

3. *Navicula clepsydra*,† n. sp.—Form on F. V. elongated

* Dedicated to Sir Walter Calverley Trevelyan, Bart., Wallington, Northumberland.

† I have placed this species, as well as the new species of *Naviculæ* with costate striæ, described in this contribution, in the genus *Navicula*, because I believe the genera *Stauroneis*, Ehr., and *Pinnularia*, Ehr., to be merely sections of the genus *Navicula*, and the characters on which they are established of a purely *specific* nature. Even the late Prof. Smith did not adhere strictly to the definition of these two genera, as given by Ehrenberg, for we find in the 'Synopsis' that he places in the genus *Pinnularia* species which have the features of *Stauroneis*, i.e., *P. divergens*, *P. interrupta*, and *P. Stauronei-formis*. In like manner *Pinnularia Johnsonii*, Sm., is a Navicula in the acceptation of Ehrenberg.

quadrangular, constricted laterally; S. V. linear elliptical, extremities rounded; valve convex, compressed laterally, with an imperfectly orbicular stauros not reaching to the margin; striæ coarse, moniliform, monilæ irregular elongated. Length, from ·0025″ to ·0350″; breadth, from ·0008″ to ·0010″.

This species I have named from the hourglass-shaped outline of the F. V.; it is a very abundant littoral form, being present in the greater number of gatherings I have made from time to time on the Northumbrian shore; it is very little subject to variation in outline and striation; and though closely allied to *Stauroneis pulchella*, it differs from that species in being a much smaller form, in the outline of the F. V., in the much greater convexity of the valve, in its striation, and size and shape of the stauros. The var. of *S. pulchella*, figured by Professor Smith ('Synop.,' vol. i, pl. xix, fig. 194, *b*), is common on the Northumbrian shore, and seems to take the place of the typical form, which is rare.

Hab. Cresswell, Druridge Bay, Tynemouth; coast of Normandy, De Brébisson. (fig. 4)

4. *Navicula truncata*, n. sp.—Form on F. V. rectangular, constricted laterally, angles truncated. On S. V. narrow, linear elliptical; extremities subacute; valve convex, compressed laterally; striæ *costate, coarse, parallel*, reaching nearly to the median line. Length, from ·0025″ to ·0035″; breadth of S. V. about ·0005″.

Hab. Boulmar Bay, Druridge Bay, Cresswell, Tynemouth, abundant. Frith of Clyde, the late Professor Gregory. (fig. 5)

5. *Navicula Northumbrica*, n. sp.—Form on F. V. broad, quadrangular, with gently rounded angles, and slightly constricted laterally; striæ delicate, *moniliform*; those opposite and on either side of central nodule coarse and opaque, forming a dark bar, extending from nodule towards the margin of valve; valve highly convex, and compressed laterally, from the margins towards the median line, into a keel. S. V. narrow, lanceolate acute. Length, from ·0018″ to ·0030″; breadth of F. V., from ·0012″ to ·0018″, of S. V. ·0004″.

The delicate moniliform striæ and opaque line opposite the central nodules, as seen on the F. V., readily distinguish this form from its allies. The narrow acute S. V. is also very remarkable; for, owing to the valve being so strongly compressed and convex, its margins and median line cannot be brought into focus at the same time with a $\frac{1}{4}$-in. or a

$\frac{1}{5}$ objective; so that the striæ can only be examined on the F. V.

Hab. Very abundant on the Northumbrian shore, in several localities, from May to September, 1857, 1858, and 1859. Coast of Normandy, De Brébisson.

6. *Navicula hyalina*, n. sp. (fig. 6).—Form on S. V. gracefully elliptical, valve colourless, median line bordered on either side by an opaque, shadowy line, broad, gradually widening on either side of central nodule, and suddenly contracting near terminal nodules. Striæ very fine and delicate, probably 75 in ·0001″.

The gracefully elliptical outline, hyaline appearance of the valve, and its striation, more delicate than most of the finely marked *Pleurosigmata*, sufficiently distinguish this species from any of the marine *Naviculæ* with which I am acquainted. It is a severe test-object for the best objectives below a one-eighth inch focus.

Hab. Cresswell and Boulmar Bay, from July to September, 1858 and 1859.

7. *Navicula cruciformis*, n. sp.—Form on F. V. oblong, constricted laterally, extremities truncate. S. V. linear elliptical; valve convex, compressed laterally, colour brown; striæ costate, about 35 in ·001″, reaching to median line, absent from centre, so as to leave a stauros reaching to the margin. Length, about ·0030″; breadth of S. V. ·0006″.

The marine habitat alone, independent of structural peculiarities, distinguishes this species at once from *N. Brébissonii*, Kütz. (*N. Stauroneiformis*, Sm.), which is often gathered at very high altitudes, and which it somewhat resembles in its general appearance.

Hab. Boulmar Bay and Cresswell, abundant.

8. *Navicula arenaria*, n. sp.—Form on F. V. oblong, extremities truncate; on S. V. narrow, lanceolate, acute; striæ costate, coarse, slightly convergent opposite central nodule, reaching to the median line; length from ·0012″ to ·0012″.

This small form is the most abundant of the littoral species with which I am acquainted, with the exception of *N. gregaria*, the next form to be described, which, however, is more restricted to certain localities.

Hab. Boulmar Bay, Druridge Bay, Cresswell, Lyne Mouth, Newbiggin, Tynemouth.

9. *Navicula gregaria*, n. sp.—Form on S. V. broadly lanceolate, apiculate; striæ *obscure*.

This exceedingly minute form is very abundant in localities where small streams pass over the sandy beach into the sea, below the high-water level. In such situation it is therefore covered with fresh water for a short period during ebb tide, and with salt water for several hours during the flow. It is not, however, confined to the beach, but forms an olive stratum on the surface of the piers, stones, and piles of our harbours, between the high and low water level, and may be looked upon as the species which occurs in most abundance on our coasts.

In the gatherings I have made of this species I have observed that all the specimens, in a very short space of time, congregated and adhered around any extraneous matter present in the gathering, and that the groups thus formed adhered with wonderful tenacity. This phenomenon I have frequently observed under the microscope, and have been astonished to observe numberless individuals simultaneously directing their course towards the same object, as if controlled by an influence higher than physical force, to which alone the movements of the Diatomaceæ have been referred by many observers.

Hab. Chibburn mouth, Druridge Bay, Lyne Mouth, Blyth Harbour, Tynemouth.

10. *Amphora ocellata*, n. sp.—Form on F. V. broad, rectangular, extremities very slightly rounded, colourless; hoop on dorsal surface transversely and very delicately striated; valve inflated, finely striated, with a broad, hyaline band extending across it from posterior margin to central nodule; central nodule indefinite, marginal. Length, about ·0028″; breadth, about ·0014″.

The hyaline, transverse band gives rise to an opaque, eye-shaped spot on each margin of the frustule, when seen on the F. V. From a comparison of specimens of both forms, I feel satisfied that this species is distinct from *A. lævis*, Greg. ('Trans. R. Soc. Edin.,' vol. xxi, part iv, pl. iv, fig. 74).

11. *Amphora naviculacea*, n. sp.—Form on F. V. rectangular, angles slightly rounded, valve highly convex, median line gently curved; striæ on dorsal or outer half of valve *continuous*, and nearly parallel; an inner or ventral half coarser, *interrupted*, and *absent* opposite central nodule, strongly divergent on either side of it, and strongly convergent near terminal nodules. Length, from 0030″ to ·0035″; breadth of F. V. about ·0011″.

This species strongly resembles a *Navicula* in its F. V., though the want of symmetry of the valve on either side of the median line, even observable in this view of the frustule, easily determines its generic position.

Hab. Cresswell, common, May, 1858.

12. *Amphora lineolata*, n. sp.—Form on F. V. nearly rectangular, slightly convex laterally. Hoop with several longitudinal plicæ, finely striated transversely; valve slightly convex, arcuate on dorsal and linear on ventral margin, with delicate transverse striæ; median line gently curved. Length, about ·0030″; breadth of F. V. ·0012″.

Hab. Cresswell and Druridge Bay, May to August, 1857 and 1858.

SYSTEPHANIA, *Ehr.*

"Frustules orbicular; disc cellulose, neither septate nor radiate, with an external circlet of spines or an erect membrane on the disc, not on the margin; cellules in parallel rows. The spines are subalate, and not unlike the peristome of a moss." (Pritchard's 'Infusoria,' 4to edition, p. 832.)

Such are the characters given by Ehrenberg to a genus of which he has described three species, namely, *S. aculeata*, distinguished by its few spines (12 to 15) and coarse cellules *S. corona*, with numerous spines (40 to 50) and finer cellules; (about 11 in ·001″); and *S. diadema*, with numerous *incurved* spines and still finer cellules (about 13 in ·001″). These three species have only been found, hitherto, in a fossil state in the Bermuda earth.

13. *Systephania Anglica*, n. sp.—Valve circular, finely punctate; punctæ excentric; spines about nineteen, acute, and curved about the margin of the valve. Diameter, from ·0012″ to ·0015″.

I am glad to be able to add this most curious form to the list of British species; it is the only living representative of the genus hitherto discovered, and from the description above given it will be perceived it differs from *S. aculeata*, *S. corona*, and *S. diadema* in the number and nature of its spines and the minuteness of its areolæ. These are only visible, as excentric lines of punctæ, with a superior English one-fifth or one-eighth objective, and suitable illumination, and would, therefore, have been perfectly invisible by the glasses used by Ehrenberg.

Hab. Cresswell, May and June, 1858. Although this species is rare, I have examined several specimens from this locality.

DRURIDGIA,* nov. gen., *Donkin.*

Filament free, compressed, of two (or few?) frustules; frustules oblong or elliptical, geminate by the persistence of the connecting membrane; valve compressed, elliptical, punctate, siliceous throughout.

This new genus I have established to refer to it a species whose characters cannot be reconciled either to the genus *Podosira*, in which the filament is *attached*, the frustule *spherical* or *cylindrical*, and the valve *hemispherical*, with an *absence of silex from its apex;* or to *Melosira*, in which the filament is composed of *numerous cylindrical frustules*, with *hemispherical* valves.

14. *Druridgia geminata*, n. sp.—Filament of two frustules; cingulum transparent, delicate; frustule on F. V. oblong, with rounded angles, approaching to elliptical, brown when dry; hoop absent, or restricted to a mere line; valve compressed, on S. V. elliptical, minutely and obscurely punctate. Length, from ·0007″ to 0016″; breadth, ·0004″.

In the living state the endochrome presents a large, dark, circular spot at each angle of the filament.

In the previous number of this Journal Mr. West has described and figured (vol. viii, Pl. VII, fig. 11) a form, under the name of *Podosira ? compressa*, which seems, from his description, to be identical with *Druridgia geminata;* if so, Mr. West has represented the puncta to be much coarser and more scattered and distinct than they ought to be. So much so, that I feel assured that specimens could not be identified by his figure. Mr. West states that his *P. compressa* and *Atheya decora* were found in Druridge Bay and at Cresswell by Mr. Athey, of West Cramlington, from whom he derived his materials. Concerning the publication of these two forms by Mr. West, I think it just to observe that he was well aware, from a call he made me in December, 1859, that I had in my possession a large number of new MSS. species, discovered by me at Cresswell and other localities on the Northumbrian shore, all of which I intended shortly to publish, and only a few of which I had time to show to him on that occasion. Now, bearing this fact in remembrance, I hold that Mr. West, before publishing the two species in question, ought to have inquired whether they were amongst the number of MSS. species. If he had done so, I would have informed him that I discovered them both at Cresswell,

* From Druridge, Northumberland.

so long ago as the month of June, 1857, at a time, in short, when neither Mr. Athey nor any one else in this country knew that marine diatoms were to be found on the sands in such localities.

Navicula retusa, De Bréb. (fig. 17).—Form on F. V. oblong, angles rounded, constricted in the middle; S. V. linear, narrow, extremities rounded. Valve convex near the margin; striæ parallel, costate, subdistant, short, not reaching to the median line, shortest opposite the central nodule; median line delicate; middle third of valve hyaline. Length, from ·0020″ to ·0025″; breadth, about ·0004″.

Concerning this form, much confusion prevails amongst observers. I have thought it necessary to give a figure of it, to show more clearly the points of difference between it and *N. truncata* and *N. Northumbrica*, to which it is closely allied. The description I have above given of *N. retusa* corresponds with that of Prof. Smith, given in the appendix to the 'Synopsis,' and also with the description of the S. V. given by De Brébisson; it differs from its nearest allies, especially in the linear outline of its S. V., in its short thick striæ, cut short at a considerable distance from the median line, so that the middle third of the valve is hyaline. The F. V. figured by De Brébisson ('Diat. Litt. de Cherl.,' fig. 6) belongs to a different species—to *N. truncata*—although his delineation of the S. V. is correct in outline.

What the late Professor Smith meant by *N. pectinalis*, Bréb., is now somewhat uncertain. According to Professor Arnott, it was unknown to De Brébisson ('Microscopical Journal,' vol. vii, p. 177); its striæ, according to Smith's description, are 16 in ·001″, and therefore as coarse as those of *N. retusa*, but much coarser than those of *N. truncata* and *N. Northumbrica*. Professor Arnott, however, appears to be acquainted with *N. pectinalis*, and would confer a benefit on the science by describing and figuring it.

15. *Amphiprora fulva*, n. sp., Donkin ('Trans. Micro. Soc. Lond.,' n. sp., vol. vi, Pl. III, fig. 48).—Form on F. V. oblong, extremities rounded, gradually and deeply constricted in the middle; S. V. narrow, lanceolate, apiculate; valve slightly alate, compressed laterally; median line straight; striæ transverse, fine, probably 60 in ·001″; dry valve of a rich salmon colour. Length, from ·0050″ to ·0055″.

In my previous contribution (op. cit.), I described and figured the F. V. of this species as that of *Pl. lanceolatum*; but I have since discovered that, in doing so, I have committed an error, and use the present opportunity of correcting it. The F. V. of *Pl. lanceolatum* is that of a typical member of the genus, and is, therefore, not constricted in the middle.

Hab. Cresswell and Druridge Bay, plentiful.

CONTRIBUTIONS *to the knowledge of the* DEVELOPMENT *of the* GONIDIA *of* LICHENS, *in relation to the* UNICELLULAR ALGÆ. By J. BRAXTON HICKS, M.D., LOND., F.L.S.

Fasciculus II.

CLADONIA.

IN the former fasciculus I endeavoured to show that the green cell-growth everywhere covering trees, walls, palings, &c., which was commonly called "Chlorococcus," and ranked as an alga, was really, as had been suspected by some botanists, the *gonidia* of lichens, which, for an indefinite time, continuing to undergo segmentation, ultimately extended over considerable surfaces. I also showed that the *lichen-gonidium* and the *chlorococcus-gonidium* both went through the same changes of segmentation, and ultimately, by the production of a fibre, became a *soridium*, within which, again, certain conditions of segmentation went on till it became a *thallus* in miniature. I mentioned that, though these were the changes common to the generality of lichens, yet that there were some notable exceptions, one of the most remarkable being that found in the subject of the present contribution.

Although the following remarks have reference principally to *Cladonia pyxidata*, yet it must not be supposed that the changes are confined to it, for I have found them in at least two other species; besides which, as will be again noticed, they are to be found in other lichens of a different genus. I had proceeded some way with these observations when I had the pleasure of reading a communication on the same subject in the 'Botanische Zeitung' (January 5th, 1855), by J. Sachs, accompanied by figures, in which he points out the origin of *Gleocapsa* from *Cladonia pyxidata*. He has noticed it as proceeding from the ends of the felted fibres on the surface of the *thallus*. My observations go further than his, and also point out that it arises from within the *soridium,* and that, under varied circumstances, the changes which the *lichen-gonidium* undergoes are far more diversified than has been hitherto suspected.

If we observe carefully the *gonidia* on *Cladonia pyxidata,* we find them, generally at least, passing through the segmental stage in the same way as those of *Parmelia,* for instance, and in the same way as in *Chlorococcus;** and to proceed, in course of time, to the formation of *soridia,* by similar stages; and this holds if this lichen be growing in a dry position, or during a hot or dry season; but should the weather become damp, or the plant grow in a moist situation, or be removed to one, then the changes which form the basis of this fasciculus appear very constantly. I have noticed it in specimens from so many parts of the south of England, that it may, without hesitation, be said to be a normal condition.

To observe the early changes it will be necessary to break up the *soridium* by pressure, or otherwise; after a time the contents escape from one side of the soridium, or break up the whole simultaneously.

The first change observable is, that some of the segments become enveloped by a layer of mucus, inside of which subdivision still further proceeds, the portions in most cases possessing, after a little time, each a separate mucous envelope. This is shown in Plate II, at figs. 4, 6, 7. Thus, we have all the elements of a *Gleocapsa* (Kützing) growth. At first, commonly, the subdivision is maintained on the binary plan, which may continue for some time, as at fig. 7. Frequently the quaternary plan prevails, as at fig. 10. After a while the subdivisions become separated, each with a mucous layer, as in the smaller cells at fig. 8, the process of segmentation being arrested. Again, in some the mucous envelope of the original cell does not dissolve away while segmentation proceeds within, so that many of the Gleocapsiform cells have from one to three common envelopes (fig. 11, *a, a,* fig. 14, *a, a,* &c. &c). A condition being thus produced similar to Hassall's *Hæmatococcus rupestris* (*Gleocapsa polydermatica,* Kützing). In the same mass—the produce of the *Cladonia-soridia*—will be found every variety of subdivision, each form constituting a mass of a greater or smaller extent; generally, I may observe, (and this is a point worthy of notice,) but not always indiscriminately mingled, as if a particular kind having once commenced, it would, circum-

* See Fasciculus I, 'Microscopical Journal,' Oct., 1860.

stances continuing the same, proceed in the same direction for an unlimited time.

Mingled with the above, we find some large cells, generally globular, sometimes however oval (mother cells), without any mucous coat, which contain a number of very small, green cells (fig. 8, *b*, *c*). When these are set free by the bursting open of the mother cell-wall, they gradually become surrounded with a mucous envelope, and then appear as the other Gleocapsa-forms above noticed. These may produce ultimately mother cells, or may go on to any of the other forms. They are shown at fig. 8, *d*, fig. 9, *b*, in different conditions of growth. The oval mother cells sometimes are developed early, as seen at fig. 5, *b*. They may be solitary, as fig. 11, *b*, enveloped with a mucous layer, or even two layers, as at fig. 11, *c*; or combined within a common envelope, in groups of from two to twelve, or even more, as shown at fig. 9, *a*. The contents of these cells, on dispersion, become like those of the naked, round mother cells at fig. 8, *b*.

When the *soridia* undergoing this transformation are placed in water, the mucous envelope becomes much increased in diameter, the cells become more numerous and smaller, and assume the appearance of *Hæmatococcus alpestris* (*frustrulosus*, Hassall (fig. 15). It proceeds sometimes to such extreme division that the process seems almost indefinite, and the results resemble *Hæmatococcus theriacus* and *minutissimus*, Hass. (fig. 16, *a*). Segmentation here goes on in various ways, as seen in figs. 15, 16. The proportion the mucous coat bears to the cell is exceedingly variable, as shown in fig. 15.

Another result of this process is the formation of a group of large, oval cells, precisely similar to *Palmoglæa*, Kützing (*Cylindrocystis*, Meagh., *Coccochloris*, Hass.), each of them being surrounded by a mucous layer. At first, they are contained in a common, firm mucous envelope, of a purplish-brown colour, which, at first, extends between the various cells, as shown at fig. 12. The groups vary in number, from two to sixteen, or perhaps more. After a time, the outer purple coating breaks up, or dissolves away, and the contained *Palmoglææ* escape, and segmentation proceeds as in the above cases (fig. 14, *b*, *b*).

Each of the oval cells contains one or two distinct nuclei, as in *Palmoglæa Brébissonii*. After they have remained in water some time they assume the appearance represented at fig. 13, *a*, *b*, *c*, where the chlorophyll contents have acquired a round form, but of smaller size. These cells agree in every particular with the marks of the genus *Coccochloris,* Hassall, and seem visually identical with *C. Brébissonii.* I have not had any opportunity of testing whether they, like it, possess the property of conjugating; it is an interesting question for future investigators; nor is such a process by any means impossible, when it is remembered that it is merely an act of fusion, not of impregnation.

It will be seen that the mass ("frond") is at first definite, but becomes indefinite as soon as the common envelope is broken up or dissolved. After this these Palmoglæa-cells may multiply as *Palmoglææ,* till a large mass is formed, and then, circumstances changing, the cell-development proceeds in one of the other modes, which will account for the mass frequently possessing more or less of a uniform character throughout its whole extent. I have seen cells precisely similar to these amongst aquatic algæ, and which are *possibly* of the same origin. I say *possibly* because, from observations in other directions, I have good reason to believe that other vegetable organisms do, in some of their phases, form masses of *Gleocapsa*-like cells.

What other changes take place under varying circumstances in the *Cladonia-gonidium* it is impossible to say, but I am disposed to consider that by no means have all been noticed. Nor are they confined to *Cladonia* alone; I have found all the early changes sparingly in *Lecanora, Parmelia,* and one or two others: also the *Palmoglæa*-growth in *Parmelia;* and it is very probable that future observations may extend it to many others, for I shall, in a future contribution, show that there is considerable tendency in the gonidium to vary in other directions than those just mentioned.

The next point I wish to remark upon is, that about and amongst these masses of *Gleocapsa, Palmoglæa,* &c., fine fibres are to be found (tubular, jointed occasionally, and branching), which dip in between the component masses and cells, as I have drawn in figs. 11, 14 *c,* 17 *a,* and 18; such have also been noticed to exist in the masses classed under Palmellaceæ, and supposed by Thwaites * and others to belong to the cells. Under the belief that the Palmellaceæ were distinct algæ, their existence was very inexplicable, and their connection doubted. From the above remarks, however, the matter will, I think, be very easy of solution, for, as I noticed in the former fasciculus, the branches of the fibre of the soridium passed inwards, between the segments of the soridium. Now, when the Gleocapsa-formation takes place, these fibres (pro-

* 'Annals of Natural History,' Second Series, vol. iii, pp. 241, 243.

bably under the influence of the same moisture) elongate, become more delicate, and as the *soridium* breaks up they become detached, whilst their origin is rendered obscure. I have seen them gradually become very delicate, and dipping between the mucous covering of the *Palmoglœa*-form cells in almost every specimen. This, I think, clears up the mystery hanging over these delicate fibres, which have been a source of much disputation amongst some of our best observers in this branch. If the reader will refer to my former contribution on this subject, he will observe that it was remarked that the "Chlorococcus" of any given neighbourhood varied very constantly with the prevalent lichen of that spot, and this remark applies peculiarly to localities where *Cladonia* prevails. If any old wall where *Cladonia* is growing be observed carefully, it will be found that where the *Chlorococcus* has gone on to the formation of soridia (provided the weather be damp and moderately warm) that all the changes mentioned above are taking place within the latter. It will be seen that, sooner or later, over a considerable surface originally covered by *Chlorococcus*, the latter has been supplanted by a *Palmella*-form of growth, forming broad patches of a gelatinous "frond," and these growths proceeding rapidly, the stratum soon acquires considerable thickness. By comparing and tracing the formation of the *Cladonia-gonidium*, and its spreading away from the parent lichen to form a Chlorococcus, and by noting the subsequent changes it undergoes till it forms a broad patch of a *Palmella*-form growth, I conceive it will readily be conceded by any one taking the pains to observe that the origin of the latter so-called alga is as above described.

What are the required changes of circumstances which tend to direct cell-growth into this or that form of subdivision is still inexplicable; it suffices here to state a palpable condition; but whatever changes of form and appearance they may undergo, I have no doubt, from numerous observations, that even these *Gleocapsæ*, &c., do, by the condensation or desiccation of the mucous sheath and by the enlargement of the green cell, ultimately revert to the form of the original *gonidium* from which they arose.

Perhaps the best example in support of the above remarks is to be found on the *podetia* of *Cladonia pyxidata*, where, by watching from time to time the *gonidia* as they appear on the surface, the whole process may be observed. It may also be noticed at one and the same time on different parts of the *podetia*; for in the *scyphus*, or cup, are found the *Chlorococcus* stage and *soridia*; half-way down, the *Gleocapsa* stage; and at the base will be seen the latter changing into a small thallus—a squamule.

I have kept patches of *Chlorococcus* from the neighbourhood of *Cladonia* on the bark of trees and under glass till soridia appeared, and then it became in every respect a mass of *Gleocapsa*. I have never found *Cladonia pyxidata* without it, except in very dry situations; but when they were removed to a moist atmosphere the Gleocapsa appeared. The *Chlorococcus* from heathery places, where *Cladonia* alone grew, always produced the same results.

Besides the origin of *Gleocapsa, Palmoglœa, Sorospora,* &c., from the soridia, and besides the mode set forth by H. Sachs, there is another way in which the above organisms spring from *Cladonia.* In this latter the whole of the gonidial layer of the thallus sometimes becomes converted into them; the finest masses of *Palmoglœa* I have met with came from this source. In this condition the mucous layer of the cells is at first of small thickness, and more or less angular by mutual compression (being much as is seen in *Palmella cruenta,* only of a green colour), but as segmentation proceeds they overcome the resistance, expand, and become more globular. The resulting forms are then as I have above described as arising from the *soridia.* In some I have noticed a condition precisely like that of Hassall's *Coccochloris variabilis.* When all the gonidia of a thallus assume the *Gleocapsa* change the separate masses of each variety are of larger extent, but they even then are so blended as to preclude any doubt as to their common origin. In Plate II, fig. 18, I have shown a portion of these masses.

The felted fibres are more or less mingled with the *Gleocapsa* and other forms, and their presence in a mass of unknown origin will indicate its parentage.

It will be readily seen from the above observations that these facts have an important bearing upon the independent existence of many of the unicellular algæ.

In the accompanying plate will be observed almost every form of what has formerly been called *Hæmatococcus,* Agardh, and more recently *Gleocapsa,* Kützing. All these forms have been named as distinct species, but how unsatisfactorily so I leave the best observers to testify.

If it be a fact, as appears to me very evident, that all these forms can and do arise from one cell, then their existence as distinct species and genera is at an end, and in this I go further than Sachs, and consider that we must exclude *Coccochloris,* Spv. (*Palmoglœa,* Kützing), (for the growth found after immersion or in very damp situations possesses every character of that genus), and *Sorospora virescens*, Hassall (*Microhaloa*, Kützing).

Distinctions drawn from a defined or undefined condition, either at first or subsequently, of the mucous portion of the mass, I hold, as the result of numerous observations, to be valueless as a specific character, and the same may be said of the persistence of the parent mucous envelope to the second or third generation, such as forms the character of *Hæmatococcus*, Agardh (*Gleocapsa polydermatica*, Kützing), for in the plate accompanying this paper, and in that illustrating Sachs' paper,* every variety may be seen so intimately blended, that one can, by no possibility, deny their common origin.

Whether *Palmoglæa Brébissonii*, which may be frequently seen conjugating, be identical with the *Cladonia-Palmoglæa*, requires further observation to determine. The remainder of the British species of *Palmoglæa* or *Coccochloris* can certainly be produced from *Cladonia*. Nor do I consider the size of the cell of any importance as a specific character. From the remarks I have already made, and which I repeat here, it may be noticed, that the size of cells in a state of subdivision, however produced, depends on the rapidity of the segmentary process compared with that of the growth of the individual cell. When the former process is very active, then the resulting produce is small; but when it proceeds slowly, then the individual cells are larger, and continue to grow (so long as the segmentary process is kept in abeyance) till they arrive at full maturity.

As far as my researches have extended, the following forms, hitherto distinguished as species, have been observed to spring from the *soridium* of *Cladonia pyxidata*:

HASSALL.	KÜTZING.
Hæmatococcus rupestris.	*Gleocapsa polydermatica.*
,, *granosus.*	,, *granosa.*
,, *alpestris.*	
,, *frustulosus?*	
,, *arenarius.*	
,, *binalis.*	
,, *furfuraceus.*	
,, *lividus?*	
,, *æruginosus.*	,, *æruginosa.*
,, *theriacus.*	

* Op. cit.

HASSALL.	KÜTZING.
Hæmatococcus vulgaris.	*Gleocapsa vulgaris* (*Chlorococcus vulgare*, Greville).
,, *microsporus.*	,, *montana.*
,, *minutissimus.*	,, *confluens.*
Coccochloris protuberans.	*Palmoglæa.*
,, *variabilis.*	
,, *muscicola.*	
,, *hyalina.*	
,, *depressa.*	
,, *rivularis.*	
,, *Grevillii.*	
,, *obscura.*	
,, *Brébissonii?*	
Sorospora virescens.	*Microhaloa.*

And if we regard those similar forms of a red colour as merely a *winter* condition of those of green colour, which is now pretty well certain, then we must add to the above list, probably, *Palmella cruenta*, Hassall; *Hæmatococcus insignis* and *sanguineus*, Hassall; and some forms of *Protococcus nivalis*, Hassall.

It is very possible that, as observations extend, other lichen-gonidia may be found, yielding explanations of the life-history of many kindred forms. At the same time, because we have shown that the *lichen-gonidium* can produce *Gleocapsa*, *Palmoglæa*, &c., it is not hence, by any means, intended to be asserted that such is their sole origin; on the contrary, there can be little doubt but that other vegetable growths are, during certain vegetating processes, capable of giving rise to very similar cells. In either case, it seems we can no longer assign them that position they have hitherto held as separate existences; but they must fall before the extended study of the life-history of plants into the rank of but one of the many alternations which, it becomes more evident every day, many families of the vegetable kingdom periodically pass through.

The relation of the lichen-gonidium to *Nostoc* and its allies will form the basis of Fasciculus III.

Some further EXPERIMENTS *and* OBSERVATIONS *on the* MODE *of* FORMATION *and* COALESCENCE *of* CARBONATE OF LIME GLOBULES, *and the* DEVELOPMENT *of* SHELL-TISSUES. By G. RAINEY, M.R.C.S., Lecturer and Demonstrator of Microscopical and Surgical Anatomy at St. Thomas's Hospital.

As I believe it is generally admitted, especially by those who have examined my specimens of carbonate of lime, as it occurs in shell-tissues, and compared them with the analogous artificial forms, that both are formed in the same manner; and as in this case the experimental investigation of the artificial process will furnish the best clue to a precise and certain knowledge of the natural one, by showing more clearly how much is due to physical agency, I have been anxious to extend and improve my former process for obtaining the globular form of carbonate of lime by making the conditions more like the natural ones, and by so performing the experiments that the changes, which the carbonate undergoes in its passage from an apparently amorphous state to large globules, may, as they are taking place, allow of being examined by the microscope.

The process about to be described is the same in principle as that given in the "Transactions of the Microscopical Society," published in the 'Quarterly Journal of Microscopic Science' for January, 1858. It consists in employing a very shallow cell, open at both ends, for the decomposition of the salts of lime contained in gum-arabic by subcarbonate of potash. This cell is made by cementing two ledges of thin glass, about two inches in length and a quarter of an inch in width, placed parallel with one another, to a microscope-slide, and placing upon them a thin glass cover, fixed in its place by thick gold-size. At one of the ends of this cell a very thick and clear solution of gum-arabic is to be introduced by capillary attraction, sufficient in quantity almost to fill it, and at the other a small quantity of still denser solution of gum, saturated with subcarbonate of potash, sufficient, with the first solution, entirely to fill the cell. The alkaline solution should be sufficient to fill about a fifth of it. The excess of gum is then to be removed from each end, after which they are to be closed up by very thick gold-size, or some similar cement. The cell thus charged should be kept in a horizontal position, and examined by the microscope as occasion may require. The rapidity with which the globules will be formed, and afterwards increase in size, will depend upon the densities of the solutions. If they are not very dense, globular particles will be apparent in a few hours; but if they are as thick as they can be, to admit of being attracted into the cell, the carbonate will remain in an amorphous state for a week or two. The best results are produced when the solutions are as thick as possible. In this case the globules will go on gradually increasing in diameter for four or five months, and I have no doubt but the experiment might be so performed that this period would be greatly prolonged, as it will depend upon the relative proportions of the simple and alkaline solutions of gum, so that the globules would keep growing so long as there is any simple solution to furnish the earthy carbonate, and alkaline solution to decompose the salts of lime it contains. At first, the globules increase rapidly, but afterwards slowly, and ultimately they acquire even a larger size than those formed according to the first process. The great advantage of this mode of experimenting is that, by the employment of the micrometer, the progressive changes taking place in the form and shape of the globules can be accurately measured. And, besides, such experiments require but little time, and may be said to be attended with no expense. The mechanical conditions, also, under which these globules are produced resemble more those in sheli-tissues. I may add, that the solutions ought to be made perfectly clear by repeatedly filtering; if not sufficiently thick, they must be further inspissated. On a careful examination of the contents of these cells as above prepared, the first appearance is that of a cloudiness of the fluid in the cell where the solutions are in the act of mixing, which, if the solutions are very dense, remain so for several days, after which it becomes slightly granular; if, on the contrary, a thin solution of gum is employed, minute globules and dumb-bells appear in a few hours. The same amorphous condition of the carbonate with gum is obtained by mixing intimately strong alkaline and simple solutions of gum together, and filtering the mixture through blotting-paper. After four times filtering, I have found amorphous matter in the filtered fluid, which afterwards passes into globules and dumb-bells; but globules formed in this manner do not increase much, but remain small, and nearly all about the same size.

The globules which form on the part of the floor of the cell covered with amorphous deposit have in their centre a quantity, more or less abundant, of granular, amorphous matter, sometimes surrounded by a granular layer or two (see Plate IV, fig. 1). As these globules increase, the amorphous deposit around them partially disappears, leaving only minute crystals of oxalate of lime. The disappearance of this matter is best seen by examining it from time to time where it exists between two globules, and noticing particularly the amount of diminution during stated intervals. As the globules increase in size the crystals also increase, but more slowly than the globules, so that one part of this amorphous matter appears to be attracted by crystals and another by the globules, a fact which seems to indicate that each has a kind of specific attraction, exerted at sensible distances. As the globules get larger, the carbonate which their surface receives is clear, being probably now the fresh carbonate attracted by them, without first collecting in sufficient quantity to appear in an amorphous shape. See fig. 2, which shows two globules, with the amorphous matter between them, and fig. 3, the same two globules examined a week later, from between which all this matter has disappeared. During this interval both globules had increased in diameter. If globules form where there is no amorphous matter, as on the cover of the cell, they have no granular matter in the centre, but are clear throughout. In some cases, a portion of the granular matter remains attached to the floor of the cell, without passing into globules or dumb-bells. The form of the globules is very much influenced by that of the surface of the glass. If this be rendered rough, and thus the points of attraction be increased, the number of globules will be increased accordingly, but their size diminished; but if the surface be coated with shell-lac, a repellent action will be exerted upon the solution of gum, and globules of a larger size will result; lastly, if the carbonate be formed only in very small quantities, it will be attracted by the glass in minute but separate globules, and the interstices between them becoming gradually filled up by subsequent additions, a film of coalesced globules will be formed, covering the surface of the slide, similar to some forms of shell-tissue. All the appearances above described are best seen when the solutions of gum are as thick as possible, in which case, as before stated, the time required for their production will be slow. I have not noticed in those globules which have an amorphous nucleus that this nucleus has, in three or four months, suffered any visible change, either in size or appearance. In some globules the central part is made up of an aggregation of small globules, whilst the peripheral one is more or less clear and laminated, as represented in fig. 4. These bear a strong resemblance to the otolithes of small fishes in an early stage of development. See fig. 5, which is a representation of the otolithe of a young stickleback, and fig. 6 of one from a very small whitebait. These bodies are formed by the deposition of carbonate of lime in small sacs, which carbonate seems to go through the same changes of form as in shells, but I have not found the globules presenting so well-defined a cross under polarized light as in some forms of shell. With respect to the manner in which the calcareous globules, in the artificial process, acquire their increase of size and become coalesced into one mass, I may notice that the explanation given in my first paper is founded on a theoretical error, which more accurate experiments and more careful observations have since enabled me to correct. In my first method of obtaining the globules of carbonate of lime with gum, the different changes which these bodies underwent being produced in bottles, were entirely out of the reach of direct observation, and therefore the manner in which these forms were produced must be, to some extent, a matter of inference. The larger must either have resulted from the incorporation of smaller ones, as globules of a liquid would unite, or they must grow by addition to the surface. The various appearances which they assumed, especially those of the dumb-bell forms, seemed to be best accounted for on the first hypothesis; and as certain lenticular calcareous bodies occurring in the scales of fishes, similar to the globules of carbonate found in the incipient stage of shell-growth, had been described as undergoing a process of complete fusion or incorporation, I adopted this hypothesis in respect to the artificial products, as appearing to me to be the right one. However, Dr. Gladstone, on examining some specimens which I showed to him, considered that these globules were produced according to the super-position theory, and Mr. Warrington and Mr. Brooke, who saw them afterwards, were of the same opinion. As I had great confidence in their opinions on this subject, and as my only wish was to know the truth, and, moreover, as I considered, in experiments so completely physical and chemical, and admitting so easily of being brought within the reach of direct observation, certainty upon this point was attainable, and no doubt need remain respecting it, I proceeded to perform the series of experiments above detailed, which I will now briefly apply in explanation of the manner in which the calcareous globules acquire an increase of size, according to the super-position hypothesis. Though these experiments, so far as this point goes, may not show anything new, yet they will have the advantage of removing all doubt as to the manner in which the analogous forms of carbonate of lime are produced in organized bodies, to which the same decisive mode of testing this fact could not be so easily applied; and in physiological science positive, experimental evidence is especially needed. In merely describing the different characters of the calcareous globules in the glass cells before alluded to, this subject has been anticipated, and therefore it only remains to show, by the measurement of these globules during their growth, how their increase of diameter and their coalescence takes place. Two globules attached to the floor of a cell containing the two solutions of gum, in which decomposition and the formation of carbonate of lime were slowly going on, were measured by means of the micrometer eye-piece on the 27th of August, 1860, and their distance apart accurately determined, which was $\frac{4}{2500}$ of an inch, that is, four spaces between the lines of the micrometer, each space being $\frac{1}{2500}$ of an inch. On the 29th instant, the interval had become diminished $\frac{1}{2500}$ of an inch, and the diameter of the globules increased accordingly. On September 10th, it had diminished another $\frac{1}{2500}$ of an inch, with a proportionate increase of the globules; $\frac{2}{2500}$ of an inch were now left, which were gradually filled up between the present time and the 27th of November, when the globules had acquired such an increase of size as to be in contact. Similar measurements were made of other globules, with a like result, and the experiment is so easily performed that any one can, without either much trouble or sacrifice of time, verify its correctness. As the interval between two or more globules is in progress of being filled up, none of the particles of the carbonate of lime which are being added to their surface are visible, and the surface itself appears perfectly smooth and sharply defined. These observations are best made on the globules which form on the cover of the cell, these being more clear than those on the floor, and if the cover be sufficiently thin, a lens of $\frac{1}{8}$ or $\frac{1}{12}$ of an inch focus can be employed in the examination. The invisibility of the increments which these globules receive during the time ordinarily employed in the examination of any minute part of an object, supposing that time to be one minute, will admit of an obvious explanation, on considering the entire space between two globules, divided by the number of minutes contained in the time required to fill it up, and the extreme minuteness of each of these divisions. In the above experiment, a space equal to $\frac{1}{1250}$ of an inch was filled up in seventy-eight days; hence the size of the particle added to each globule in one minute would be more than the two-hundred millioneth of an inch in diameter. This would be on the supposition that the increments which each globule received in equal spaces of time are equal, but as the filling in of this space takes place more slowly as the globules in these experiments get nearer together, the degree of minuteness of the particles in question would far exceed that above mentioned. In this case, their size, when the globules were on the point of actual contact, would be several thousand times smaller than that of the smallest particle of matter visible by any known power of the microscope. But however small these particles are, they have, doubtless, a definite size, otherwise the surface of the increasing globules would, most probably, not be so sharply defined, but gradually shaded off. Besides, it can be shown, by dissolving out the earthy component, and leaving the gum one, that the layer of a globule last formed is the densest. For this purpose, it is only necessary to put the slides on which these globules have been deposited into a solution of gum, which, either being itself an acid or from the free acid it contains, gradually dissolves out all the carbonate with effervescence, and leaves the gum-element insoluble, and more or less of the form of the original globule, this depending very much upon the relative quantity of gum in combination with the earthy matter. Hence the globules which have been made in a strong solution of gum are the best for demonstrating this fact, and those made in the bottles according to the first process are necessary for this experiment. The gum-constituent, thus prepared, presents under the microscope the appearance of a nucleated cell; but that which appears to be a nucleus is rather a vacuity, and in these globules, when examined by the microscope by polarized light, in which the carbonate is only partially removed, the central part is generally dark, without having a cross, showing either a very small quantity or a total absence of the carbonate of lime. In many globules thus treated the exterior gum-layer appears quite like a dense husk, enclosing the parts within. These gum-residua, being insoluble, can be kept in glycerine, but if any of the carbonate had been left in them it becomes gradually removed. I have noticed in my paper on the dental tissues the same fact taking place in the calcareous globules of a delicate film of calcifying oyster-shell. Now, two facts are obvious from these experiments—one is, that the particles of gum and carbonate of lime are combined in these globules in inconceivably minute quantities; and the other, that the gum becomes insoluble in water. In these respects, gum in plants bears an analogy to albumen in animals. With respect to the globular form of carbonate of lime, I may state that I am perfectly aware that there are other cases in which carbonate of lime may be made to take the globular form. In this respect it seems to be a compound like salicine, asparagine, and some others, in which the force causing the crystalline form is feeble, and therefore easily overcome by that which causes particles to become globular; but this does not in the least affect the fact of carbonate of lime, when formed in a sufficiently strong solution of gum or albumen, becoming globular, or its applicability to the organism in which this compound is produced, as experiment shows that it is in such a state of combination as this that it occurs in organic tissues. To show the effect which gum has in determining the form of carbonate of lime, slides were put into bottles containing the same alkaline solution, which in all was as much inspissated as possible to be fluid, but the simple solution of gum was of different densities in each bottle. The slides were removed from the solutions in about four weeks. The carbonate on those which had been in the densest solution was all either in globules or dumb-bells. There were no crystals, whilst that deposited on the slides taken out of the weakest solution was in globules below, that is, near to the surface of the dense alkaline solutions, but in crystals above, where the quantity of gum in the solution was smallest. All these crystals examined from above downwards were seen gradually to lose their crystalline form, having their angles gradually rounded and their sides variously curved; after that they assumed the character of dumb-bells of different forms, and lastly they became globules. Fig. 7 is an accurate representation of the forms of carbonate of lime on one of these slides. The other slides presented various forms of carbonate intermediate between those extremes, but fully confirming the correctness of the conclusion that the globular form is due to the gum, and that the various modifications of the crystalline forms, as shown in the figure just referred to, are dependent upon the relative quantities of gum and carbonate of lime entering into their composition. Now, it is worthy of remark that all these various forms exist in calcified tissues. In some, the crystalline form prevails, especially in the densest shells, and in those parts of the less dense ones which are the hardest. In others, the globular form most abounds, and especially where the shell is in an incipient stage of growth, and before the membrane on which the carbonate is formed is entirely covered by coalesced particles; and lastly, there are shells, as that of the shrimp and prawn, which present both globules and modified crystals near together.

The cause of these modifications of form produced by the different proportions of gum in combination with the earthy constituents, seems deducible from the facts already mentioned, namely, that these elements become intimately mixed together in inconceivably minute quantities, and that the gum in the mixture is rendered insoluble, so that the particles so formed and their elements being thus combined, would be under the joint influence of the forces which each element by itself would have been acted upon, and by which its form would be determined. The particles of pure carbonate of lime, being under a force which disposes them in straight lines, would take the crystalline form; whilst those of gum or albumen, in which the tendency to attract one another is probably strong, as indicated by their tenacity, would, by their mutual attraction, be brought into the globular form. Hence, in the mixture composed of the carbonate element in great excess, the crystalline form would prevail, whilst in that in which the viscid element preponderated the globular form would predominate; and of course intermediate forms would result from such different proportions of these elements as might between these extremes. Some compounds formed in gum do not become globular, as, for instance, oxalate of lime. It remains beautifully crystalline, and increases by the addition of fresh invisible particles to the surface of the crystals, just as the globules do by the addition of particles of carbonate and gum to their surface. This probably arises from the oxalate not combining with the viscid substance and solidifying it in the manner that the carbonate does. If the particles of carbonate become deposited on a crystal of oxalate of lime, they coat it with a globular, and not with a crystalline, layer, so that it would appear that these particles in their very earliest state are spherical. Besides, the fact of the particles of carbonate thus combined with gum, when so small as only just to be visible with the highest magnifying powers, being also spherical, is in favour of this conclusion. All the globular forms of carbonate of lime are considered by some to be crystalline, and are called globular crystals. In some of these forms there is a slight appearance of a crystalline structure; in others, where either the gum is small in quantity or where the form of carbonate is mixed with some other crystalline compound, or is a carbonate of lime of a more highly crystalline character, this appearance is more strongly marked; whilst there are those carbonate globules combined with so large a proportion of gum as to present no appearance whatever of crystallization, which, notwithstanding, exhibit a distinct cross under polarized light. Now, how far these ought to be looked upon as crystals, I shall not attempt to decide; I may observe, however, that the physical force producing globular shapes is, without doubt, the very opposite of those which produce crystalline ones, and that, even in those cases in which globules are made up of a spherical conglomeration of minute crystals, it may only be where there has been an arrest of that force (attraction) which, though sufficient to bring these crystals into a globular form, would, if its action had extended to their ultimate atoms, also have arranged them in globules. I have now to introduce the account of some very interesting experiments on the reparation of shell-tissue, made by Mr. C. Stewart, of St. Bartholomew's Hospital, confirmatory of observations of the manner in which this class of structures is formed, published by me some years ago. Mr. Stewart's mode of experimenting is entirely his own. The following is a verbatim copy of his letter to me:

"Dear Sir,—Having repeatedly found that snails, which had suffered from an injury to their shells, had repaired them by the formation of new shelly matter, I thought that they would afford a good opportunity for examining the process by which the shell naturally grows. I accordingly removed a portion of the shell of an *Helix aspersa,* without injuring the animal. I then found, that in a few hours an extremely delicate and perfectly structureless membrane covered the surface of the mantle, and was attached to the edges of the fracture.

"On examination at the end of two days, the membrane was seen to be covered externally with crystals of phosphate of lime, and also with some compound globules of all sizes, undergoing coalescence into larger ones, as well as very minute particles of lime, of various and more or less regular forms, exactly like those of the carbonate of lime produced artificially. These, no doubt, are formed on the *outer* side of the membrane, in consequence of its extreme delicacy, allowing the fluid secreted by the mantle, in which the salts of lime are in solution, to percolate through it.

"On the third or fourth day, the new shell (which is colourless) is rendered sufficiently strong, by the addition of fresh particles of lime, to allow of the animal being withdrawn from the shell without breaking it. The process of repair now progresses very slowly, it taking months, or even years, to form a perfect and coloured lip, if the injury be to that part. The colouring of the shell I believe to be owing to the pigment contained in the cells of the mantle being discharged, in consequence of their having arrived at maturity, and blending with the calcareous element, the colouring of the margin of the mantle being similar to that of the shell. Probably, this process is slightly modified in some instances by an especial gland providing the pigment incidentally to other functions it may have to perform. Instances of this might, perhaps, be found in those animals in which the shell, having arrived at maturity, the lip is uniformly coloured.

"From these facts I am led to believe, and, I trust, not without sufficient reason, that the shells of these animals are formed by the coalescence of minute particles of lime on the *inner* surface of a previously formed animal layer (epidermis), being attracted to it before they have time to form globules by their attraction to each other, it being the *inner*, instead of the outer, surface of this membrane, in consequence of its greater thickness preventing the fluid passing through it.

"This idea is, I think, strengthened by the fact that globules of lime, in considerable quantities and of all sizes, are found in the mucus, on the surface, and also imbedded in the free edge of the mantle of *Paludina vivipara*, and probably in those of other mollusca, if carefully examined.

"Yours truly,

"C. STEWART.

"ST. BARTHOLOMEW'S HOSPITAL;
"*Nov.* 20, 1860."

Besides the crystals above noticed, there are others which I hope to describe in a future number of this Journal, my present occupations taking up so much time as to render it impossible now to prolong this communication; I hope also to extend the subject to the structure and development of striped muscular fibre.

REMARKS *on the* GLOSSIPHONIDÆ, *a Family of* DISCOPHOROUS ANNULATA. By the Rev. W. HOUGHTON, M.A., F.L.S.

I AM induced to offer a few remarks on the above-named family, in the hopes of drawing the attention of microscopists to the structure and development of a small group of animals which appear to have been almost neglected by British naturalists, and although I have nothing to add to what M. Grube has published in his valuable memoir on the development of these animals—for he appears to have almost exhausted the subject, while the researches of De Filippi, Müller, &c., have acquainted us with much that relates to their structure and habits—yet, perhaps, as the members which compose this family are but little known, these few remarks will not be deemed altogether superfluous.

With the exception of some observations of the late Dr. Rawlins Johnson and a few incidental remarks on some of the species of this family in the pages of the 'Annals and Magazine of Natural History,' all that we know of the Glossiphonidæ is derived from the works of Grube, De Filippi, O. F. Müller, F. Müller, and Moquin-Tandon. I can hardly speak in too high praise of Grube's memoir ('Untersuchungen über die Entwickelung der Clepsinen,' Konigsburg, 1844). Having taken up the subject of the development of these Annelids before I had seen the memoir above named, I am able, from independent observation, to confirm almost every point which that naturalist has advanced.

The late Dr. Rawlins Johnson, of Bristol, was the first to establish on satisfactory grounds the genus *Glossiphonia* and to separate it from that of *Hirudo*, under which genus it had been, since the time of Linnæus, generally comprised; this was in 1816, but, strangely enough, in the following year this writer altered the very appropriate name of *Glossiphonia* into that of *Glossipora*, without any improvement in the term proposed; it is, however, but fair that one of these names should be allowed to stand in preference to the ambiguous one of *Clepsine*, proposed by Savigny in 1827, although this latter term, in violation of the acknowledged laws of zoological nomenclature, has been generally adopted. The Glossiphonidæ are all inhabitants of *fresh* water, although Mr. Gosse, in his 'Manual of Marine Zoology,' has erroneously admitted one species, *G. rachana*, W. Thompson, into the catalogue of *marine* worms.

The genus contains the following British species:—*G. bioculata, G. complanata, G. hyalina, G. verrucata, G. tessulata,* *G. marginata,* and *G. rachana.** *G. complanata, hyalina, bioculata,* appear to be common everywhere; *tessulata* and *marginata,* which latter species I have lately added to our English Fauna ('Annals and Magazine of Natural History,' vol. v, No. 28, third series), are rarely found. *G. tessulata,* which is the largest British species known, approaches in its form and consistency to the genera *Hirudo, Hæmopis,* &c.

All the members of this family are interesting objects for microscopical study, owing to the extreme transparency of young individuals and the facility with which specimens may be procured. Some of the species, as *G. complanata, G. marginata,* and *G. tessulata,* deposit their ova upon the under surface of submerged stones, pieces of wood, &c., sitting upon them until the embryos are *hatched;* they may thus literally be said to incubate, which they do with an assiduity not inferior to some of the higher orders of animal life I know not who was the first observer to record this singular habit, but nothing of the kind occurs in any other animal so low in the scale of creation; one is reminded, indeed, as Grube has observed, of the somewhat analogous case of *Coccus,* the wingless female of which sits over her ova, but in this case what is life to the new progeny is death to the parent, whose dead body forms a shield-like protection for her young; but the Glossiphon, though she shows a thin and emaciated appearance after the "lying-in," in time recovers her strength and usual figure.

The Glossiphon is a leech-like animal, with a dilated and depressed body; the upper surface is more or less convex, and in some species beset with rows of small, conical, semi-transparent papillæ; the under surface is either flat or concave; the anterior extremity, which in a few of the species may be said to form a distinct head, is always less obtuse than the posterior; the mouth, which is situated nearly at the apex of the anterior extremity, is transversely elliptical, two-lipped, and furnished with a strong, muscular, protractile proboscis, on which peculiarity Dr. R. Johnson formed the name of the genus which so appropriately characterises it; the number of eyes varies in different species, there being either one, two, three, or four pairs, generally of a black or deep-claret colour, disposed in two longitudinal series, but slightly

* The names of five other species are given in Johnston's unpublished 'Catalogue of British Annelida,' viz., *G. flava*, *G. granifera*, *G. circulans*, *G. lineata*, and *G. vitrina;* the first, which is described by Dalzell, is evidently *G. marginata,* the last appears to be a variety of *G. tessulata*, a most variable species; the claims of the three remaining species rest on very insufficient evidence.

converging towards the anterior extremity; in some individuals, and frequently in the species *G. hyalina* and *G. complanata,* the anterior pair are wanting, and the order of arrangement is confused. The posterior acetabulum is large and round; the genital openings, of which the male is the upper, occur somewhere between the twenty-fifth and twenty-eighth ring of the body; the digestive system consists of a stomach, having from five to seven pairs of gastric cæca; the intestine has uniformly four cæca. All the British members of this family are strictly oviparous; one is surprised to read in Diesing's 'Systema Helminthum' (vol. i, 446), "ut plurimum vivipara." They are incapable of swimming, and move from place to place like the caterpillars called geometric; this is particularly the case in the species *G. tessulata* and *G. marginata,* which are very active in their movements. Most of the species roll their bodies up like Onisci if taken out of the water and handled. They inhabit brooks and ponds; and though all the species above enumerated are, as stated by Diesing, "*aquarum dulcium incolæ,*" they are frequently found in water which is anything but sweet. None of the British species can be truly said to be parasitic, though any of them may be occasionally found upon the bodies of aquatic animals, on the juices of which they feed. I purpose now to make a few observations on—

1st. The structure of the Glossiphons.

2dly. Their mode of increase, and the development of the embryos.

1st. The normal form of the body, when at rest is pear-shaped, the posterior extremity being rounded and obtuse, the body narrowing somewhat suddenly towards the anterior extremity, but different species vary slightly *inter se;* the mouth, which is always subterminal and bilabiate, and without teeth, leads to the proboscis by a delicate, transparent, membranous œsophagus, with which it is continuous, and by which it is included; this membrane is drawn back over the proboscis, when it is extended, in a manner similar to the unfolding of a glove from the finger; the form of this exsertile tube is cylindrical, minutely lipped or segmented at the apex, and commonly bulbous at the base; it is of a subcartilaginous consistency, and supplied with powerful muscles, by means of which it is worked; under the microscope, the reticulated, muscular structure is observable, more especially on the bulbous portion of the proboscis. It is by means of this tube that the animal pumps out the juices of its victims, its labiated apex seeming to act the part of a mouth. There are some slight modifications of form in the different species, but the principle of mechanical action is the same in all. *G. bioculata,* the smallest British species, if put into the palm of the hand, has the habit of thrusting out its proboscis to the length of, perhaps, a third of its own body. I have not noticed this habit in any other species. Connected and continuous with the bulbous base of the proboscis is another, transparent, hollow membrane (the continuation of the œsophagus), which, when the proboscis is not exserted, twists and rests upon itself. At the base of this membrane is the commencement of the stomach, the walls of which are attached to the surface of the body of the animal. The stomach is furnished with five or seven pair of gastric cæca, which are either simple or forked at their extremities; there are also, in some species, very small cæca, in advance of the large sacs, which, perhaps, have a kindred function. The last pair of cæca, which is always the largest, is directed downwards towards the posterior extremity, while the rest are nearly at right angles to the mesial axis of the body. De Filippi ('Lettera al Sign. Rusconi, sopra l'Anatomia e lo Sviluppo delle Clepsine,' Pavia, 1839) asserts that he has observed between the digestive canal and the blood-vessels a special communication, by means of which animal juices sucked by the Glossiphon pass almost immediately into the blood-vessels, and that thus, by transfusion, as it were, the snail-leech acquires a supply of blood. I have never noticed anything of this kind in the numerous examples I have submitted to patient investigation. The intestine in these animals is furnished uniformly with four pair of cæca, the two anterior pair of which are directed upwards; the anus, which is more readily recognised when the animal is out of the water, is round, and situated just above the juncture of the acetabulum and trunk of the body. In young specimens, and more especially in those of the beautiful little species *G. hyalina,* the digestive cæca are frequently found to be of a brilliant-red or vermilion colour. Whence is this red colour derived? Moquin Taudon ('Monographie de la Famille des Hirudinées,' 1846) has figured a young *G. sexoculata* (*complanata*) with these blood-red cæca; he says the specimen had sucked the blood of an Hæmopis. But if this colour be derived solely from blood which the animal has swallowed, how can we account for the fact that it is always, as far as I remember, in the young individuals that the red colour is observed? Full-grown specimens do not exhibit this appearance. I have reared individuals from ova which had been deposited in vessels in which it was impossible for the young ones to have obtained red blood, but it was a common thing to remark that specimens of about three lines long, and seven or eight weeks old, had their digestive system thus beautifully coloured. The subject is worthy of further investigation.

The circulation in the Glossiphonidæ may be most readily watched in the young of any of the species, and in adult individuals of *G. bioculata* and *G. hyalina*, but from the transparency of the circulating fluid, and from the complexity of the vascular system, with its numerous network of vessels which communicate with the dorsal and lateral ones, it is extremely difficult to make out with satisfaction the true and complete course of the vital fluid. This much, however, I have been able to notice. There is a large and tortuous dorsal vessel, a ventral vessel, two lateral vessels, with innumerable other small ones, which form almost a network of communication between the grand central and lateral canals. The dorsal vessel is furnished, at intervals, with valve-like processes, which are arranged alternately on either side of it; it is contractile and heart-like in its functions. This group thus differs in a very important particular from the true leeches which form the genera *Hirudo, Hæmopis, Aulostoma, Trochetia,* and *Nephelis,* in all of which the side vessels, and not the dorsal, are contractile, and act the part of a heart. I have carefully studied the mechanical action of these valve-like processes alluded to above, and believe that they are designed to propel a large portion of the vital fluid to the sides; this they do by partly closing a section of the dorsal vessel, and thus stopping a certain quantity of the blood from flowing up it; this section of the dorsal vessel contracts and forces a portion of the blood into the numerous branching channels which communicate with the dorsal and lateral vessels; indeed, the dorsal vessel may be considered to consist of several hearts, each one of which, so far as its functions are concerned, being formed by the space included by the valves, which, simultaneously with the contraction, swing on their narrow bases, by which they are attached each to the opposite side of the dorsal vessel, and thus partially close it, not entirely, however, for even when the valves are closed corpuscles may be seen to pass through the narrow portal from one of the dorsal chambers to another; in this manner a large portion of the blood finds its way through the intercommunicating channels to the grand lateral vessels, for the purpose, as will be seen by and by, of becoming oxygenated. F. Müller ('De Hirudinibus circa Berolinum observatis') supposes these valves are merely intended to prevent the vital fluid from flowing *down* the main dorsal vessel, instead of *up* it. I feel confident, however, that they have such a function as I have endeavoured to explain.

Respiration in the Glossiphonidæ is, no doubt, in some measure carried on by the entire skin, as in the true red-blooded leeches, the vital fluid being oxygenated by fresh currents of water, which the animal is careful to create by attaching itself by the two extremities, and waving in an undulatory manner the intermediate portion of its body. There is, however, another and a very important method by means of which the respiration is performed. All the members of this group have the margins of the body much dilated and very thin. Careful focussing of the microscope will enable the observer to recognise the presence of minute channels down each side, which lead from the two main lateral vessels to the extreme verge of the margin; into these channels the blood flows, describing a kind of a circuit, and returning again to the lateral vessels; the extreme tenuity of the margins must thus allow the blood to be freely and rapidly renewed in those vessels which permeate it by the contact of the water which surrounds the vessels, and which is thus brought into close proximity with them.

The nervous system in these animals is readily recognisable by dissection; it lies on the ventral surface, and consists of a nervous cord, or, as it is usual to say, of two nervous filaments united together, having a large, ganglionic, œsophageal ring, with about twenty ganglia situated at irregular intervals one from the other, the last ganglion being the largest.

The generative organs are represented in Plate III, fig. 11. In the spring of the year a long, white band may be discerned through the integuments of the abdomen, reaching some way down towards the posterior extremity; these are the testes, which descend as lengthened filaments and then turn back again, the ascending and descending lines being entwined together. The spermatozoa are arranged in curious, curved, wedge-shaped masses, and, at the proper season, an immense quantity of these may be seen. The female organ is just underneath the male. The ovaries are two sac-like, membranous lobes, within which, at one period of their development, are to be seen several round vitelli, which are attached on either side of a long, tortuous cord; these are, of course, detached from the *funiculus* before exclusion. Notwithstanding most attentive observation, I have never witnessed anything like a generative act in any of the numerous individuals which I have had under inspection. F. Müller, however, has proved that this act does take place in the case of *G. tessulata,* but further observations on this point are needed before we can decide whether all these animals are self or mutually impregnating, or how far the presence of two individuals is necessary for the purpose of generation.

If specimens of these worms be procured early in March, and kept in vessels of water, ample facility will be afforded of noticing the manner of depositing the ova, the period of incubation, and the gradual development of the young from the vitellus to the perfect individual; and the extreme transparency of very young individuals renders a study of their structure easy and delightful.

G. hyalina and *G. bioculata* do not sit upon their ova, but carry them about with them on the abdominal surface. The ova and young of *G. bioculata* are very effectually protected by means of the folding inwards of the sides of the parent, which are thus made almost to meet and to form a sort of pouch; this fact will, I believe, explain the error of some who have asserted that the Glossiphons are, in some cases, viviparous.

The young are *hatched, i. e.* the partially developed embryo leaves its pellucid, gelatinous envelope in about ten days after the ovum is deposited; the number of vitelli in each envelope is variable, not only in the different species, but in individuals of the same species and in the individual itself. In *G. complanata* and *G. marginata* three to fifteen vitelli may be contained by the delicate covering. *G. tessulata* is the most prolific of all the species; I have counted a hundred and twenty young ones attached to the parent. The young, for some little time after they are perfectly formed, continue tied to their "mother's apron-strings," which they generally leave when they are about six weeks old.

The Glossiphons, like all other animals, and especially such as are aquatic, have their external and internal parasites; upon the curious, horn-like plate of membrane in the neck of *G. bioculata* it is a very common thing to find a species of Epistylis firmly attached to it. I have never observed this parasite either on any other Glossiphon or on any other part of *G. bioculata* but on the cervical plate. If it has never been described, I propose to call it *Epistylis Glossiphoniæ.*

I am quite unable to form the most remote conjecture as to the use of the plate referred to above. It is situated and opens out at the upper part of the neck. This membranous, cup-shaped body is characteristic of *G. bioculata.*

An ACCOUNT *of some* PARASITIC OVA *found attached to the* CONJUNCTIVÆ *of the* TURTLE'S EYES. By EDWIN CANTON, F.R.C.S., Surgeon to the Charing Cross Hospital, and Lecturer on Surgical Anatomy.

(Reprinted from the 'Dublin Medical Press.')

IN July last, while engaged in the microscopical examination of the tissues of the eye of the common Turtle, I discovered a large number of parasitic ova attached to all parts of the conjunctiva, with the exception of the modified portion of this membrane which extends across the cornea. The ova were equally numerous in both eyes. I repeated the examination, and, in five consecutive instances, met with these cystic bodies, in the same situation, in the two eyes of each of the turtles. In a sixth specimen, however, the ova were entirely wanting.

The turtles were *lively* at their death, which was of a sudden and violent character, and took place in the city. I could discover no epizoon on any part of their heads which were sent to me.

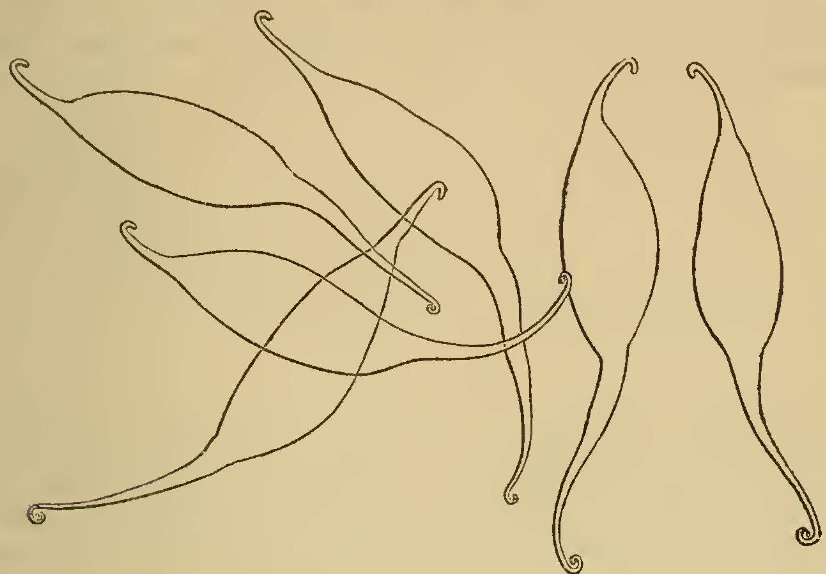
With such fixedness are the ova adherent to the conjunctiva, that not even roughly scraping off the thick, slimy, secretion which covers this tunic detaches them. I detected them once within a few hours after the death of the animal they infest, and, in this instance, found them present in large numbers on the eyes of a turtle weighing upwards of a hundred pounds. As I have already stated, they were seen on all parts of the palpebral and sclerotic, but not on the corneal conjunctiva.

So minute are these bodies, that they are undistinguishable to the naked eye.

Subjoined is a magnified view of them, in a group, as shown under the microscope, and drawn by the end of the camera lucida.

Form.—Elongated, unequally ovate; at each extremity the body is prolonged into an infundibuliform appendage, one of which is about a third of the length of the long diameter of the body, and terminates in a fine point, abruptly curved so as to constitute a short hook, whereby secure anchorage to the conjunctiva is effected; the other is larger and longer, nearly equalling in length the whole ovum, and ends also in a fine point; it is curved at the terminal point, so as to form a coil, which often presents one or two turns;

this may be regarded as the suctorial portion. The body is a simple sac, entirely destitute of internal organs.



Size.—For the convenience merely of stating the following measurements, I may refer to the different parts of an ovum as *head, neck, body,* and *tail.* Some of the ova are rather smaller than others, but the annexed has reference to one of larger and more ordinary dimensions:

	Inch.
Total length	·0132
Length of neck	·0054
,, body	·0056
,, tail	·0022
Breadth of head	·00015
Neck a little below this	·0001
,, at origin from body	·0005
Body at its widest part	·0023
Tail at origin	·0003

Colour.—The colour of all the ova is yellowish; or, perhaps, it may more correctly be said to be a light, ochreish-yellow; this tint pervades uniformly every part.

Consistence.—The chitinous shell-membrane appears to be tough and resistant; for when, in examination, an ovum has been irregularly compressed, it is thrown into large and sharply-angled folds,—no fine wrinkling is to be observed.

Aggregation.—The ova are commonly found to be solitary or in pairs; more rarely are they gregarious; but when in groups, there are five, eight, or sometimes ten, collected together.

In all the eyes examined, with the exception of those of the sixth turtle, I discovered *a second form of ovum,* not differing, however, in any material degree, from that already described.

The body is elongated, but not so swollen as in the preceding variety, though it is still unequally ovate. The shorter filament, which terminates one extremity, is less regularly infundibuliform; its thinnest portion is rather suddenly bent at an acute or right angle to the body, and ends in two hooks, joined by their convexities. From the opposite portion of the body the suctorial filament passes, and is, relatively to the corresponding part in the first-mentioned ova, longer and more thread-like; slightly funnel-shaped at its commencement, it soon contracts, and, after a more or less flexuous course, ends by a rather sudden expansion into a flattened disc.

These ova are exceedingly few in number, and are generally smaller than those first described; they are, for the most part, found solitary: I presume them to be the same as those previously mentioned, only in an earlier stage of development.

Dr. Spencer Cobbold has obligingly examined my specimens, and I am indebted to him for the favour of the following communication:—"After a careful examination, I have arrived at the conclusion that the foreign cystic bodies adherent to the conjunctiva are the ova of an ectozoon, the latter being parasitic, either upon the turtle itself, or upon some crustaceous epizoon likewise infesting the turtle.

"These ova differ in appearance from any I have hitherto encountered, and are especially interesting in the circumstance of their presenting filamentary appendages at both ends. The hook-like filament is, probably, distinctive of the *species* of parasite to which the ova may be referred.

"The eggs of various forms of entozoa, and also in the allied ectozoa, display filamentary appendages at both ends of the chitinous shell-capsules; these processes generally resembling each other, as may be seen, *e. g.* in *Monostoma verrucosum* infesting the fox, in *Tænia cyathiformis* belonging to the swallow, and in *Tænia variabilis* of the gambet. In some cases, where the filaments are shorter, the eggs more closely resemble those to which you have directed my attention. This is evident in the ova of a curious trematode—*Octobothrium lanceolatum*—attached to the gills of the common herring, and likewise in the eggs of the still more eccentric-looking parasite—*Polystoma appendiculata*—found on the branchiæ of various marine fishes.

"In all probability, the entozoon from which the ova you have found proceed is closely allied to those forms of trematode, or fluke-worm parasites, whose eggs display only one thread-like appendage, or 'holdfast.' For example, the eggs of different species of *Dactylogyrus* infesting the gills of the pike exhibit ova of this kind (a good representation of this is given by Guido Wagener in 'Siebold and Kölliker's Zeitschrift,' vol. ix, plate v, fig. 8). The eggs of *Diplozoon paradoxum* are also especially worthy of notice, as, from G. Wagener's recent Prize Essay ('Beitrage zur Entwicklungsgeschichte der Eingeweidewürmer'), it would appear that the single filament is liable to vary in length; whilst (as Van Beneden, Dujardin, and other observers have shown) the end of the filament is ordinarily coiled upon itself in a manner precisely analogous to that noticeable in the ova from the eye of the turtle.

"On the whole, therefore, I think we may safely conclude that the ova under consideration are referable to a parasite more or less allied to the well-known *Diplozoon paradoxum* of Nordman; and I have little doubt that—if not already known to some Continental helminthologist—we shall, ere long, discover them in the oviducts of some species of *Polystoma, Tristoma, Octobothrium, Dactylogyrus,* or other allied genus of trematode worm."

TRANSLATIONS.

Note on Trichina spiralis. By Professor Virchow.

('Comptes Rendus,' July 2, 1860, p. 13.)

I had the honour last autumn of communicating to the Academy some of the first results of my researches respecting the development of *Trichinæ* introduced into the animal economy through the digestive passages.

Since then the Academy has been made acquainted with the researches of Professor Leuckart, which appeared, in contradiction to mine, to show that *Trichocephalus* was a stage in the regular development of *Trichina.*

Subsequent observations have proved that *Trichina* represents a distinct genus of entozoa, and Professor Leuckart has himself recognised the truth of my first observations.

It is in rabbits that I have been able to trace the development of the *Trichina.* When a rabbit has been made to eat meal containing *Trichinæ,* after three or four weeks it will be perceived to become emaciated; its strength is sensibly diminished, and it dies about the fifth or sixth week after the ingestion of the trichinized food. The voluntary muscles of the deceased animal will be found filled with millions of *Trichinæ;* and there can be no doubt that death has ensued from a progressive muscular atrophy, consecutive upon the migrations of the *Trichinæ* into the system.

In one case I was myself witness of the animal's death. It was so weak that it could not stand on its feet; lying upon the side, it exhibited from time to time slight struggles; at last the respiratory movements ceased, whilst the heart continued to beat regularly; death took place after a few convulsive movements.

By this method of feeding I have obtained four generations of entozoa. I first fed a rabbit with living *Trichinæ* occupying a human muscle; it died at the end of a month. I then administered to a second rabbit some of the flesh of the former; it also died at the end of a month. The flesh of this rabbit was used to infect three others at the same time, two of which died three weeks afterwards, and the third at the end of a month. I then fed two others, the one with a good deal and the other with a small quantity of the flesh of these three. The first died at the end of eight days, and in this case nothing was revealed on the autopsy beyond an intestinal catarrh; the second died six weeks after the commencement of the experiment.

In all these animals, with the exception of the last but one, all the red muscles, save the heart, contained such a quantity of *Trichinæ,* that every portion examined under the microscope exhibited several, sometimes as many as a dozen.

We have here, then, to do with a mortal affection. Attentive observation of the phenomena presented in these animals, as well as in others, afforded the following results. A few hours after the ingestion of the diseased flesh the *Trichinæ,* disengaged from the muscle, are found free in the stomach; they pass thence into the duodenum, and afterwards advance still further into the small intestine, where they become developed. From the third or fourth day, ova or spermatic cells are found, the sexes in the meanwhile becoming distinctly marked. Shortly afterwards the ova are impregnated, and young, living entozoa are developed within the bodies of the female *Trichinæ.* The young are expelled through the vaginal orifice, which is situated towards the anterior half of the worm, and I have noticed them, under the form of minute *Filariæ,* in the mesenteric glands, and more especially, in considerable number, in the serous cavities, particularly the peritoneum and pericardium. According to all appearance, they had traversed the walls of the intestine, following, probably, the same course as that pursued by the *Psorospermia,* according to the researches of one of my pupils, Dr. Klebs; that is to say, they penetrate into the epithelial cells of the intestine. Further than this I have been unable to discover them either in the blood or circulatory system.

Continuing their migrations, they penetrate as far as the interior of the primitive muscular fasciculi, where they may be found, as early even as three weeks after the alimentation, in considerable numbers, and so far developed that the young entozoa have almost attained a size equal to that of the *Trichinæ* contained in the flesh which had been administered.

In order to be certain that before the experiment the animal had no *Trichinæ* in its muscles, I have, on several occasions, before administering the trichinized flesh, examined a portion of muscular tissue excised from the back, in which not a trace of the parasites could be discerned, where afterwards they would be found in such great numbers.

The *Trichinæ* progressively advance into the interior of the muscular fasciculi, where they are often seen, several in a file one after the other. Behind them the muscular tissue becomes atrophied, and around them an irritation is set up, and from the commencement of the fifth week they begin to become encysted. The sarcolemma is thickened, and the contents of the muscular fibres exhibit indications of a more active cell-growth; the cyst consequently is the product of a sort of traumatic irritation.

In the dog, the development of the *Trichinæ* in the intestine may be very readily followed, but they do not pass into the muscles, either because the intestine or the digestive secretions of the dog present obstacles to the migration or to the ulterior development of these worms.

I have to thank Professor Zencker, of Dresden, for the muscles of the woman with which I began this series of researches. In this case death had occurred under circumstances precisely similar to those which I observed in my rabbits; the autopsy disclosed no lesion beyond the presence of innumerable *Trichinæ* in the muscles, and neither here nor in the muscles of the rabbits were they visible to the naked eye.

From these facts, then, it results, that fatal cases of infection by *Trichinæ* may take place, in which the cause of death cannot be recognised except by the microscope; and that, up to the present time, no other cases had been observed except those in which the entozoa had not only become encysted, but in which the greater number of the cysts had already reached a very advanced stage of cretification; for it is in this condition only that they become visible to the naked eye.

Moreover, since the cysts are not formed before the fourth to the sixth week, nor does the cretification take place, probably, till after the lapse of some months, it may be concluded that, up to the present time, cases of this affection have not been recognised in the human subject until it had undergone a sort of cure, the symptoms belonging to the recent evolution of the *Trichinæ* having been long forgotten. If the antecedent conditions in patients who have experienced the symptoms above cited were accurately noted, we should probably soon see the number of cases of trichinization increased.

Besides the merit of having proved the existence in man of the *Trichinæ* which I had found in the intestine of the dog, experiments with reference to which I have communicated to the Academy, Professor Zencker has discovered the source of the *Trichinæ* which had infected his patient, and thus been able to throw great light upon the etiology of this affection. As the patient had been brought to the hospital at Dresden from the country, Professor Zencker instituted inquiries, and found that, four weeks previously, a pig containing *Trichinæ* had been killed in the same dwelling; that the ham and sausages made of the flesh of this animal contained a great number; and lastly, that the butcher who had slaughtered the pig, and had swallowed the *Trichinæ* in the recent state, as several other persons also did, had, as well as they, presented rheumatic and typhoid symptoms of greater or less severity; but the patient who was sent to Dresden was the only one who fell a victim to the ingestion of the flesh of this pig.

This condition therefore now involves questions of great hygienic interest.

1. The ingestion of pig's flesh, fresh or badly dressed, containing *Trichinæ*, is attended with the greatest danger, and may prove the proximate cause of death.

2. The *Trichinæ* maintain their living properties in decomposed flesh; they resist immersion in water for weeks together; and when encysted, may, without injury to their vitality, be plunged in a sufficiently dilute solution of chromic acid for at least ten days.

3. On the contrary, they perish and are deprived of all noxious influence in ham which has been well smoked, and been kept a sufficient length of time before it is consumed.

New Experiments *on* Heterogenesis, *by means of the Air contained in the Closed Cavities of Plants.* By MM. N. Joly and Ch. Mussey.

(' Comptes Rendus,' Oct. 22, 1860, p. 627.)

(*Abstract.*)

At the beginning of the year, the authors communicated to the Academy the result of some experiments instituted with the view of satisfying themselves with respect to the origin of the Microphytes and Microzoa, which are always and everywhere produced in infusions of organic matters. After new experiments, continued uninterruptedly for six months, they are prepared with fresh evidence in the cause now at issue between the partisans and the opponents of *heterogenesis*.

As, in fact, the cardinal point of the question is reduced to the means we may have of obtaining air of extreme purity, that is to say, completely deprived of the germs which are said to float in the atmosphere, they conceived the idea of experimenting with the air or gas contained in the closed cavities of organized bodies. The swimming-bladder of fishes, the fruit of the bladder-nut, the fruit of the *piment annuel*, the enormous cavity in the culinary Cucurbitaceæ, &c., afforded, as it may be said, exactly what was desired. They then proceed to detail the results of an experiment of this kind made with the Pumpkin.

They boiled for two hours in distilled water some pieces of sheep's liver. They then took a tube, blown into a pear-shaped bulb at one extremity, open and drawn out at the other. This tube was heated for half an hour, until the glass was softened, and at this moment the open end was hermetically closed with the blowpipe. When cold, the point is plunged into the boiling decoction and broken off below the surface. A portion of the fluid enters the tube, which is immediately placed on burning charcoal. Ebullition recommences, and the tube is again closed whilst the steam is escaping. The continuance of the ebullition, sometimes for more than a quarter of an hour after the removal of the tube from the fire, shows that the vacuum is as perfect as possible. When the apparatus is cooled, the point of the tube is inserted in the flesh of the gourd, and broken off after it has entered some distance. On its reaching the cavity of the fruit, a small quantity of air enters the tube containing the decoction. In order to take every possible precaution, a thick layer of copal varnish, thickened with vermilion, was placed around the wound made by the entrance of the tube. A criterion apparatus was placed alongside, as a term of comparison. This experiment, simple as it may appear, nevertheless presents considerable difficulties in the performance. The authors succeeded well twice, but made several other attempts in vain; being baffled sometimes by one cause, sometimes by another.

At the end of six days' attentive watching, they examined the decoction, and perceived in it *numerous Bacteria*. Many were already dead, and the survivors in a languid condition; a very natural result, if we consider,—1, that the air contained in the pumpkin abounds in carbonic acid, of which it holds about four per cent.; 2, that only a few bubbles of air entered the decoction, which otherwise contained very little; 3, that the air was not renewed.

The criterion apparatus presented the same animalcules, but they were far more numerous and more lively, which is to be attributed, without doubt, to the more abundant supply and easy renewal of the air in contact with the decoction.

In support of these results might be cited those which were obtained on the authors repeating, with the utmost care and with some modifications of their own, the experiments of Schultze, of Schwann, and of Mantegazza.

In the experiment performed according to the methods of Schultze and of Schwann, they obtained both Microphytes and Microzoa in the one case, and Microzoa only in the other, although the air employed had been purified by sulphuric acid, potass, or heat, and sometimes by two of these agents. With respect to Mantegazza's experiment,* which the authors think has been too little regarded in France, it has afforded in their hands results very nearly identical with those stated by that physiologist; that is to say, abundance of *Bacterium termo* and *Bacterium catenula*.

* *Vide* 'Giornale del R. Istituto Lombardo,' tom. iii, p. 467, "Richerche sulla Generazione degli Infusoriá di P. Mantegazza," Milano, 1851.

REVIEWS.

The Honey-Bee, its natural history, habits, anatomy, and microscopical beauty. By JAMES SAMUELSON, assisted by J. BRAXTON HICKS, M.D. London: Van Voorst.

THE author of this little work, and his able assistant, Dr. Hicks, are well known for a former attempt at making known the structure of some of the more frequent forms of the lower animals around us. We spoke very highly of 'The Earthworm and the Housefly,' when they appeared; and we feel called on to give the same meed of praise to 'The Honey-bee.' Although Mr. Samuelson has gone over much ground that was previously well trodden, in his account of the structure and history of the habits of the bee, he has succeeded in making the subject his own, and treating it in a way that demands our praise in a literary point of view. The general structure of the bee is highly interesting, and we do not know of any descriptions of the minuter points of the anatomy of these insects which can claim to be more minute and accurate than those contained in this little volume. As much of the matter contained in this department of the volume has not appeared before in a popular form, we take the liberty of making rather a long extract from the chapter descriptive of the eyes of the bee. The author expresses himself as indebted for this part of his work to the labours of Dr. Hicks, who is well known to the cultivators of microscopical science for the extent and accuracy of his observations.

"In order to afford some idea of the general character and operation of one of these compound eyes, we shall compare it to a bundle of telescopes (3500, remember!), so grouped together that the large terminable lenses present an extensive convex surface, whilst, in consequence of the decreasing diameter of the instruments, their narrow ends meet and form a smaller concentric curve. Now, if you can imagine it possible to look through all these telescopes at one glance, obtaining a similar effect to that of the stereoscope, you will be able to form some conception of what is probably the operation of vision in the Bee. This comparison, however, presents but a crude and imperfect idea of the organ in question, and we shall now accurately describe one of these 'telescopes,' as we have popularly termed them.

"Each of the eyelets or '*ocelli*' which, aggregated, constitute the compound eye of a Bee is itself a perfect instrument of vision, consisting of two remarkably formed lenses, namely, an outer '*corneal*' lens and an inner or 'conical' lens. The 'corneal' lens is a hexahedral or six-sided prism, and it is the assemblage of these prisms that forms what is called the '*cornea*' of the compound eye.

"This '*cornea*' may easily be peeled off, and if the whole, or a portion, be placed under the microscope, the grouping of the beautiful lenses becomes distinctly visible.

"But, stay! we must not yet part company with the corneal lens of the Bee's eyelet; for, on closer investigation, we shall perceive that it is not a *simple* but a *compound* lens,—a fact of considerable importance, that has, we believe, been overlooked by physiologists. It is composed of two plano-convex lenses (that is, as you doubtless know, lenses having a plane and a convex surface) of different densities or refracting powers, and the plane surfaces of these lenses being adherent, it follows that *the prismatic corneal lens is a compound double convex lens.**

"The effect of this arrangement is, that if there should be any aberration or divergence of the rays of light during their passage through one portion of the lens, it is rectified in its transit through the other. Now it is nothing new to find in the eye of an animal lenses of different densities, but we do not recollect ever having heard of any other instance where one compound lens has been found consisting of two adherent ones of this description.† How remarkable, then, that we should discover such a phenomenon in so humble an animal as the Bee! Aye, reader; and how remarkable, too, that we should find such a contrivance adopted by man in the construction of what he at present considers the most perfect microscopic lens!

"With untiring patience and perseverance his mind was directed to the attainment of this end, namely, to correct the aberration of light, which caused his lenses to colour and distort the objects under investigation, until he found that, by employing compound lenses of varying densities, this evil effect was counteracted; and now we see that the Creator had, probably before man was brought into existence, constructed the eye of the Bee on the same principle.

"There is one thought that cannot fail to present itself to the reflecting mind in connexion with this analogy between the eye of the Bee and the achromatic lens, confirmatory of the great declaration that 'God made man in His own image,'—Has not man invented what He no doubt suggested, but not alone through the medium of the external senses? for man knew nothing of the compound lens in the Bee's eyelet when the idea occurred to him to construct an achromatic lens for his microscope, and yet it is obvious that he hit upon one of the most perfect means of attaining the desired end!

"A word more regarding the corneal lenses of the Bee.

"It appears to us questionable whether the normal shape of these lenses is hexagonal, or whether this form is not rather a necessity of growth; that is to say, we think they are normally round, but assume the hexagonal shape during the process of development in consequence of their agglomeration. If this surmise be correct, it applies equally to the compound eyes of all insects, and our inference in this respect is drawn—

* We believe the credit of this discovery is due to Dr. J. B. Hicks.

† It is not unlikely that the eyes of other insects are similarly constructed.

"1. From the exceptional character of hexagonal or any other than circular lenses in the eyes of all animals, and from the fact of the simple eyes of insects themselves being *circular*.

"2. From the circumstance that, in the insect races, the conical lenses of the ocelli (to be described presently), which do *not* impinge one upon another, are not hexagonal but round.

"3. Because in the posterior angle of the compound eye of the worker-bee we often find some of the *corneal* or external lenses of a smaller size, and not adherent, but having a little intermediate space surrounding each, and these facets are *invariably round*.

"From the fact that in one insect at least, the sheep-tick (*Melophagus ovinus*), which ranks very low in the scale of development, we find ALL the external facets of the compound eyes non-adherent and circular.*

"So much, then, for the corneal lens of the ocellus of the Bee, a compound hexahedral prism with double convex surfaces. Following the course of a ray of light after it has passed through this lens, we find that it traverses a vacant space before entering the conical lens, this space being surrounded by the dark pigment already referred to, and constricted or narrowed midway into the form of a round hole, on the same principle as the diaphragm in the eye-piece of a microscope or in the Coddington lens.

"This natural diaphragm is so formed, that the amount of light which is permitted to pass is to some extent limited, and any remaining tendency to aberration in this wonderful instrument is thereby completely corrected. The same layer of dark colouring-matter is continued downwards between the conical lenses, so that these are effectually isolated, and the rays cannot become confused by passing from one lens to the other. The *conical* lens is curiously shaped, but simple in its structure, not being compound, as is the corneal lens, but of the same density throughout. It is also double convex, the base as well as the apex (from which the point is removed) presenting rounded surfaces.

"At the apex it comes into contact with the bulbous expansion of the optic nerve, which receives the image of the external object, and this nerve proceeds downward in a line continuous with the axis of the ocellus, until it meets the nerves of the other eyelets. These then unite and form a common trunk that communicates with what we may popularly call the insect's brain (strictly speaking, the '*cephalic ganglia*').

"But you may, perhaps, be puzzled to understand how so many small images, as must necessarily enter the compound eye of the Bee, can become amalgamated and combine to form a single picture of the external field; the effect will, however, be perfectly clear to your mind, if you only consider the action of our own two eyes, which convey to our brain not *two*, but only one distinct image of the surrounding objects; and supposing that, instead of two, we had a considerable number of eyes *properly disposed*, the ultimate effect would be just the same. Now, an examination of the external lenses of the compound eye of the Bee shows that their surfaces, especially the inner ones, are not all of equal convexity, and there appears to be, as we might expect, such an arrangement and disposition of the whole mass as to ensure the most perfect co-operation between each lens and the surrounding ones. We also find regularly scattered over the surface of the cornea—in fact, one between almost every lens and its neighbour—a great number of long hairs, and these also aid, no doubt, in

* A careful examination of the eye in the pupa, whilst in process of development, confirms the opinion here expressed.

the stoppage or diversion of indirect rays that might tend to confuse the common image.

"In a former work* we expressed the opinion that the object of these numerous facets in the compound eyes of insects is to render the external field clearer when the insect has occasion to enter the dim hollows of flowers and other dark places in search of food, through the formation of a single picture by the union of a great number of smaller images; and this view would appear to receive striking confirmation from the organs of vision in the Bee, which spends a considerable portion of his time in the corollæ of flowers, or in the darkened hive."

After this lengthened extract, which will give our readers a good idea of the style and the matter of the work, we can only say that many other points in the anatomy of the bee are treated in the same way. The functions of the bee are examined in detail, not omitting the curious question of the parthenogenetic origin of the male or drone bees. The question of the original form of the cell, as to whether it be hexagonal or cylindrical, is discussed; and the author is inclined to adopt the view of Mr. Darwin that they are originally cylindrical. The drawings illustrating the anatomy of the insect are admirably done, and they will be found invaluable to those who wish to mark, with microscope in hand, the beautiful structure of these familiar creatures. This volume is a worthy companion of 'The Earthworm and the Housefly,' and is, in fact, as far as matter and treatment go, superior to that volume. There are other "humble creatures" whose history might be profitably told in the same way, and we hope Mr. Samuelson and Dr. Hicks will be encouraged to go on in the interesting path which they have thus far so successfully trodden.

* 'The Earthworm and Housefly.'

A History of Infusoria, including the Desmidiaceæ and Diatomaceæ, &c. By ANDREW PRITCHARD, M.R.I. Fourth Edition. Enlarged and revised by J. T. ARLIDGE, W. ARCHER, J. RALFS, W. C. WILLIAMSON, and the Author. Forty Plates, pp. 968.

WHEN a work has reached a *fourth* edition, it may be considered in most cases to have passed beyond the domain of the reviewer; and Pritchard's 'Infusoria' has been so long before the world, and, as the number of editions through which it has passed shows, so well appreciated by microscopical observers, that it might now fairly be expected to have escaped any further critical ordeal. But the fact is, that although the old title, and a considerable part of the contents of former editions, are retained, the present may, in all essential respects, be regarded as a new and, to some extent, an original work. As such, we cannot but congratulate the world of microscopists upon its appearance. The names on the title-page are sufficient guarantee for the value of the respective portions they have contributed to the contents; and we have no hesitation, after a careful survey, in saying that we regard Mr. Pritchard's work, in its present guise, as a valuable contribution to science, and well calculated to afford to those who are interested in the subjects upon which it treats a satisfactory and lucid compendium of nearly all that recent observations have brought to light.

Nothing is more striking in the progress of biological science than the daily increasing extent to which the subdivision of labour is carried; whilst, at the same time, for the advance of real knowledge nothing has become more indispensable. The indefatigable and continual labours of collectors and observers have so multiplied the objects of natural history in all branches, that it is now quite impossible for any individual, however acute his perceptive faculties, or however retentive his memory, to embrace more than a very limited range of subjects. This is obvious enough even in the case of the higher and specifically less numerous classes of animals and plants; and in the lower, the multiplicity of forms is so vast, as to render even extreme subdivision imperatively necessary for their accurate study. And the same considerations apply in their fullest force to those lowest forms of living organisms which constitute more peculiarly the subjects of microscopic study. We consequently find, that although Ehrenberg, but a few years back, was able, like a second Linnæus on a small scale, to embrace the whole of the then known microscopic world, at the present time anything like a sufficient view of it, even in a general sense, requires the concurrence of several observers, each of whom has made a particular department in it the subject of his special attention. The present work is a favorable instance of what may be effected by this scientific co-operation.

The work is divided into two parts; the former comprising a "General History," and the second a "Systematic History, of the Infusoria," as they are termed. But this term, it must be understood, is here used in a wider sense than that in which it is now usually accepted. Mr. Pritchard, we presume, for the sake of keeping up a uniformity of title with the former editions of the work, retains the term "Infusoria" in the wide or Ehrenbergian sense; whilst most recent writers confine it to a particular class or division of the rather vague sub-kingdom *Protozoa*, corresponding pretty nearly with the "sub-section" here (p. 266) termed *Ciliata*. The necessity of adhering so closely to the old title of the work may, in a commercial point of view, have been considered imperative, but in a scientific, it is much to be regretted; for in science—and this applies as strongly to science presented in a popular form as in a more rigid guise—precision in the use of terms, it is perhaps needless to insist, is of the utmost importance. The Infusoria, then, as the term is here employed, are subdivided into—1, Bacillaria; 2, Phytozoa; 3, Protozoa; 4, Rotatoria, or Rotifera; and 5, Tardigrada; and the mere sight of these names is sufficient to show the confusion that must arise in the non-scientific mind, when it finds organisms of such extreme diversity embraced under any common term, and especially when it discovers that that term has, within a few years, been employed to distinguish a group of organisms regarded almost as an equivalent to a sub-kingdom of animals. In this sense it has long been discarded by all naturalists, and it is much to be regretted, as it appears to us, that a work so deservedly popular as the present will undoubtedly become should have a tendency, from the want of due explanation, to perpetuate a grievous error.

With respect to the mode in which the different sections of the work have been elaborated by the respective editors or authors, as they might properly be termed, we can only repeat that it is in the highest degree satisfactory. The care and judgment with which the most recent observations and views have been collected, condensed, and in many instances commented upon, are deserving of the highest commendation. And as regards the general arrangement and execution of the book, our verdict would be equally satisfactory, although some space, perhaps, might have been saved by the omission from the "second part" of many particulars concerning different groups which either are or might have been embraced in the first part, or General History.

The additional illustrations, filling twenty-one new plates, appear to have been well selected, and equally well executed.

Without any special reference to the present work, which, it must be confessed, is sufficiently bulky already, we would remark upon the strange circumstance, that in most works devoted to microscopic objects, scarcely any notice is taken of one of the most numerous, varied, and beautiful class of microscopic creatures—viz., the Polyzoa. Not only are the beauty and variety of form presented in these animals as great as in any others of those which more commonly come under the observation of the amateur microscopist, but in a scientific, and more particularly in a geological point of view, their study is fully as important and interesting as is that of the *Diatomaceæ* and *Foraminifera.* We hope therefore, in time, to see these brought more conspicuously under popular notice in works expressly devoted to the entertainment and instruction of MICROSCOPISTS.

Notes on the presence of Animal Life at vast depths in the Sea, with Observations on the Nature of the Sea-bed as bearing on Submarine Telegraphs. By G. C. WALLICH, M.D., &c.

DR. WALLICH has just returned from an arduous undertaking. At a very short notice, animated by the ardent zeal by which he is distinguished, he started as naturalist on board the Bulldog, commanded by Sir L. M'Clintock, and employed in the survey of a proposed telegraphic route to North America. The first-fruits of this expedition, in anticipation, doubtless, of a further and more detailed account of his observations, have been printed by Dr. Wallich, under the above title; and a very interesting communication it is. It is scarcely too much to say, that Dr. Wallich's observations, on this voyage, will have the result of considerably modifying the views of naturalists, as to the necessary limits placed by depth in the ocean to the existence of animal life. The results of former observations of the soundings obtained in the survey of the route for the Great Atlantic Telegraph showed the strong probability, if not the absolute certainty, that animal life could be maintained at the enormous depth of between four and five miles; in fact, that the bed of the ocean, throughout a vast tract, was composed of a soft bed, formed of the shells of defunct and living Foraminifera, for the most part *Globigerina*;—a fact perfectly in accordance with what might have been concluded from our knowledge of the composition of Chalk, and other similar formations of a more recent date; as for instance, that which occurs near Oran, in Algeria. But Dr. Wallich's late dredgings, if the term can be used, have shown, that not only can the lowly organized Rhizopod exist far "removed from light of day," and under a pressure of many tons on the square inch, but that creatures of the high type of organization presented in the Echinodermata are also capable of existing at a depth of 1260 fathoms, or in water condensed under a pressure of about 4000 lbs. on the square inch and what is more marvellous still, that animals of that complex structure can bear to be suddenly brought to the surface, without apparent injury. Besides this, "on two occasions, living specimens of *Serpula*, one from 680 fathoms, and in conjunction with a living *Spirorbis*, other free Annelids and two Amphipod Crustaceans were also taken alive at 445 fathoms."

Here, then, as Dr. Wallich observes, "there is a fresh starting-point, in the natural history of the sea. At a depth of two miles below the surface, where the pressure must amount to at least a ton and a half on the square inch—where it is difficult to believe that the most attenuated ray of life can penetrate—we find a highly organized species of radiate animal living, and evidently flourishing; its red and light pink-coloured tints as clear and brilliant as in its congeners inhabiting the shallow waters, where the sun's rays penetrate freely."

The circumstances recorded leave no doubt that the *Ophiocoma* in question, of which numbers were brought up, must have resided at the depth mentioned; and this fact might be concluded even from the contents of its stomach, which consisted of Globigerina shells, more or less completely freed of their soft contents.

The little brochure contains many other highly interesting observations, and especially some having reference to the value of microscopic soundings in the determination of the course, &c., of oceanic currents—a subject which had attracted the attention of the late lamented Professor Bailey, and which promises to afford important results in the hands of future observers, who will now have the advantage of being armed with an ingenious contrivance for the bringing up of deep soundings, for which naturalists are, we believe, mainly indebted to the ingenuity of Dr. Wallich.

Chemistry in its Relations to Physiology and Medicine. By GEORGE E. DAY, M.D. London: Bailliere.

ALTHOUGH the science of physiology cannot be fully comprehended, unless studied in connection with the organs which perform the functions of life, there can be now little doubt of the vast importance to be attached to the chemical constitution and changes which the organs of living bodies undergo. In fact, the great development, in recent years, of physiological science has been in the direction of chemical inquiry. It is the object of Dr. Day, in this book, to set forth more particularly the relations of chemistry to physiology; and he has produced a work of great practical value. We have been previously indebted to him for having translated Simon's work on 'Animal Chemistry' and Lehmann's 'Physiological Chemistry,' and no one could be better fitted for giving a view of the whole subject than Dr. Day. But whilst it is easy to separate the chemistry of life from any detailed account of the morphology of the organs of living beings, it is impossible to treat this subject satisfactorily, without describing the histological structure of the organs and secretions. Hence the necessity for the use of the microscope, and the examination by its aid of the various tissues and secretions. Whilst, therefore, writing a book expressly devoted to the chemistry of life, Dr. Day has felt himself compelled to refer constantly to the nature of those living products which can only be detected by the aid of the microscope. The work is accompanied by five plates, illustrative of the microscopic structure of the crystals and histological elements found in the blood and secretions. These illustrations are got up in the style of those published in Funk's 'Physiological Atlas,' and will be found of great value to the student who is beginning to work at this subject.

Dr. Day has divided his work into three great heads or departments: 1, The organic substrata of the body; 2, The chemistry of the animal juices and tissues; 3, The great zoochemical processes. It is in the second part more particularly that the student of the microscope will find the subjects of his study more specially treated of. The subjects there successively taken up are the digestive fluids, the blood and its allies, the fluids connected with generation and development, the secretions of the mucous membrane and the skin, the urine, pus, and the solid tissues of the body. To those who wish to make the use of the microscope subservient to the study of physiology, we confidently recommend Dr. Day's volume as one of the most trustworthy guides in our language.

NOTES AND CORRESPONDENCE.

Atmospheric Micrography.—Under the above heading, there appeared in No. XXII of the 'Microscopical Journal' the translation of a paper by Professor Pouchet, of Rouen, purporting to be the description of an instrument termed the aëroscope, but which, at the same time, revived what some might call the exploded theory of spontaneous generation.

As it appears to me that this question cannot be said to be finally disposed of, but as the learned professor's arguments in favour of the theory are somewhat biassed, it may not be inappropriate that the attention of microscopists should be once more directed to the subject.

By most advanced naturalists, the theory of spontaneous generation has been discarded as absurd, or, at least, as highly improbable, and mainly, I believe, on two distinct grounds, viz.—1st, that it is directly opposed to the accepted theory that, for the production of a new *individual*, in either the animal or vegetable kingdom, there must be a conjugation of the "germ" and "sperm" cells (pre-existent, therefore); and 2dly, in consequence of the well-known experiment of Professor Schultze with filtrated and unfiltrated air upon decomposing animal substances.*

Neither of these grounds suffices, however, for the final rejection of the theory; for in a great many of the Protozoa conjugation has never been traced, and, so far as *they* are concerned, the sexual theory is, to some extent, hypothetical; and secondly, I do not recollect having read or heard that Schultze's experiment has ever been confirmed by any English or foreign microscopist or chemist of note, although the complete confirmation of this experiment would effectually dispose of the theory.

Having thus given fair play to the advocates of the theory, I shall now proceed briefly to examine Dr. Pouchet's arguments in its favour.

* See 'Carpenter on the Microscope,' p. 485, &c. &c.

His evidence consists, on the one hand, of the fact stated by him, that his investigation of the atmosphere with his aëroscope has not enabled him to detect the *"ova of infusoria;"* and, on the other hand, that when *"suitable"* infusions are exposed to the air, millions of *"infusoria"* are sure to make their appearance in it.

(I would draw especial attention to the words in italics.)

At the same time, he declares that the *"ova"* are *"infinitely rare,"* even in situations where they might be expected to occur.

In the first place, it is right that I should remind your readers of the fact (of which I can hardly suppose Dr. Pouchet to be ignorant), that the term "infusoria," formerly applied by Ehrenberg and others to a great variety of forms belonging to the Protophyta, Protozoa, Annuloida, &c. &c., is now restricted to that group still denominated "Polygastrica," by Dr. Pouchet.

As before stated, in many of these forms, conjugation of the "germ" and "sperm" cells has never been traced, and I think I am correct in saying no "ova" have been discovered.

It is therefore not surprising that Dr. Pouchet should not have been able to detect the "ova" of Polygastrica (so called) in the atmosphere, granting even the utmost perfection to his apparatus; and I should be much surprised if I heard that even the highest powers of our microscopes had revealed the dried germs of these organisms in their earliest stage.

This brings us to the second phase in Dr. Pouchet's evidence. He says, that whenever a *suitable* infusion is employed, and placed in contact with not more than a décimètre of air, millions of infusoria are almost sure to make their appearance.

He does not state of what his "suitable infusion" consists, nor what are his infusoria.

In No. XVII (October, 1856) of this Journal, you published an abstract of my paper, read before the British Association, in which I described an experiment tried by me with an infusion of chlorophyll. This consisted of the juice of cabbage mixed with a solution of gum, and baked at an intense heat over a furnace, so that all traces of life must have been destroyed; the chlorophyll cake thus obtained was dissolved in *distilled* water, and this formed the infusion.

I found, on exposing this compound to the air, that in a day or two, a few of the forms known as *"Glaucoma scintillans"* made their appearance; and these multiplied with incredible rapidity. The conclusion at which I arrived from this experiment was, that the dried zoospores, or germs, floated about in the atmosphere; and I had at least as good reason to believe so as Dr. Pouchet has for assuming that when a suitable infusion is exposed to the air, the "*ova*" of infusoria, or the infusoria themselves, spring into life by spontaneous generation. The value of this portion of his evidence would have been better appreciated if he had stated accurately of what substances his suitable infusion consisted, whence the substances were obtained, what species of infusoria made their appearance, and after what lapse of time the first appeared.

Dr. Pouchet, as a physiologist, would not wittingly seek to uphold an erroneous theory simply because he had formerly espoused it as correct.

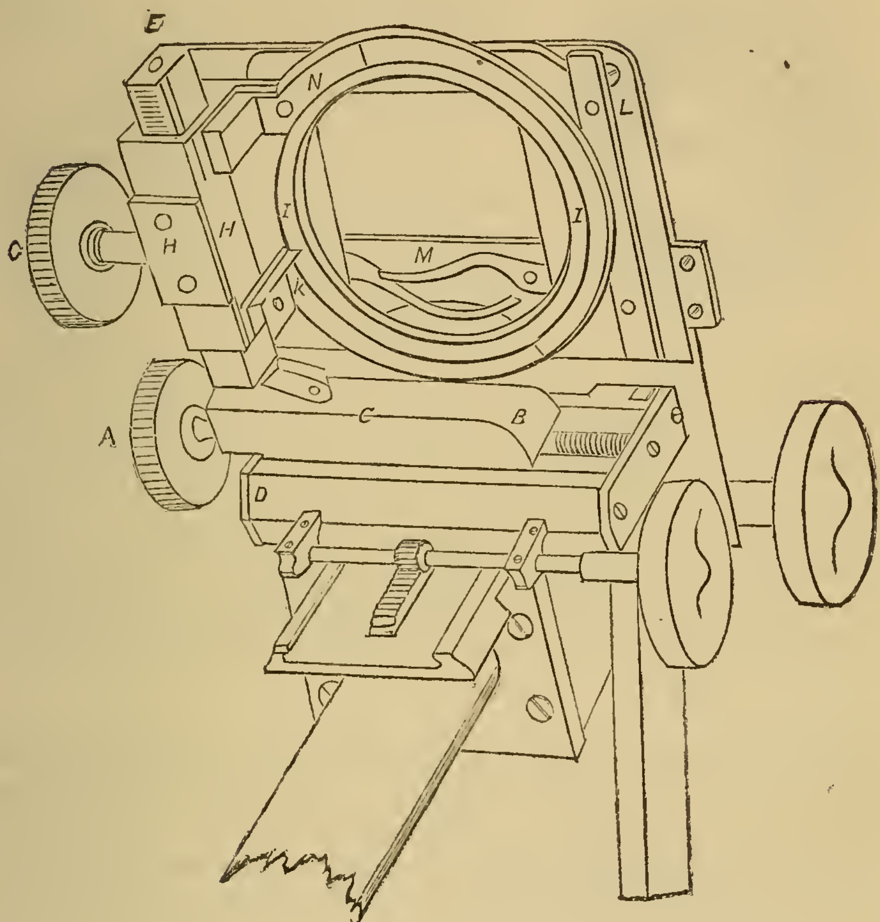
No doubt he and others will again give it an unprejudiced trial, and it appears to me that there are various ways of arriving at a satisfactory conclusion.

Any one, even without a laboratory at his disposal, may verify or controvert the statement of Professor Schultze.

The exposure of *various* dissimilar infusions to the atmosphere in the same place, and of *similar* infusions in different places (care being taken in every case that the germs of life are extinct in the substance exposed), and the examination of the living forms that appear in them, would also aid in solving the problem. If the latter expedient be resorted to, it would be as well to bear in mind that, in the infusion of cabbage juice and distilled water exposed by me in the neighbourhood of Hull, the form that presented itself (alone, so far as my memory serves) was *Glaucoma scintillans*.

Without reference to the question of "spontaneous generation," I feel satisfied that good results would follow from a repetition of these experiments; for the observer must necessarily watch the development of different forms of animal and vegetable existence, and in so doing he would not only obtain a clearer insight into this organisation, but would, in all probability, be able to add to the small stock of information that we possess on this interesting branch of natural history.—James Samuelson.

thin Stage for the Microscope. Constructed by Thomas Ross.—D D is a dovetail plate affixed to the main body or box of the instrument. In this works the fitting C, which has a strong bar, E E, at right angles to it (all one casting). Motion is given to the fitting, C, by means of the screw B. A, milled head fastened to screw; this screw works in a spring box, which prevents loss of time. On the bar, at right angles to C, moves a strong-fitting box, K K, to which motion is communicated by the milled head and pinion G. Surmounted on box, K K, is a plate, I I, supported by two strong curved brackets, N N, which give great strength and support to the



plate, I I, in which a circular plate is fitted, and to which the top stage-plate, L, is also fixed. By means of the circular plate the upper stage may be rotated.

This form of stage is exceedingly convenient, and, applied to the more portable instruments, will enable them to work with the same illuminating apparatus as the larger ones. The entire thickness does not exceed one quarter of an inch, and the support brackets are so constructed as to prevent tremor.

Oscillatoriaceæ.—When going over some of these organisms, a few days ago, I observed one coiled up like the accompanying diagram, in which it will be observed that both extremities of the filament are pointing in the same direction.

The filament thus coiled continued to revolve steadily upon the centre of the coil, in the same direction, viz., from left to right, for half an hour, at the expiration of which time I was obliged to leave it; on my return, in about a quarter of an hour, it had vanished, and could not of course be recognised among its numerous brethren, when uncoiled.

If I do not err in supposing that a motion of this kind in *Oscillatoria* has not been recorded, I beg you will be good enough to "make a note of it" in your columns for this purpose.

The filaments of this species are transparent tubes, sparsely studded with small granules, that appear brown, or reddish brown, by transmitted light; their diameter is 1-6000th of an inch; the length varies, but amounted in the longest to 1-50th of an inch. No markings or segments were visible with Ross's quarter. I did not use any higher power. They were gathered from the bottom of a very muddy pond, nearly dried up, when searching for the "Tank-worm."—J. Mitchell, Lieutenant, Madras Veterans.

On preparing the Shells of the Polycystinæ, from Springfield, Barbadoes.—Through the kindness of one of our members, Admiral Duff, I was put in possession of some of the Barbadoes earth from Springfield estate. The shells are in countless multitudes, but imbedded in a light porous substance resembling discoloured chalk. As the shells are known to be siliceous, some of the earth was boiled in hydrochloric acid, some in nitric, and some in sulphuric, but no effect was produced. Some was boiled in caustic soda, but the shells dissolved as freely as the matrix. As it is needless to describe numerous failures, I shall proceed at once to the process which succeeded.

There was procured—

1. A large glass vessel such as gold-fish are put in; 3 or 4 quarts of ordinary pipe water were put into this.
2. A new tin saucepan, holding about a pint.
3. Two thin precipitating glasses, holding about 10 ounces each.

Take about 3 ounces of Barbadoes earth (lumps are best), and break them with a piercer into tolerably small fragments. The earth should be quite dry. Put 3 or 4 ounces of *common washing soda* into the tin, and half fill the vessel with common water. Set on a clear fire until it boils strongly; then throw in the earth, and let it boil for half an hour or more; take off the fire and pour about nine tenths of what is in the saucepan into the large glass vessel holding the cold water. The undissolved lumps which remain in the tin may now be gently crushed with a soft bristle brush, soda and water added as before, and boiled again; pour off as before, and repeat the process until nothing of value remain in the tin. Then take an ivory spatula, and stir round and round the contents of the large glass vessel; let it stand for about three minutes, and then pour off gently nine tenths of the contents, a considerable quantity of a sandy-looking substance will be found at the bottom. These are the shells partially freed from the matrix, but still very unclean. Wash out your tin, cover the large glass vessel, and the shells will keep for the next leisure evening.

Second process.—Put common washing soda, as before, and water into your tin; transfer all your shells into the tin, and boil as before for an hour or more. Transfer all into the large glass vessel containing water, as before, and after standing one minute pour off the muddy contents; add a large quantity of cold water, stand for a minute, and pour off. The shells may now be transferred to one of the precipitating-glasses.

Each washing brings over more and more of a kind of *flock*, which seems to be the skins of the sarcode bodies of those minute creatures.

We are now ready for the third process.

Drain off the water from the shells which are in your precipitating-glass until not more than half an ounce of water remains above them; add about half a teaspoonful of bicarbonate of soda, which will dissolve perfectly with a little warmth; then pour in gently about an ounce of strong sulphuric acid. The violent effervescence acts as a purge on the shells, blowing out the softened contents, and liberating a large quantity of sarcode flock. The acid also (which is in great excess) dissolves the iron colouring-matter, making the shells beautifully transparent. All that remains now to do is repeated washing, during which process the shells can be sorted. Thus, fill the precipitating-glass having the shells in it with water, let stand for three quarters of a minute, and pour the water into the second precipitating-glass; let the second glass stand for two minutes, and throw away what still remains suspended; repeat this, and all the smaller shells will find their way into the second glass, and all the larger ones will remain in the first. If the large shells are not perfectly clear, repeat the boil in soda, the acid, and the washing.

It is true, this method destroys a few of your larger globes; but you can afford to lose them, as they are too large for the microscope.

You can examine the shells from time to time by a drop-tube, letting a single drop fall on a glass slide placed horizontally on the stage. An oblique light shows them best.—Thomas Furlong, 10, Sydney Place, Bath.

Further Notes on Finders.—At the conclusion of a letter on "Finders" (inserted in your Journal for last July), I endeavoured to impress upon opticians the desirableness of directing more attention to the subject of the Binocular Microscope than they have hitherto done; and it appeared to me a singular coincidence, that the very number containing my suggestion should also contain what looked like a precise answer to it. I allude, of course, to the intensely interesting essay by Mr. Wenham, at page 154 of the 'Transactions.' On reading that paper, I felt quite satisfied that the *ultimatum*, or something very near it, had at length been attained; and immediately commenced a correspondence with Mr. Wenham upon the subject. Nothing could possibly exceed the kindness with which that gentleman took up the matter; even offering to send me his own instrument for examination. But this I declined, as it was clear to me that the mode he had adopted *must* answer. I, according, requested him to supervise the adaptation of one of his prisms to a double tube added to my miscroscope.

And now that this has been done, and I have had time for a fair and deliberate examination and trial of it, I should consider myself very deficient in duty to my brother microscopists, if I delayed another moment to recommend it to them, as by far the greatest advance that has been made upon the instrument since the invention of achromatics. It is, indeed, a very magnificent improvement. The comfort (or, I may truly say, the *luxury*) of using both eyes equally, when both are equally good, is very delightful; but that is not the only nor, indeed, the chief point of superiority. It is the entire relief from all that unpleasant optical fatigue produced by the old practice of using one eye at a time. With the binocular arrangement the observer may go on hour after hour with perfect impunity, feeling no worse than if he had merely been reading a book through a binocular hand-glass or a common pair of spectacles. But after long use of the one-eyed tube, it is not so. It produces more or less feeling of pain, confusion, megrims, giddiness, &c., and, in the course of years, is pretty sure to effect some degree of permanent injury to the chiefly used eye, as I can testify from experience. It would have been a great boon to me if I could have had the Wenham Binocular thirty years ago; and, therefore, I consider it, as I have said, a *duty* to recommend it to those who are commencing their microscopic career.

Now, with regard to its "performance" (as the opticians say), I almost fear to write all I think, lest my own words (in my letter alluded to, page 201) should be retaliated upon me, and I should be accused of giving a "*flaming* account!" I would, therefore, rather express my own opinion in the words of one of the firm of Smith, Beck, and Beck, who adapted the prism, and made the brass-work, &c. He says, in a letter which was privately shown to me, "I am delighted with it. For injections it is glorious! I do not wish to see any thing better." And, in a letter to me, since sending the instrument, he writes, "I am getting to like it more and more." The latter remark is wonderfully borne out in practice; for, as a prisoner who has long hobbled in shackles is, when relieved of them, some time before he comes to the full enjoyment of the *natural* use of his limbs, so a microscopist who has for years been in the habit of poking and straining through his *half*-microscope with one eye, while he winks and blinks, and squeezes up the other, or (as I have seen multitudes do) holds down its lid with his fingers, is really some time before he comes to the full enjoyment of using both eyes in a *natural* manner. This, however, is, when the eyes are good, soon surmounted; and then commences what may truly be called "the real binocular delight!"

But here an objector may put in, "Fine talking, sir! but I have heard that, although these new-fangled double-barrelled affairs may do for low powers (inches and two inches, &c.), in order to exhibit 'pretty things' as a raree-show for young people, &c., yet they will not do for high powers, and are quite insufficient for 'test-objects' of every kind," &c.

I reply, never was there a greater mistake. The new instrument certainly has a clearer field with a low power, and with the one-inch objective and lowest eye-pieces I can distinctly read the Lord's Prayer, which was written for me with Mr. Peters's machine ('Microscopical Journal,' No. XII, p. 55) within a circle of the one fiftieth of an inch. With the half-inch it is as legible as pica print. With the quarter-inch I can beautifully exhibit what were, not very long since, considered "high tests;" such as the delicate markings on the scale of the *Podura,* and the lines and *cross-bars* on the fan-shaped scale of the *Morpho Menelaus.*

This is as far as most persons care to go. Nevertheless, I do not deny, that *beyond* this there does exist a very limited class of what I call "excruciating objects" for which "the Binocular" is not so well adapted; and for such profoundly erudite researches the determined observer may keep an old single barrel, which can be adapted, in place of the double one, in less than half a minute. It should be contrived to pack into the same case, and should be called "the excruciating tube."

By its means, together with a Powell's one sixteenth or a Wenham's one twenty-fifth, he may possibly be enabled to solve such infinitesimally argute problems as whether the scale of *Pontia brassica* has, or has not, diagonal as well as longitudinal lines; and whether the dots on *Pleurosigma angulatum* are of a round shape, as represented in 'Microscopical Journal,' vol. iv, Pl. XII, or hexagonal, as revealed in Dr. Carpenter's 'Revelations,'* p. 307;—researches which, to use the quaint words of Dr. Goring, are "about as profitable to ourselves and our fellow-creatures as if we were engaged in the sublime and important occupation of determining whether the small star of ε Bootes is of a greenish blue or bluish green, or whether some nebula is very gradually, or very suddenly, much brighter in the middle."†—HENRY U. JANSON, Pennsylvania Park, Exeter.

* It is to be regretted that it should have been stated in that work that there is a difficulty in adapting the Wenham binocular to "the varying distances of the eyes of different individuals." The truth is, the said adaptation is one of the best things about it, and consists merely in drawing out or pushing in the two eye-tubes.

† 'Microscopic Illustrations,' p. 211.

PROCEEDINGS OF SOCIETIES.

Microscopical Society, *October* 10*th*, 1860.

Dr. Lankester in the Chair.

C. T. Simpson, Esq., and Dr. Betts were balloted for and duly elected members of the Society.

The following papers were read:—"On the Self-Division of *Micrasterias denticulata*," by Mr. Lobb ('Trans.,' p. 1).

"On a portable Field or Clinical Microscope," by Dr. Beale ('Trans.,' p. 3).

"Description of the Objects in the Slides of Diatomaceæ," presented by the Boston (U. S.) Natural History Society.

November 14*th*, 1860.

Dr. Lankester in the Chair.

L. C. Baily, Esq.; Thos. Wain, Esq.; P. J. Mitchell, Esq.; John Burton, Esq.; and M. Bywater, Esq., were balloted for and duly elected members of the Society.

The following papers were read:—"On a New Form of Dissecting Microscope," by Mr. Smith ('Trans.,' p. 10).

"On New Undescribed Species of Diatomaceæ," by Mr. Norman ('Trans.,' p. 5).

December 12*th*, 1860.

Dr. Lankester in the Chair.

Geo. Western, Esq.; Jas. H. Steward, Esq.; Alexander Fitzgerald, Esq.; Peter Jones, Esq.; P. J. Firmin, Esq.; Jas. Samuelson, Esq.; and W. L. Freestone, Esq., were balloted for and duly elected members of the Society.

The following papers were read:—"On a New Form of Binocular Microscope," by Mr. Wenham ('Trans.,' p. 16).

"On the Corpuscles of the Blood," by Dr. Addison ('Trans.,' p. 20).

Presentations to the Microscopical Society.

October 10*th*.

	Presented by
Observations on the Genus Unio. By Dr. Lea .	The Author.
Description of Eight New Species of Unionidæ. By Dr. Lea	Ditto.
First Report of a Geological Reconnoissance of the Northern Counties of Arkansas during 1857, 1858. By David Dale Owen . . .	Ditto.
List of Diatomaceæ found in the neighbourhood of Hull. By George Norman . . .	Ditto.
Annuaire de l'Academie Royale de Belgique .	The Society.
Bulletins ditto ditto . .	Ditto.
Transactions of the Academy of Science of St Louis, for 1857 . . .	Ditto.
Ditto ditto ditto for 1858, Nos. 1, 2, 3	Ditto.
Journal of the Proceedings of the Linnean Society. Supplement to Vol. IV—Zoology . .	Ditto.
Recreative Science, Nos. 11, 13, 14 . .	The Editor.
Annals and Magazine of Natural History, Nos. 30—34.	Purchased.
Proceedings of the Literary and Philosophical Society of Liverpool, No. 14 . . .	The Society.
The Canadian Journal of Industry, Science, and Art .	Ditto.
Transactions of the Tyneside Naturalists' Field Club. Vol. IV, part 3	Ditto.
Proceedings of the Academy of Natural Sciences of Philadelphia	Ditto.
Journal of the Geological Society, No. 62 .	Ditto.
Photographic Journal, Nos. 98 to 101 . .	The Editor.
British Dental Journal, Nos. 48, 49, 51 . .	Ditto.
A Box containing slides of American Diatomaceæ, from the Boston Natural History Society . .	The Society.

November 14*th*.

The British Diatomaceæ. By the Rev. W. Smith, Vols. I, II, 1853, 1856 . . ; Ralf's British Desmidiæ, 1848 .	Hackney Micr. Soc., per F. C. S. Roper, Esq.
Pritchard's History of Infusorial Animalcules, 1852 .	Ditto.
The whole of the Quarterly Journals of Microscopic Science up to the present time . .	Ditto.
The Select Works of Antony van Leeuwenhoek, Vols. I, II, 1800 to 1807 . . .	Dr. Millar.
Swammerdam Historia Insectorum, Vols. I, II, III, 1737	Ditto.
Hooke's Micrographia, 1667 . . .	Ditto.
Adam's Essays on the Microscope, 1787 . .	Ditto.
Esperienze interno alla generazione degl' insetti fatte da Francisci Redi de Animalcules . .	Ditto.
On the Foraminifera, T. R. Jones and W. R. Parker .	The Authors.
Quarterly Journal of the Geological Society, Vol. XVI, parts 3, 4	The Society.

The Annals and Magazine of Natural History, No. 35	Purchased.
The Canadian Journal of Science and Art, No. 29 .	The Editor.
The Photographic Journal, No. 102 . .	Ditto.
Recreative Science, No. 16 . . .	Ditto.
Six Microscopic Slides . . .	J. F. Norman, Esq.
Two Microscopic Photographs . . .	G. Jackson, Esq.

December 12th.

Researches on the Foraminifera. By Dr. Carpenter, from 'Phil. Transactions,' June 17th, 1858 .	The Author.
Researches on *Tomopteris onisciformis*. By Dr. Carpenter, from 'Transactions of Linnean Society,' 1859 and 1860	Ditto.
Eight Slides illustrating the Development of the Comatula	Dr. Carpenter.
Six Slides of Bryozoa from Arran . .	Ditto.
Journal of Recreative Science, No. 17 . .	The Editor.
Photographic Journal, No. 103 . .	Ditto.
Journal of the Proceedings of the Linnean Society, Vol. V, No. 18	Ditto.
Annals and Magazine of Natural History, No. 36 .	Purchased.
Notes on the Presence of Animal Life at vast Depths in the Sea, with observations on the nature of the Sea-bed, as bearing on submarine telegraphy. By Dr. G. C. Wallich . . .	The Author.
Observations on the Neuration of the Hind Wings of Hymenopterous Insects, and on the Hooks which join the Fore and Hind Wings together in flight. By Miss Staveley	Ditto.
British Journal of Dental Science, six numbers .	Editor.
One Slide of Insect	S. C. Whitbread, Esq.

W. G. Searson, Curator.

The Royal Society of Edinburgh *and the* Neill Medal.

At the opening meeting, on 5th curt., for session 1859-60, of the Royal Society of Edinburgh, the Neill medal and prize was presented, through Professor Balfour, to W. Lauder Lindsay, M.D., F.L.S., for his 'Memoir on the Spermogones and Pycnides of filamentous, fruticulose, and foliaceous Lichens,' read to the Society during the last session. In addition to awarding this prize, the Society is expending a considerable sum in publishing the memoir in question in the forthcoming part of its 'Transactions' (vol. xxii), and in engraving the relative illustrations, executed by the author, which consist of twelve plates of between 400 and 500 drawings.

Hull Micro-Philosophical Society.

The first meeting of the sessional course of this Society took place on Friday evening last (21st September, 1860), at their rooms in the Royal Institution, on which occasion Mr. P. Bruce delivered a lecture on the "Use and Construction of the Microscope," in the course of which he congratulated the Society on its progress, and on the resolution of the previous meeting to form a microscopic library and museum. Mr. Bruce alluded to the fact of the introduction by him of the first achromatic microscope into Hull, and to his discovery (hitherto attributed in all microscopic works to Mr. Sollitt and Mr. Harrison) of the delicate markings on certain Diatomaceæ, which have since become the almost universal test for a good instrument; if, indeed, they have not contributed greatly to the production of the present high quality of the achromatic object-glass. An animated discussion took place on the various subjects connected with the lecture, which occupied the meeting till the usual hour of separation.—*Hull Packet.*

Islington Literary and Scientific Institution.

A microscopical soirée was held at this institution, November 1st, 1860. About fifty microscopes were exhibited by Mr. Thomas Ross, Messrs. Powell and Lealand, Messrs. Smith and Beck, and other makers, and several members of the institution.

Among the objects exhibited were the rotatory circulation of the sap of the *Valisneria spiralis*, exhibited by Mr. Lobb; the circulation of the sap in the hairs of the petal of the *Tradescantia* and of the blood in a small water-newt, by Messrs. Powell and Lealand; the ciliary action of a portion of the gill of a bivalve mollusc, by Messrs. Smith and Beck; some curious microscopic photographs of a thousand-pound note, the Lord's Prayer, the Creed, and several views of cathedrals, &c., by Mr. Dancer, of Manchester; and also some beautiful crystals by polarized light, by some of the members of the institution. Mr. Thomas Ross exhibited some new microscopic objectives, which were remarkable for their large aperture and accurate defining power.

Mr. Hislop delivered a lecture on the construction and uses of the Microscope, illustrated by diagrams of Ross's large Microscope, and of the earliest Achromatic Microscope, which was manufactured by Mr. Tulley, of Islington, one of which is now in the possession of Dr. Bowerbank.

This institution has, in connection with it, a class for the study of the microscope, and the following papers are announced to be read during the ensuing session:—"On Entomostraca and the Eyes of Insects," by Mr. T. W. Burr; "On Marine and Fresh-water Polyzoa," by Mr. W. Hislop; "On Fresh-water Algæ," by Mr. Mestayer; "On the Vegetable Cell," by Mr. R. Moreland, jun.; "On the Organization of Insects," by Mr. Reiner; "On Foraminifera," by Mr. Slade; "On Polarizing Crystals," by Mr. Thomson.

Manchester Literary and Philosophical Society.

Microscopical Section.

April 16th, 1860.—The Secretary read a paper, by Mr. Hepworth, "On Preparing and Mounting Insects."

Mr. Hepworth first destroys life by sulphuric ether, then washes the insects thoroughly in two or three waters in a wide-necked bottle; he afterwards immerses them in caustic potash or Brandish's solution, and allows them to remain from one day to several weeks or months, according to the opacity of the insect; with a camel-hair pencil in each hand, he then in a saucer of clean water presses out the contents of the abdomen and other soft parts dissolved by the potash, holding the head and thorax with one brush, and gently pressing the other with a rolling motion from the head to the extremities, to expel the softened matter: a stroking motion would be liable to separate the head from the body. The Author suggests a small pith or cork roller for this purpose. The potash must afterwards be completely washed away, or crystals may form. The insects must then be dried, the more delicate specimens being spread out or floated on to glass slides, covered with thin glass and tied down with thread. When dry they must be immersed in rectified spirits of turpentine, placed under the exhausted receiver of an air-pump. When sufficiently saturated they will be ready for mounting in Canada balsam, but they may be retained for months in the turpentine without injury. Before mounting, as much turpentine must be drained and cleaned off the slide as possible, but the thin glass must not be removed, or air would be re-admitted. Balsam thinned with chloroform is then to be dropped on the slide so as to touch the cover, and it will be drawn under by capillary attraction. After pressing down the cover, the slide may be left to dry and to be finished off. If quicker drying be required, the slide may be warmed over a spirit lamp, but not made too hot, as boiling disarranges the object. Vapours of turpentine or chloroform may cause a few bubbles, which will subside when condensed by cooling.

Various specimens, beautifully mounted by this process by Mr. Hepworth, were exhibited.

Mr. Mosley read an account of a Microscopical Examination of Flour, illustrative of the commercial advantages which may be occasionally derived from a knowledge of the use of the microscope.

Mr. Dancer exhibited Diatomacea and Foraminifera, obtained from deep soundings in the Atlantic and from the Red Sea.

Mr. Lynde exhibited pupa cases of Insects, from the Gold Coast of Africa.

Mr. Hepworth sent for inspection an ingenious diatom box, constructed for a friend going to travel on the Continent.

Annual Meeting, *May* 21*st*, 1860.—The following gentlemen were elected Officers of the Section for the ensuing session:—

President, Professor W. C. Williamson, F.R.S.

Vice-Presidents, E. W. Binney, F.R.S., F.G.S., W. J. Rideout, Joseph Sidebotham.

Treasurer, J. G. Lynde, M. Inst. C.E., F.G.S.

Secretary, George Mosley.

Mr. Lynde presented two slides of pupa cases of insects, called Gold Shells, from the Gold Coast of Africa. He also exhibited the circulation of the blood in the tail of the stickleback.

Mr. Latham presented to the Section, and also to each member present, a portion of sand, from Aden, in the Red Sea, containing Foraminifera, Spicula, &c.

Mr. Dancer exhibited a number of slides of various new and interesting objects.

June 20*th*, 1860.—The Secretary read a few extracts from a private letter from Mr. Frembly, of Gibraltar, in which he refers to the rotifera found in that neighbourhood: they differ very little from the British species described by Carpenter, Henfrey, &c. He found with them, free vorticella with spiral stalk or tail, whilst in England the free vorticella is generally found without tail. Its utility in the case of those living with such neighbours is manifest, for the vorticella would now and again become involved in the eddy made by the cilia of the rotifera, but invariably before coming in contact did they succeed in escaping by the muscular power of the tail, which by suddenly coiling enabled them to throw themselves out of the influence of the current.

Mr. Frembly had found one of the Algæ of the chlorosperm order, which was new to him, and of which he had not found any description. He intends to send specimens for examination.

A letter was read from Mr. Hepworth, of Crofts Bank, accompanying specimens of Sarcina, injected kidney, spores of Equisetum, Euglena, *Batrachospermum moniliformis* of two kinds, some diatoms, &c.

Mr. Samuel Hardman, of Davyhulme, presented a few well-mounted specimens of the larva of the wire-worm, willow moth, Cimex, and Curculio.

Mr. Mosley exhibited the living (so-called) skeleton larva and pupa of the *Corethra plumicornis* (Pritchard), pupa of Ephemera, marine Gammarus from Gibraltar, and aquatic Gammarus from near Northenden, almost identical with each other; the shell or scales of the marine animal being most transparent.

Mr. Brothers exhibited the tongue of a cricket, circulation in the chara, &c.

Mr. Dancer sent for exhibition a specimen of Topaz, with natural cavities containing fluid and gases, which on boiling present curious phenomena; also a box of objects, two microscopes, &c.

September 17*th*, 1860.—A specimen of envelopes was exhibited by the Secretary, such as were proposed to be sent to captains of vessels, in which to preserve the soundings they obtain in different parts of the world, for this section. The envelopes were much approved of, and were thought likely to be productive of future interest to the section, and to microscopists in general.

Mr. Latham referred to Mr. Hepworth's method of mounting insects in Canada balsam, and described his own experience of the same. Mr. Latham spoke in very favorable terms of the facility with which slides can be washed off and finished. He found that the balsam should be as thick as possible, almost even to dryness; then dissolved in chloroform, to a consistence only thin enough to flow easily under the thin glass; the object having previously been mounted by Mr. Hepworth's process, under thin glass tied on with thread, exhausted of air, and saturated with turpentine. After heating over a spirit-lamp the balsam sets hard almost as soon as cool, when the slide, after cleaning with alcohol, is ready for the cabinet. Mr. Latham exhibited several slides thus mounted, with specimens of the gizzard of a cricket, the saw-fly, entire trachea system of the silkworm, ichneumon-fly, spiracle of the silkworm, goldfish scale, leaf of wheat showing spiral vessels.

Mr. Lynde exhibited a fine Plumatella living on the shell of a large Lymnea or water-snail.

Mr. Mosley exhibited specimens of Hydra and other aquatic objects.

October 15*th*, 1860.—A circular was read, addressed to captains of vessels, with a request that they will preserve the produce of the soundings they make when abroad, in the envelopes sent therewith.—A letter was read from Mr. Hayman, of Liverpool, to the effect that circulars and envelopes have been supplied to the captains of eight steamers belonging to Messrs. John Bibby and Sons, in the Mediterranean trade; three of Messrs. M'Iver's steamers, plying between Liverpool and New York; to the steamer Armenian, for Madeira, Sierra Leone, Calabar, &c.; to the Marco Polo, and two other vessels to Melbourne; as well as to vessels which have gone to Woosung in China, Bombay, Alexandria, &c., &c.

The Chairman made some observations in praise of the plan, which he had no doubt would be productive of advantage, and add to the interest of the meetings of the section.

It was suggested by Mr. Brothers that a special subject, previously fixed upon, should be discussed at each meeting; the suggestion was at once adopted. The subject for discussion at the next meeting will be, "Upon the Best Method of Preparing and Mounting Diatoms, &c., obtained from Soundings and other

Sources." It is requested that the members of the section will meanwhile obtain and communicate all the information they can on the subject.

Mr. Lynde exhibited a specimen of a small insect allied to the Podura, which he found leaping about on the surface of the water in his aquarium. Mr. Lynde had never seen a description of such an insect, nor was it known to any of the members of the section present.

Mr. Brothers exhibited the *Hydra viridis*, &c.

A few specimens and parts of flowers obtained at the Botanical Gardens were exhibited by the secretary. In the tank of the Victoria Regia little minute animal life could be discovered during a short visit. A specimen of Cetochilus was shown, which was found there, as also a few diatoms not fully examined.

November 19*th*, 1860.—A letter was read from Mr. R. D. Darbishire, relative to the deposits from the raised sea bottom found at Capell Backen, Uddevalla, near Gottenburgh, in Sweden. He observes that "the hill side from a height of about fifty feet above the level of the sea to that of about two hundred and thirty feet, consists of layers of fossil shells, varying from ten to thirty feet thick, alternating with beds of more or less coarse gravel and clayey sand." Mr. Darbishire contributed, for the use of the members, a parcel of washings from shells, and a box containing dry sieved soil for microscopical examination.

A letter was read from Mr. John Hepworth, of Crofts Bank, describing his method of washing and mounting calcareous and siliceous shells, dry and in balsam. Mr. Hepworth also presented to the Members of the Section, for mounting, a piece of injected kidney.

A paper by Mr. J. B. Dancer, F.R.A.S., was read, "On cleaning and preparing diatoms obtained from soundings and other sources."

The Secretary exhibited a portion of sea-weed from the Gulf Stream, in which were found a few diatoms, remains of entomostraca, &c., contributed by Mr. A. da S. Lima, of London.

ZOOPHYTOLOGY.

Description *of* New Polyzoa, *collected by* J. Y. Johnson, Esq., *at* Madeira, *in the years* 1859 *and* 1860. By G. Busk, F.R.S.

(*Continued from* vol. viii, p. 285.)

I. Cheilostomata.

Fam. 1. Scrupocellariidæ, B.

Gen. 1. *Scrupocellaria.* V. Ben.

1. *S. Maderensis*, B. Pl. XXXII, fig. 1.

Having, upon further search, met with a tolerably good specimen of this species, which is described in the last part of "Zoophytology" (vol. viii, p. 280), I now give a figure of it, sufficient to facilitate its recognition.

Fam. 2. Membraniporidæ.

Gen. 2. *Membranipora.* Blain, S.

1. *M. irregularis*, D'Orb. Pl. XXXIII, fig. 3.

Cellulis distantibus subovalibus, inæqualibus irregulariter dispositis; margine granulato, inermi; avicular iis 0 (?)

Cells distant, mostly oval or suborbicular, very irregular in size, and placed irregularly; margin granular, wholly unarmed; no avicularia.

M. irregularis, D'Orbig., (Am. Mérid., pl. viii, fig. 6).
(?) *M. simplex*, D'Orbigny (ib., figs. 7—9).
(?) *M. Lacroixii* (var.), Aud.; Bk.; Alder.
(?) *Flustra distans*, Hassall; Johnston; W. Thompson.

There are two or three species with which the present might be confounded, and, in fact, from which its absolute distinctness is by no means certain.

These are:

1. *M. imbellis*, Hincks.
2. *M. Lacroixii*, Aud.
3. *M. simplex*, D'Orb.

From the former, which, with the greatest deference to Mr. Hincks' opinion, I am disposed to regard simply as an unarmed variety of *M. Flemingii*, *M. irregularis* differs principally in the more oval or rounded shape, and more irregular disposition, and inequality in size of the cells. From worn specimens of *M. Lacroixii* it would be difficult to distinguish *M. irregularis*, excepting by the total absence of any marginal spines and of any vestige of avicularia; whilst between *M. irregularis* and *M. simplex*, D'Orbigny, I am unable to perceive any important diversity.

Gen. 2. *Lepralia*, Johnst.

1. *L. multispinata*, n. sp. Pl. XXXII, fig. 5.

Cellulis suberectis, immersis, inferne ventricosis, superne coarctatis; superficie granulosâ; orificio arcuato, labio inferiori recto integro; peristomate producto crasso, anticè excavato; spinis marginalibus 8—10.

Cells suberect, immersed and ventricose below, contracted above; surface granular; orifice arched, with an entire, straight lower lip; peristome raised, thick, forming a cup in front of the orifice; 8—10 marginal spines.

Hab.—Madeira, on shell, *J. Y. J.*

Fam. 3. Celleporidæ, B.

Gen. 3. *Cellepora*, O. Fab.

1. *C. ampullacea*, n. sp. Pl XXXII, fig. 4.

Cellulis ovatis ventricosis; superfice sparse perforatâ, vel punctatâ; orificio orbiculari: peristomate tenui, integro; avicularis 0.

Cells ovate, ventricose; surface smooth, sparsely punctured, chiefly in the upper part of the cell, or dotted; orifice circular; peristome thin, annular; no avicularia.

Hab.—Madeira, on shell, *J. Y. J.*

Fam. 4. Escharidæ, B.

Gen. 4. *Eschara*, Ray.

1. *E. tubulata*, n. sp. Plate XXXIII, fig. 1.

Polyzoario e ramis linearibus subcompressis, tenuibus, curvatis composito Cellulis tubulatis, productis, superficie delicatule granulosâ; orificio orbiculari mandibulo semicirculari ascendenti, intus armato; peristomate incrassato simplici.

Polyzoary composed of linear, curved, slender, subcompressed branches. Cells tubular, produced above; surface finely granular; orifice orbicular, with an avicularium just within the lower border, the semicircular mandible looking upwards and backwards; peristome thickened.

Hab.—Madeira, *J. Y. J.*

A species of Eschara occurs in the Egean Sea (of which I have specimens collected by E. Forbes), having the polyzoary constituted of slender, subcylindrical branches, and the cells produced in a tubular form above, and which consequently in some respects corresponds with the present species, but on closer comparison the two will be found quite distinct. In the Egean form (of which a figure and description, under the name of *E. cervicornis*, are given in "Zoophytology" ('Quart. Journ. Micr. Soc.,' vol. iii, p. 322, Pl. IV, figs. 4, 6). The cells, are in the first place, more or less ventricose below, whilst the orifice is not quite circular, and presents a small denticle on the lower border, and has no avicularium within it.

Gen. 2. PSILESCHARA, n. g.

Polyzoario erecto, e ramis linearitus subcompressis composito ; cellulas in unâ faciei tantùm gerente ; cellulis quincuncialibus, in seriebus longitudinalibus dispositis.

Polyzoary erect, branched, branches linear, compressed; cells opening on one side only, quincuncial in longitudinal series.

1. *P. Maderensis*, n. sp. Pl. XXXII, fig. 2.

Cellulis superne liberis subtubulosis, ad basin immersis, margine elevato circumdatis; ad latera punctatis, superficie granulosâ, avicularium mandibulo acuto ascendente, infra orificium medio gerentibus.

Cells free and subtubular above, immersed below, surrounded with a raised border, and punctured on the sides; surface granular. An avicularium immediately below the orifice in the middle and front; mandible acute, ascending.

Hab.—Madeira, *J. Y. J.*

In a list of some fossil Polyzoa, collected by the Rev. J. E. Woods in South Australia, given by me in 'Quart Journ., Geol. Soc.' (vol. xviii, p. 261), I have enumerated two species of Escharidæ, which differ from the other members included in that family in having a simple, branched, not reticulated, polyzoary, constituted of a single layer of cells, that is to say, in which the openings of the cells are all on one side of the branches, the opposite surface presenting only the backs of the cells. To these two fossil forms is now to be added a third living one. The Family Escharidæ will now include—

Eschara,
Melicerita,
Biflustra,
Retepora,
Psileschara, and
Cœleschara, only known at present as a fossil form.

II. CYCLOSTOMATA.

Fam. I. IDMONEIDÆ.

Gen. 1. *Hornera*, Lamx.

1. *H. pectinata*, n. sp. Pl. XXXIII, figs. 4, 5, 6.

Polyzoarium parvum, basi diffuso affixum, irregulariter ramosum ramusculis teretibus ; cellularum orificio exserto, denticulato ; superficie anteriori sparsè punctâto, polito, irregulariter sulcato ; posteriori sparsè punctata.

Polyzoarium small, branched, attached by an expanded base, branches irregular terete; tubes exserted, border of orifice toothed; surface sparsely punctured, porcellanous, irregularly sulcate; posterior sparsely punctured like the anterior.

Hab.—Madeira, *J. Y. L.*

This *Hornera* appears, from the specimens furnished, to be of small size, probably not exceeding an inch at most in height. The erect, irregularly branched growth arises from a wide, expanded, discoid base, and the branches taper towards the ends. The character of the surface and the pectinate border of the orifice suffice at once to distinguish it from any other species, recent or fossil, with which I am acquainted.

(To be continued.)

DESCRIPTION OF PLATES XXXII & XXXIII.

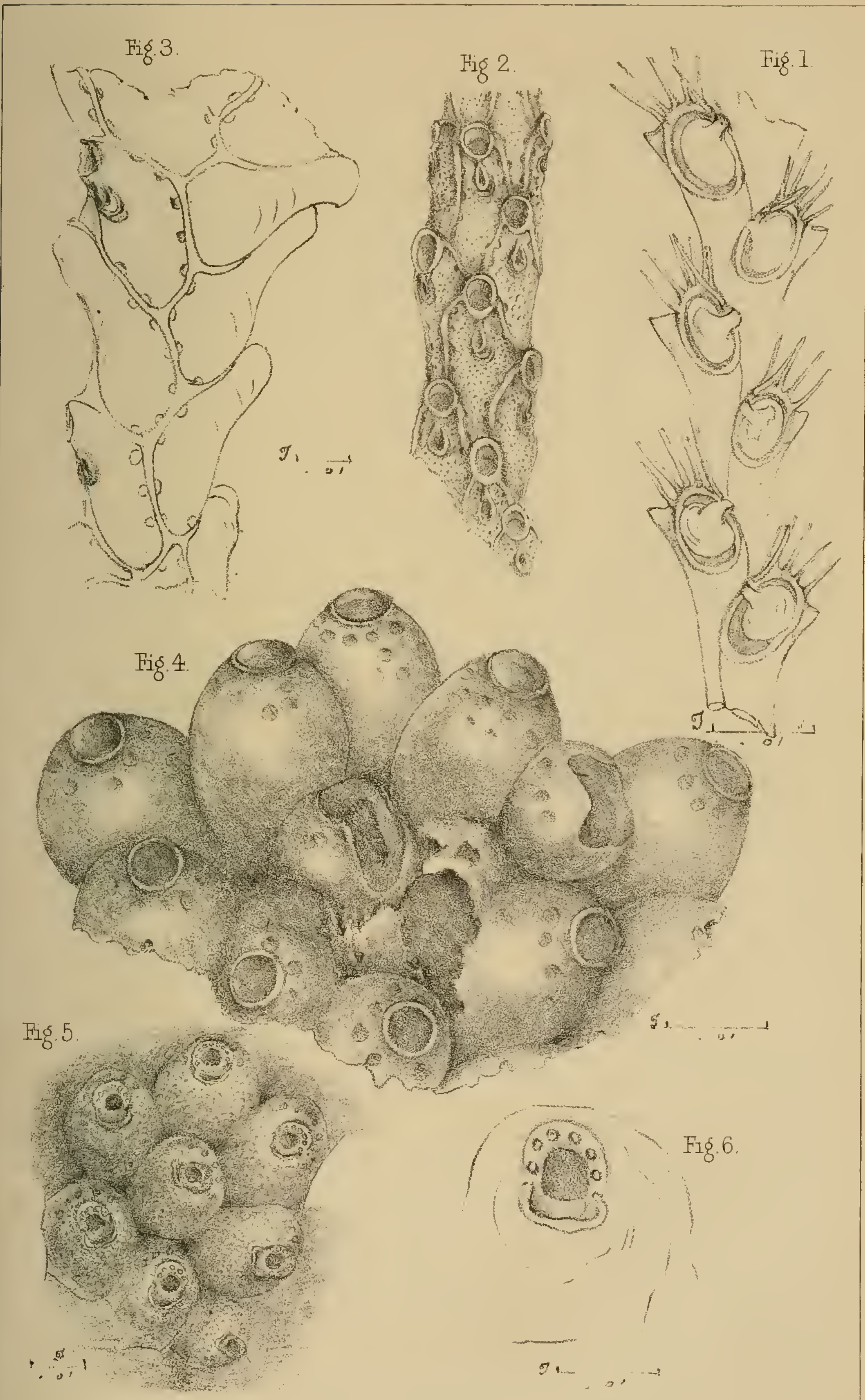
PLATE XXXII.

Fig.
1.—*Scrupocellaria Maderensis*, p. 65.
2.—*Psileschara Maderensis*, p. 67.
3.— „ (back).
4.—*Cellepora ampulliacea*, p. 66.
5.—*Lepralia multispirata*, p. 66.
6.— „ × 50 diam.

PLATE XXXIII.

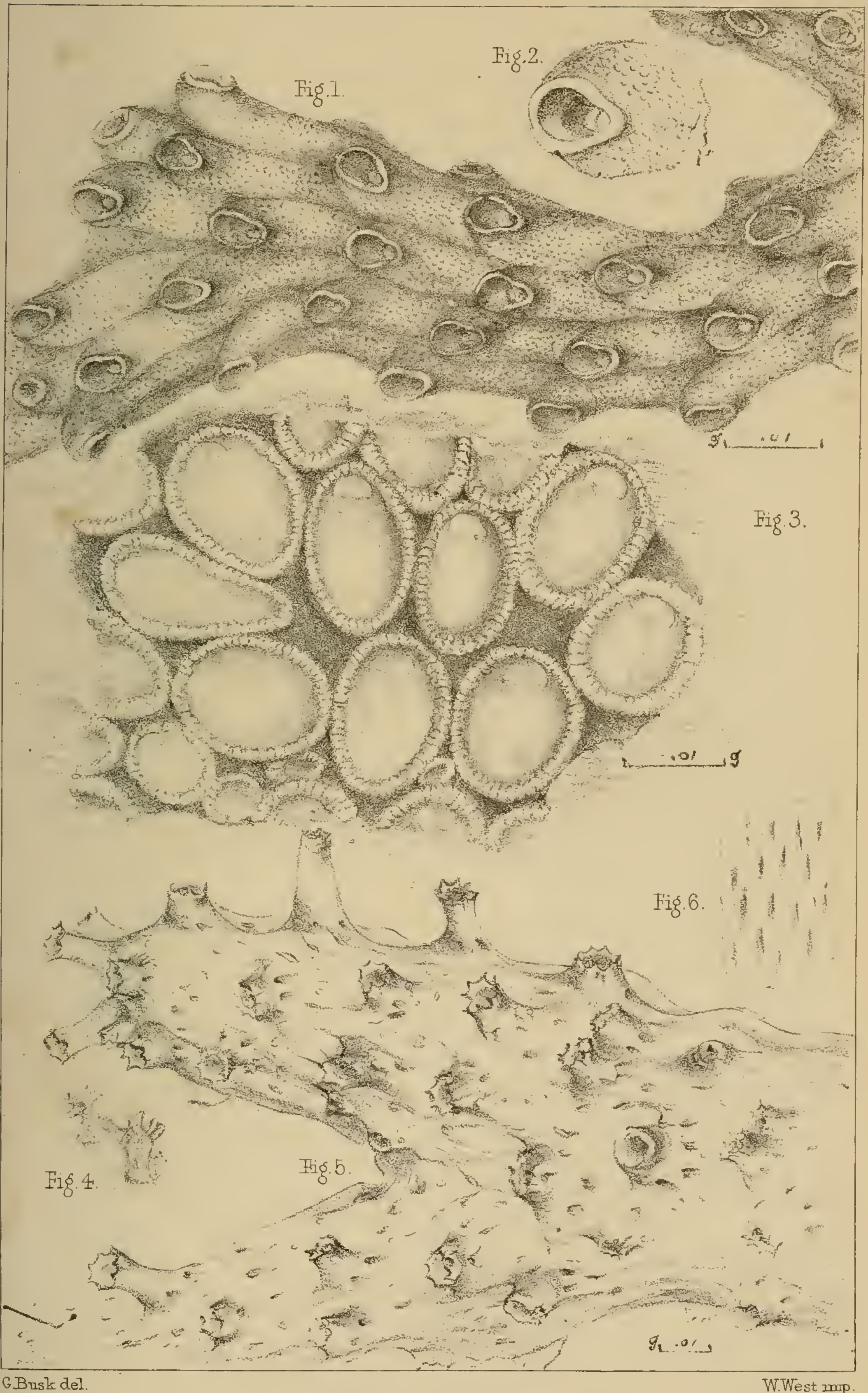
1.—*Eschara tubulata*, p. 66.
2.— „ (orifice × 50 diam.)
3.—*Membranipora irregularis*, p. 65.
4.—*Hornera pectinata* (nat. size).
5.— „ × 25 diam.
6.— „ portion of back.

Plate XXXII.



G. Busk del. W. West imp.

Plate XXXIII



G. Busk del.

W. West imp.

ORIGINAL COMMUNICATIONS.

On Changes of Form in the Red Corpuscles *of* Human Blood. By William Addison, M.D., F.R.S.

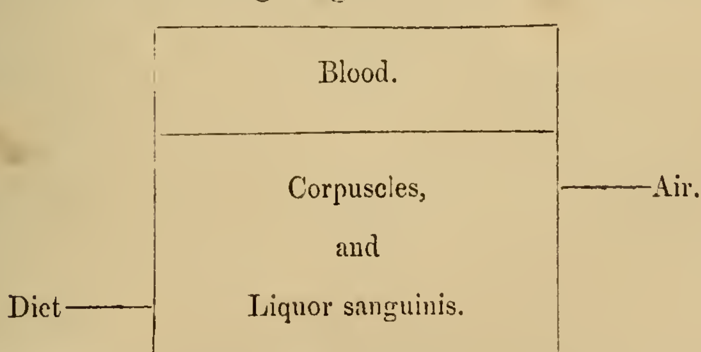
In the natural history of plants and animals, the relations between different parts of the structure of an individual have, on many occasions, been established by the study of malformations or irregularities.

In botany, the relation of stamens and petals to leaves has been made out by irregularity in the structure of the flower; and in human anatomy, the relations and uses of an organ have been illustrated by some malformation—some departure of it from the normal form.

In any effort made to distinguish the relations subsisting between the two principal elements of blood, and between these and outward things, it must be remembered that the corpuscles are in contact with the liquor sanguinis, and that they come into contact with air in the lungs. Also that the liquor sanguinis is replenished by diet—food and drink, and that the corpuscles of the blood swim in it.

The offices of the stomach are more closely associated with the liquor sanguinis than with the corpuscles; whereas the office of the lungs has chiefly do with the corpuscles.

These several relations (1) between the two parts of the blood, (2) between articles of diet and the liquor sanguinis, and (3) between the corpuscles of blood and the air, are sketched in the following diagram:



It follows that the corpuscles may have their properties changed or interfered with by substances in solution in the liquor sanguinis, and also by substances in solution in the air; and that the liquor sanguinis may have its properties altered by substances taken into the stomach, also by matter which may be discharged into it from the corpuscles.

Bearing upon the relations subsisting between the liquor sanguinis and the corpuscles of the blood, an interesting example of malformation or irregularity of structure in point has been narrated by Mr. Erichson, and we ground our argument in part upon the results of his experiments.

Thomas Furley, aged thirteen years, an intelligent but sickly-looking lad, has been afflicted with extroversion of the bladder from birth. The inner surface of the posterior aspect of the bladder protrudes through an opening in the abdominal wall, and forms a tumour the size of half an orange. At the under surface of this tumour are the orifices of the ureters. "I eagerly seized this opportunity," says Mr. Erichson, "of making some observations and experiments respecting the length of time that elapses between the introduction of different substances into the stomach and their appearance in the urine. The substances experimented with were the yellow ferrocyanuret or prussiate of potass, infusion of galls, of rhubarb, of madder, of uva ursi, and decoction of logwood; the citrates of soda and potass, tartrate of soda and acetate of potass."

The experiments with prussiate of potass, galls, and uva ursi were performed, by receiving the drops of urine, as they fell from the ureter, into a glass containing a solution of persulphate of iron; those with rhubarb, by receiving the urine into a dilute solution of potass; and those with the citrates, tartrates, and acetates of potass and soda, by testing the urine with litmus or turmeric paper.

Ten experiments were made with prussiate of potass, the quantity taken at a time varying from 20 to 40 grains. The period which elapsed between taking the salt and its appearance in the urine depended upon the state of the stomach; when no food had been taken for some hours, the salt could be detected in the urine in two minutes after it had been swallowed; whereas when it was taken shortly after a meal, it required from six to forty minutes for its passage from the stomach into the urine. The time required for the vegetable substances to make their appearance in the urine varied from sixteen to thirty-nine minutes. The citrates and tartrates of soda and potass made the urine alkaline in from twenty-eight to forty minutes, and greatly increased its flow.*

* 'London Medical Gazette,' vol. i, 1845, p. 363.

In the year 1832 numerous cases of epidemic cholera were treated with saline liquids, injected into the blood, not only without detriment to the patients, but in many instances the injected fluid evidently conduced to the preservation of life. In the 'Provincial Medical Journal' of October, 1844, eight cases of cholera treated by injection are reported, in one of which (case 4) ten quarts of a saline liquid were thrown into the circulation in fourteen hours, and the patient recovered. A very remarkable case is reported in the 'Lancet,' in which five gallons of a saline fluid were injected by a vein in the course of four days. At seven in the morning of the 29th of May an injection of ten pounds of the fluid, with ten grains of sulphate of *quinine,* was made; and on the 2d of June six drops of a solution of *morphia* were added to the fluid used for injection.*

Now Mr. Erichson does not state that the substances given to Furley in any way impaired his health. The only evidence of their passage through the blood was that they were found in the urine. And, with respect to the cholera cases, there is abundant evidence that the condition of the patients was improved by the liquids forced into the blood. Knowing, then, the great importance of the red corpuscles of the blood in the functions of life, the natural inference is that they were not injured in their essential properties by the proceedings in either of the two examples. And it would seem that prussiate of potass is a salt which may pass through the liquor sanguinis without disturbing either the corpuscles of the blood or the cellular elements of any of the fixed organs, except perhaps those of the kidney.

Dark or venous blood, inclosed in a moist bladder and exposed to the air, soon assumes the bright arterial tint. The change of colour has reference to the corpuscles, and the experiment proves that these bodies do not lose this, one of their most striking properties, until at least some time after their withdrawal from the body.

In the preceding number of this Journal, (January, 1861) we have described and figured certain changes of form or outline which blood-corpuscles spontaneously undergo when just withdrawn from the human body (p. 20, Plate III); also the changes of form they experience by mingling weak saline, alkaline, and acid fluids with the liquor sanguinis. Moreover, we have shown that corpuscles which have been thus changed may be restored to their normal form and appearance by a counteracting agent. Acids restore them

* 'Lancet,' 1831-32, vol. ii, p. 748. Also, for another remarkable case, see 'Lancet,' 1831-32, vol. ii, p. 275.

when they have been altered by an alkali, and *vice versâ*. That is to say, corpuscles which have assumed the rough or alkaline outline regain their natural aspect under the influence of the diluted hydrochloric acid, and retain it for a longer or shorter space before assuming the form characteristic of the acid influence. (Plate III, figs. 2 and 3.) We have made a saline solution similar to that used for injection into the blood in cholera cases, and we find it gives the corpuscles a rough outline, as do other saline and alkaline fluids; but the altered corpuscles are very readily changed back again to the normal form, upon the addition to them of an acid. In a solution of prussiate of potass, in the proportion of a grain of the salt to one fluid drachm of water, the corpuscles undergo the same changes as they do in weak acid fluids (Plate III, fig. 3); and they recover their normal form very readily upon the application of liquor potassæ. In this experiment—as I have said of others—the liquor potassæ destroys numerous corpuscles; but when it is diluted with the required amount of liquor sanguinis, there the changes we refer to take place (*ante*, p. 23).

Again, when sherry wine is mingled with the liquor sanguinis, the corpuscles exhibit actions of a very curious kind. A molecular matter exudes from them, floating off into the liquor sanguinis; and long tails, with a singular movement, are projected from the interior of the corpuscles. In all these phenomena it is the quality, and not specific gravity, of the fluids which governs the effect. Changes of form thus wrought in blood-corpuscles by mingling extraneous matter with the liquor sanguinis is additional evidence that, notwithstanding their withdrawal from the body, they still possess special properties; and so long as the changes thus produced are of the same kind with, and do not exceed those which the corpuscles spontaneously exhibit, and as long as they retain the property of recovering their normal form and appearance by the application of a counteracting agent, so long we may presume they are not greatly injured. When viewing the circulation of blood in the frog's foot, we may see many corpuscles bent, elongated, and squeezed into all manner of shapes; but they regain their natural form when the restraint or obstacles are overcome, and the animal suffers no detriment from the temporary alteration in the corpuscular forms.

Likewise, it may be argued with respect to the action of sherry wine, that so long as the corpuscles retain the property of projecting moveable tails, thus long they retain their active qualities. That the action in this case is an exhaustive one, and the corpuscles are ultimately destroyed by it, does not vary the argument that the projection of the tails is an exhibition of a species of reaction on the part of the corpuscles, produced by the vinous fluid when mingled with the liquor sanguinis.

Now, on repeating our experiments, we have found that *quinine, morphia,* and *strychnine* do not vary the phenomena. They do not prevent corpuscles which have spontaneously changed their form, nor those which have been altered by a saline or alkaline liquid, from resuming their normal form under the influence of an acid. Nor do these vegetable alkaloids interfere with the action of sherry wine, even when they are in the proportion of a grain to a fluid drachm of the wine. Whereas, if only the one eighth of a grain of the bichloride of mercury be added to a fluid drachm of the wine, not only is the projection of tails from the corpuscles prevented, but also those corpuscles which have changed their outline are rendered incapable of restoration to their normal form.

Experiment.—Nine grains of refined sugar were dissolved in half a fluid ounce of water, and an experiment was made in the manner described in our former paper (page 20, *ante*). The corpuscles which *floated out* into the fluid had a smooth outline. A mixture was now made of four parts sugar solution and one part laudanum. Upon using this mixture there were numerous corpuscles with a rough or prickly outline, mingled with smooth ones. But liquor potassæ rendered the corpuscles with smooth outilnes prickly; and diluted hydrochloric acid restored the prickly forms to their normal shape, just the same as if no laudanum were present.

It would appear, then, that substances which are poisonous to the brain and nervous matter have no particular effect, no marked action, upon the corpuscles of the blood.

A parenchymatous organ (the brain, liver, salivary glands, and kidney) is composed of cellular particles to which the *special* function and susceptibilities of the organ are attributed. And in medical practice it is well known, that one organ may be influenced by a medicine or remedy taken by the stomach, to the exclusion of other organs.

The corpuscles of blood are cellular particles of an analogous kind; and that they should possess analogous properties—a measure of indifference or even of resistance against some substances in the liquor sanguinis, and a special susceptibility to other substances—is no more than might have been expected if they be bodies with the properties of cells.

In every department of nature, cellular bodies, whether fixed or moveable, so long as they preserve their vital properties, have special susceptibilities; they are not at the mercy of every inorganic element which may assail them. In every experiment we have made with the corpuscles of human blood, some have been found more altered in outline than others, although swimming side by side in the same current; because, as we apprehend it, amongst a great multitude of these bodies some are more susceptible than others. We would avoid laying too much stress upon microscopical observations; but when their evidence points in the same direction with that of other facts, they are entitled to full consideration.

The whole of the evidence concurs in indicating that the most striking distinction between the active elements of a fixed parenchymatous organ and the active elements—the corpuscles—of the blood is that the former are grouped in fixed positions and irrigated by the liquor sanguinis, whereas the latter are mobile, in circulation, swimming in the liquor sanguinis. And inasmuch as all cellular bodies, whether fixed or moveable, have a vital or physiological property of resistance in common, so therefore we look for evidence of a resisting power in the corpuscles of blood.* At all events, we know that morphia and laudanum may be taken by the stomach so as to act upon the brain, without any known evidence of disorder in the corpuscles of the blood. Our microscopical observations show that neither morphia nor laudanum has any interfering effect upon the corpuscles of blood; and the conclusion we draw from our investigation is that—

The liquor sanguinis may be altered in various ways—by an unwholesome diet, by medicines and poisons, by substances taken into the stomach, so as to influence the elements of some fixed organ—before interfering with the properties of the corpuscles of the blood.

Supposing this conclusion established, how, it may be asked, are we to know when the corpuscles of the blood are interfered with? What are the signs or symptoms of an injurious action upon these bodies as distinguished from the liquor sanguinis? These questions we hope to attempt to answer on a future occasion.

* Gulstonian Lectures, 1859, vide 'British Medical Journal,' April, May, &c., 1859.

On Amphipleura pellucida.

By Wm. Hendry, Esq., Surgeon, Hull.

Being favoured with the published results of Messrs. Sullivant and Wormley's investigations on the subject of Nobert's test-plate and the striæ of *Amphipleura pellucida*, and in support of my views heretofore advanced in the 'Microscopical Journal' (July, 1860) relative to a coarse striation of many of these diatoms, I now transmit the measure of a series contained in several slides in my present possession, as under; having rejected every aspect of ambiguous character, and exercised due care in the micrometer adjustment.

I have selected purposely a comparative coarse striation, in contrast to the high numbers promulgated by Mr. Sollitt, whose 135 striæ in ·001″ said to be counted, and whose 175 in ·001″ reputed to be visible, are beyond my comprehension and experience; at the same time I believe myself prepared to compete in the exhibition of the finest visible striation, using for my own part a $\frac{1}{12}$th objective made by Dallmeyer, optician, of London.

Slides.	Striæ.				
No. 1 *a*	. 42	in	·001″	*Amphipleura*	*pellucida.*
2 *a*	. 40	,,	,,	,,	,,
,, *b*	. 40	,,	,,	,,	,,
,, *c*	. 40	,,	,,	,,	,,
3 *a*	. 42	,,	,,	,,	,,
,, *b*	. 38	,,	,,	,,	,,
4 *a*	. 38	,,	,,	,,	,,
,, *b*	. 35	,,	,,	,,	,,
,, *c*	. 49	,,	,,	,,	,,
5 *a*	. 45	,,	,,	,,	,,
,, *b*	. 45	,,	,,	,,	,,
6 *a*	. 34	,,	,,	,,	,,
,, *b*	. 40	,,	,,	,,	,,
,, *c*	. 40	,,	,,	,,	,,
7 *a*	. 39	,,	,,	,,	,,
8 *a*	. 39	,,	,,	,,	,,
9 *a*	. 24	,,	,,	,,	,,
,, *b*	. 48	,,	,,	,,	,,
,, *c*	. 41	,,	,,	,,	,,
10 *a*	. 40	,,	,,	,,	,,
11 *a*	. 34	,,	,,	,,	,,

In the measurement of the above, as on all other occasions, I have found it convenient to tabulate the adjustments of objective to different foci; thus the index being marked 5, 10, 15, 20, the revolution of index occasions circumstances of importance in actual practice.

					Eyepiece Microm., lines each.
Index at	10	covered,	closed	value	17,500
„	15	„	a little open	„	17,250
„	20	„	more open	„	17,000
„	5	„	midway	„	16,500
„	10	uncovered,	tending to close	„	16,000
„	15	„	nearly closed	„	15,750
„	20	„	closed	„	15,500

It is hence evident that, with index at 10, the micrometer value may be either 17,500ths or 16,000ths of an inch, and so also of any other term of indices; and hence the necessity, in every case of measurement, that the objective should be removed from the body of the instrument, and carefully examined as to the relations of the index to being wholly or partly covered or uncovered, when differences will be thus obtained materially affecting the value of observations, especially in dealing with fine striation.

In slide 9 the lines are not fully developed, or rather displayed, but exhibit tops and bottoms, *id est*, marginal markings so regular as to leave not a shadow of doubt of their being of the true nature of striæ; in no one instance have I ever been able to resolve a coarse striation of *Amp. pellucida* into dots, like *angulatum*, &c. I suppose such transverse striæ to partake of the character of canaliculi.

Slide 11 exhibits a singular development of lines, the dark colour of which, together with the intermediate spaces of light, surpass any diatom I have hitherto seen; and thus leaving not a shade of doubt as to truthful interpretation by the most sceptical regarding the existence of veritable striation.

I believe the severity of test to depend not so much on the number of lines in ·001″, as on degree of development. For example, compare Nobert's test-plate, 14th and 15th bands, with the Fasciola; and both these, again, with the lines upon *Nitzschia angularis*; all of which range from about 52 to 56 in ·001″, but differ widely in facility of resolution. Neither do the highest powers invariably exhibit the highest markings equally distinct with powers somewhat inferior; penetration being required in some cases even at a sacrifice of amplification. Observe *Nitzschia sigmoidea*, for example, with $\frac{1}{8}$th and $\frac{1}{12}$th objectives. So also with *Amphipleura pellucida*; and although

I have never used the $\frac{1}{16}$th or $\frac{1}{30}$th inch objectives, or any accessory apparatus, I deem such of no utility for the object of the present research.

In surveying a slide for the more shallow or difficult markings, almost every shell lying in a proper position should be carefully examined with an $\frac{1}{8}$th or $\frac{1}{12}$th inch objective, and B eye-piece; and when indications are observed, then all attention, both to direction and precise focus, must be paid; which will not unfrequently open out a striation when not expected, and which is far from *illusory;* for with such latter appearances I do not, for my own part, profess to deal, leaving others to answer for themselves, in reply to Messrs. Sullivant and Wormley.

I believe there is yet much to overcome in the preparation (boiling, &c.) and mounting of slides. The observer should not trust too much to the apparent beauty of his slide, nor yet suppose that because of the great brilliancy of a coarser diatom, the finer should be necessarily resolved, if resolvable at all; such a result does not always follow in practice, for the vapours of asphalt, siliceous precipitation, altered refraction, and other causes, yet unknown, may possibly interfere to foil every effort in observation.

I am fully satisfied as to the ready resolution of the true striæ of *Amphipleura pellucida,* and in the several slides above referred to can bring out fifty other shells when required. I am equally satisfied that *Amphipleura pellucida* presents, in opposition to Messrs. Sullivant and Wormley's views, *a wide* numerical value in striation, in common with some other diatoms, as *Nitzschia sigmoidea,* for example; and were I to abandon these views, I should be at once ready to account the indications of the microscope for the most part fallacious; believing, however, that these views, honestly set forth, will be ultimately confirmed and adopted.

Contributions *to the knowledge of the* Development *of the* Gonidia *of* Lichens, *in relation to the* Unicellular Algæ, &c. By J. Braxton Hicks, M.D. Lond., F.L.S., &c.

Fasciculus III.

Collema and Nostoc, &c. &c.

Before entering upon the subject I have proposed for consideration in the present contribution, it will be needful to remark that, in 1854, H. Itzigsohn, in the 'Botanische Zeitung' (" Wie verhält sich Collema zu Nostoc und zu Nostochineen)" page 521, and J. Sachs, in the same journal, in 1855, 5th January ("Zur Entwicklungsgeschichte des Collema, &c."), insisted upon the origin of *Nostoc* from *Collema*; and they have pointed out one method by which *Nostoc* springs from that lichen; namely, from a small ball of the jelly-like mucus, enclosing a few of the beaded cells, which becomes extruded from the parent thallus. When one such ball becomes free, it may take one of two modes of development: 1st, it may produce the continuous colourless threads, and thus pass into Collema (fig. 7); or 2nd, without any tendency to the formation of these fibres, the ball will increase in size and transparency, become less dense, while the green beaded filaments increase by subdivision, and the heterocysts common to the Nostochaceæ are found at intervals. This latter is Nostoc, and this is one method by which it may arise. In the same condition the development may continue for an indefinite period. The first stages are shown at Pl. V, figs. 5 and 6.

But there are other modes by which Nostoc may spring from Collema; I am not aware of their having been noticed before, and they form the subject of these remarks. H. Itzigsohn has gone further than any botanist in considering it highly probable that all the Nostochaceæ are derived from lichen-gonidia. Be this as it may, there are many points in his observations which are worthy of more careful consideration and following out than they have hitherto received in this country; the more so, as some of his instances had already been agreed upon by other excellent observers. However, I shall revert to this subject presently.

The Collemas, like the other lichens, expel certain gonidia from their surface, which can be recognised even within the thallus as larger and lighter green than the others. When they arrive on the exterior, they appear to undergo segmentation as the so-called *Chlorococcus;* but generally they are small and delicate in appearance (fig. 1 *a*). For how long a period this process may proceed I am not in a position to show, except that I have not met with any considerable mass of *Chlorococcus* from this source. No doubt in most instances they begin to assume a change which is analogous to *Cladonia-Gleocapsa,* for we find the results of segmentation become included in a common mucous envelope, such as *Gleocapsa* possesses. But there are these differences at first; that while in *Cladonia-Gleocapsa* the mucous layer is colourless and delicate, that in *Collema* is more dense and solid, and coloured more or less of a bluish-green hue. Also, while in the former growth the results of segmentation are nearly always symmetrical, in *Collema* they are generally irregular, the outline of the protoplasm being indistinct at the commencement of these changes. This is shown at figs. 1 *b,* 2 *a,* 8 *a.*

After these early stages the growth proceeds on various plans. In one method the whole mass, both cell-contents and the mucous layer, are of a dark purple colour; each cell undergoing binary division is surrounded by its own mucous layer, the whole being included in a common one (fig. 2 *b*). After a while the purple coating becomes colourless and fused into one; while the cell-contents become green, and the divisions separated (fig. 3). As segmentation proceeds, the resulting cells assume a linear tendency, till at last a number of moniliform filaments are formed, having here and there the vesicular cells (*heterocysts*) found in the Nostochaceæ (fig. 4). Thus Collema passes into Nostoc. A second manner is represented at fig. 8. At *a,* the early changes above alluded to are shown; the protoplasm and the mucous coating becoming of a bluish-green hue; but after the segmentary process has proceeded a little, the latter becomes more transparent, colourless, and highly refractive (fig. 8 *b*). Sooner or later there is a disposition shown in the subdivisions of the cells to arrange themselves linearly, whereby a small Nostoc-mass is produced; the vesicular cells appearing about the same time (fig. 8, *c, d*). Thus again *Collema* passes to *Nostoc.*

But the connection between the two is more clearly shown in the fact, that the gonidia of *Nostoc* pass through *precisely the same changes;* so that a description of them would be superfluous, being a repetition of the facts just stated.

Many variations occur during the formation of the above into the mature *Nostoc.*

For instance, when the development has arrived at the stage indicated at fig. 8 *c,* and the vesicular cells are just forming, the mass becomes converted, in part or entirely, into the forms indicated at 9 *b*, each of which consists of a vesicular cell, having an oval mass of bluish-green mucus extending on one side, containing a single or double row of four or five cells, the green contents and mucus not being distinctly separated from each other. These may develop themselves in the linear direction, as at 9 *a*, and ultimately pass into Nostoc through the forms indicated at 9 *c*. Whether they may continue growing in the linear direction I have no direct evidence to prove, but consider it highly probable. They may also pass directly from the forms at 9 *b*, to those shown 9 *c*. The variations, however, are numerous, some consisting of two or three portions united by the vesicular cells. These do not originate from the simpler form at 9 *b*, but consist of a larger portion of a beaded thread which includes two or more of the vesicular cells.

Whether the forms at 9 *b* can arise directly from the Nostoc- or Collema-gonidia without passing into the early condition of a Nostoc, or, in other terms, whether the vesicular cell can arise at so early a period of the change as at 8 *a*, I have not been able to satisfy myself by direct evidence; still I have every reason to think it highly probable.

When these forms are compared with the change which sometimes takes place in the beaded filaments of the Nostoc shown at fig. 10, the similarity of the plan upon which each passes into *Nostoc* will be sufficiently evident to show how strong a connection exists between *Collema* and *Nostoc*. Whether the state of the Nostoc filaments, as shown at fig. 10, should be called a "sporangium" seems questionable; because, at least in this particular instance, it can scarcely be said to produce spores, that is, free spores.

At 8 *e*, is a form in which the cells undergo binary divisions, and appear similar to the cells of the beaded filaments under a similar condition (fig. 11 *a*).

Besides those instances, the gonidia may undergo this Gleocapsoid change within the parent thallus, as I have noticed in the thallus of *Cladonia* (see Fasciculus II); this is by no means a very unusual condition, and is recognised easily by the dark-green balls visible upon compressing the frond. At fig. 13 is shown a section of a thallus in this state. After a while the thallus by extrusion, or more commonly by solution, sets them free, when they assume in some Collemas a Gleocapsa state, the protoplasm being of a very bright green colour, and the mucous sheath colourless and of increased thickness (fig. 13 *a*).

In many the subdivisions assume a quarternary form (fig. 13 *c*), although they may go on to produce large masses (fig. 13 *b*). The quarternary forms have a resemblance to the "tetraspores" of the algæ, and may possibly be homologous with them. It would be worth while extending this observation to Lichina.

Having thus shown various lines of development through which the Collema- and Nostoc-gonidia pass into Nostoc, I shall now bring forward instances in which it will be seen that *Nostoc*, by producing the colourless fibres and the so-called epidermic layer, tends to revert to its parent *Collema.*

In old masses of Nostoc, especially where they have been removed to a dry situation, it will not be difficult, by careful search, to find within its substance portions, here and there, in which fibres are developed possessing every character of those in *Collema.* I have represented this condition at fig. 11, which was taken from a large mass of *Nostoc.* The precise origin of the fibres I did not make out—whether from the vesicular cells or not; but they were unmistakeable in their appearance. Again, in *Nostoc* derived from those Collemas which have a so-called epidermis, I have found them, by keeping in dry situations, to have a tendency to produce a similar layer—evidently from changes in the vesicular cells in the mode represented at fig. 12. The various vesicular cells in a neighbourhood become enlarged, lobed, or branching, and jointed; when these portions come into contact, and so produce the appearance of a reticulated epidermis of the Collema.

If, in addition to this, we refer to the remarks I made at first, that the Nostoc balls which were extruded from the thallus of *Collema* (figs. 5, 6) had so strong a disposition to throw out these fibres, that very soon they passed into *Collema* (fig. 7), the connection is thence apparent; for retard the fibre-growth at the same time that the gonidial growth proceeds, we then shall have a mass of Nostoc.

Thus a connection is established in both directions between *Nostoc* and *Collema.*

But, as I have before alluded to, the power of producing *Nostoc* is not confined to *Collema.*

One instance I have met with, in which the gonidia of a gymnocarpous lichen, whose apothecia, with theca and spores, are figured at fig. 15, *a*, *b*, developed themselves into Nostoc balls while still beneath the apothecia, and within the thallus, which was crustaceous.

Fig. 14 represents a section of an immature apothecium, the gonidia beneath being unchanged. Fig. 16 shows a portion of the thallus, in which one gonidium is undergoing the Gleocapsoid change, as at figs. 1 *b* and 8 *a*. The further changes which the gonidia pass through, in order to arrive at Nostoc are indicated in figs. 17, 18, 19. Comparing these with the changes in Collema-gonidia, the similarity is evident. At fig. 15 *a* is shown a perfect apothecia, where all the gonidia are now fully developed Nostoc balls.

From the evidence just brought forward, in addition to that advanced by Itzigsohn and Sachs above spoken of, I conceive we can no longer consider Nostoc as an *alga;* but that we must, in company with *Gleocapsa, Palmoglœa,* &c., confide them to the care of lichenologists, and thus add a new field for their observations, and a new phase in the life-history of those curious organisms.

Hitherto the origin of *Nostoc* has only been traced up to *Collema,* and to the gymnocarpous lichen above mentioned; but as researches have only been recently made in this direction, it is by no means improbable that other instances may be added to their number.

There is one point to which I wish to draw the attention of observers, namely, to watch the changes which the Collema- and Nostoc-gonidia may undergo; for, from what I have shown above, it surely cannot be considered an impossibility that they may assume a great variety of conditions, and thus give rise to many of the Nostochaceæ. Indeed, it has been stated by Itzigsohn* as his opinion that all the Nostochaceæ are, in all probability, derived from the gonidia of lichens. Whether this be the case, partially or wholly, or not, from what has been shown at figs. 8, 9, 10, 11, such a condition is possible; for if the beaded threads of Nostoc can become modified into such forms as are represented at 9 *a,* the mucous coating becoming broken up at the same time, setting them free, it certainly cannot be considered beyond the range of physiological probability for them to develop themselves into one of the linear Nostochaceæ; for let us suppose, instead of a short portion of a Nostoc thread becoming changed, as at figs. 10 and 11, that a long portion was so affected, or that the short portion so affected continued to segment linearly, and reproduce the altered state—a process which obtains in other vegetations—then we should have forms allied to, if not identical with, the Nostochaceæ. Supposing such a condition proceeded intermittently, how could it be recognised from such forms as *Trichormus, Sphærozyga, Spermosira, Dolichospermum,* &c.? I am not, from direct observation, prepared to assert that such is the origin of these growths; but the following fact seems to be strongly confirmative of Itzigsohn's opinion.

* 'Botan. Zeitung,' 1854, p. 521.

At fig. 20 I have figured a Nostoc ball, in the interior of which is a long, bluish-green, articulated thread (*a*), which has its origin in a vesicular cell (heterocyst) *b*; as do many of the ordinary beaded threads of Nostoc. The whole was unmistakeably *within* the mass, and dipped towards the centre, and evidently could not have been derived from without. Besides, it is worthy of notice, that Nostoc balls are always remarkably free from extraneous matter; a condition to be explained by their mode of increase. Hence we may conclude that this growth had its origin from the Nostoc-gonidia.

There is another fact which may perhaps help us, namely, that in contact with some Nostoc balls are to be found many forms of these linear Nostochaceæ; they are so intimately united, and so mixed up with them, as must to any observer be suggestive of an intimate connection. Such forms I have represented at figs. 21 and 22; and if we admit the articulated thread at fig. 20 to have had a Nostoc origin, then there is no difficulty in accepting a similar source for those at figs. 21 and 22—a form allied to *Schizosiphon.* In the same position I have seen *Scytonema.*

For these observations I do not wish to claim more importance than they deserve; still they bear strongly upon the opinion advanced by the author above named.

In the papers of Itzigsohn* on the diamorphosis of *Chroococcus* and *Gleocapsa,* and on the relation of *Nostoc* and the Nostochaceæ to *Collema,* there are many remarks which, although they may not be immediately assented to by English observers, yet are worthy, to say the least, of careful consideration; and as he is in part supported by Kützing, and by some observations of V. Flotow on the *Ephebe pubescens,* many points which he has advanced should scarcely be passed aside, without good negative evidence, with such remarks as these, "We do not place much reliance on the statements of Itzigsohn."† To enter into the whole question of the relations of *Lyngbya, Ulothrix,* &c., is not within the intention of the present contributions; but, the possibility being granted upon ordinary physiological grounds, we should be prepared to put aside our former notions upon any well-proved fact appearing. Besides, there is nothing difficult in supposing that some forms of *Palmella cruenta,* for instance, represent the unicellar condition of some of the Oscillatoriæ, which have broken up into single cells; and then that these latter

* 'Bot. Zeitung,' 1854, pp. 520 and 642.
† 'Micrograph. Diction.,' 2d edit., p. 496.

are, in their turn, capable of undergoing segmentation, and thus multiply in that phase. Such changes are in accordance with well-known conditions in other vegetables.

Of course, whilst admitting the probability of these points, we should be very careful that the connection is fairly traced out, and assume nothing as intermediate stages without ocular proof, or such circumstantial evidence as cannot be escaped from. Thus the life-history of one, carefully traced, will be worth a hundred new forms without any history. It is to be observed, that the fact of these structures under consideration having been included among the algæ by algeologists is not to be considered any proof of their really being so; for, their life-history not having been followed out by the observers of species, they can only be considered as provisionally so placed; as indeed must all organisms, vegetable or animal, whose various states, both vegetative and sexual, have not been carefully watched throughout.

That many of the above points are now clear and have had their exceeding ambiguity in some measure explained, will, I think, now scarcely be denied. Doubtless a large field is open in this direction, if care and patience be bestowed upon it.

As I have before remarked, we must not look upon *Gleocapsa*, &c., as arising only from lichens. From facts which have come under my notice during the observations now brought forward, other origins also are to be given these growths, that is to say, forms undistinguishable from them; and hence it follows that the study of their life-history is the only means of assigning them their true position. At present *all* the so-called unicellular algæ, and some Confervoideæ, are on a most unsatisfactory basis; nor can any arrangement possibly take place till more extended researches are carried out in the directions above indicated. I have placed in a tabular form the different phases of the lichen-gonidium, according to the observations included in these contributions.

Phases in the Life-History of the Lichen-Gonidia.

Origin.	*Changes.*						*Results.*
Resting Chloro-coccus and Lichen-Gonidium.	Various forms of subdivision.	Chlorococcus.					Chlorococcus.
		Mature Chlorococcus and Gonidium.	Soridium.				Soridium.
			Soridium.				Chlorococcus.
			Soridium.				Lichen Thallus.
			Soridium.	Palmoglea. Gleocapsa. Sorospora.	Chlorococcus.	Through any of the other stages.	
				Gleocapsoid bodies			Nostoc.
Resting Gonidium of Collema.	Chlorococcus.	Gleocapsa.					Gleocapsa.
		Gleocapsoid bodies.	Nostoc.	Nostoc.			Nostoc.
				Nostoc. Gleocapsoid bodies.	Collema.		Nostoc. Chlorococcus. Collema. Gleocapsoid bodies.
			Nostoc.	Trichormus Cylindrospermum Spherozyga Spermosira Dolichospermum Monormia. Schizosiphon.	?		Nostocacheæ?
			Nostoc				Collema.

On Ophryodendron abietinum.
By T. Strethill Wright, M.D.

A very curious protozoon appeared about five years ago in a limited locality, near Granton, on the southern shores of the Frith of Forth, from whence it spreads upwards towards Cramond, and now infests the Sertulariæ (*S. pumila*) which abound for miles along the coast. I described it in September, 1858, in a letter to Dr. Arlidge, one of the editors of Pritchard's 'Infusoria,' who has introduced it into the last edition of that work, under the title of *Corethria sertulariæ* (Wright). I have also given a rough sketch of it in the 'Edin. Phil. Journal' for July, 1859. Professor Claparède, however, has informed me, that he and Lachmann had previously deposited an account of it with the Academy of Sciences of Paris. It will be found referred to as *Ophryodendron abietinum,* in their recently published studies,* and it is to be more fully described in the concluding number of that excellent work.

Both Claparède and Lachmann and myself have independently placed this creature among the Acinetinians, but not without considerable doubt, as it differs so widely in shape and habits from all others of that family. Dr. Arlidge writes to me, that "there is something so bizarre about the organism that I cannot interpret it."

The body of the animal consists of an oblong mass attached to the polypidom of the Sertularia (Plate VI, fig. 1). From one end of the mass arises a closely wrinkled appendage or proboscis, surmounted by a tuft of short tentacles. Such is the general appearance of the animal; but a second appendage is frequently present, which appears to be a gemma, as it is sometimes found separated from the animal, and attached to the Sertularia.

When I described this protozoon in 1859, I had not seen any motion in the proboscis; but, during the last summer, when I kept a number of *Ophryodendra* in large vessels of sea-water, I was surprised to find the organ in constant motion, sometimes almost withdrawn into the body, and again, at other times, extended to an astonishing length, until it became a clear glassy wand, thirty times as long as the body, and clothed at its upper end by about forty scattered tentacles, which twined about in most violent motion. The animal

* 'Études sur les Infusoires et les Rhizopodes,' par Edouard Claparède et Johannes Lachmann.

seemed to be constantly searching the water around it for prey, and occasionally to press the tentacles firmly to the body of the proboscis, as if to imbed some matter in the substance of the latter. I was unable to detect any opening at the summit of the organ.

As *Ophryodendron* now exists in great abundance in the neighbourhood of several eminent microscopic observers, we must hope that its anatomy and mode of reproduction will be worked out during the ensuing summer, and that it may be discovered in other localities. Claparède and Lachmann describe it as found on Campanularias; but I have never seen it on any of that class of zoophytes, even when they have been growing intermixed with *Sertularia*. I have only found it on one species of Sertularia, *S. pumila*.

On the Embryology *of* Asteracanthion violaceus (L.) By Professor Wyville Thomson, LL.D., F.R.S.E., M.R.I.A., F.G.S., &c.

Sars, in his wonderfully suggestive 'Beskrivelser,' &c., published in Bergen in 1835, threw the first ray of light upon the structure of the singular provisional appendages which have been since found to accompany the embryonic condition of most, if not all, of the Echinoderms. We are indebted to the same naturalist for several subsequent communications on the same subject; the most important a detailed description* of the early stages in the development of *Echinaster sanguinolentus* (Müller), and a shorter notice of the same process in *Asteracanthion Mülleri* (Sars). These observations are so well known, that I need only refer to them briefly.

Sars found that in these two species the mode of reproduction conformed pretty closely to the usual invertebrate type. Complete segmentation of the yelk took place, and the greater part of the mulberry mass was then moulded into the embryo Star-fish.

The process presented, however, this peculiarity. A club-shaped appendage, with three or four short radiating processes, each terminated by a sucker, was developed from one part of the surface of the embryonic mass, and remained ched to the embryo during the earlier stages of its

* 'Fauna littoralis Norvegiæ,' Part i, Christiania, 1846.

growth, withering and disappearing when the permanent external form and internal structure of the embryo became well defined.

The appendage was attached to the dorsal surface of the embryo in *Echinaster sanguinolentus*, and apparently towards the oral aspect in *Asteracanthion Mülleri*. Sars' impression was that the cicatrix indicating the point of separation was the madreporiform tubercle. Sars observed an opaque tubercle in the centre between the four terminal suckers of the peduncular appendage, but could detect no mouth-opening in this position.

Desor ('Proc. Boston Soc. of Nat. Hist.,' February, 1848) describes a mode of development slightly different, but on precisely the same type, in an American Star-fish. In this case the peduncle is simple, and depends excentrically from the oral surface of the embryo. Desor regards the peduncle as a vitelline sac, and believes it to be directly connected with the digestive system, into whose general cavity its contents are gradually absorbed.

Agassiz ('Lectures on Comparative Embryology,' Boston, 1849) confirms Desor's observations, but gives no definite opinion on the relations of the accessory appendage.

Busch ('Beobachtungen über Anatomie und Entwickelung einiger wirbellosen Seethiere,' Berlin, 1851) describes the development of *Echinaster sepositus*. The embryo of this species closely resembles that of *Ech. sanguinolentus*, described by Sars. Busch, however, figures the peduncle as disappearing at the oral surface, and he describes a mouth in the centre of the peduncle, between the four suckers. It is unfortunate that Johannes Müller, the great authority on echinoderm development, had no opportunity of observing any of this group of embryos alive, all his observations having been made on swimming larvæ taken with the towing-net in the open sea; he examined, however, carefully, specimens sent to him in spirits, could detect no mouth-orifice to the peduncle, and concluded that the hollow suckers had no immediate connexion with the stomach, which was developed as a distinct sac at some distance from their point of attachment.

According to Busch, the plan of development in *Asteracanthion glacialis* (L.) is somewhat different, associating itself apparently with the very interesting type described by Koren and Danielssen ('Fauna littoralis Norvegiæ,' part ii, Bergen, 1856) in *Pteraster militaris* (M. and T.), to which I shall have to refer hereafter.

Several writers, and particularly Dr. Carpenter, in his valuable compilations on Comparative Physiology, have suggested a correspondence between the provisional appendages of the Echinoderms and the temporary vascular apparatus of the vertebrate embryo. This view I believe to be correct, and capable of more accurate definition, as will be seen in the sequel.

A series of careful observations which I have had an opportunity of making during the last few months upon a common littoral species of *Asteracanthion*, agree in almost every particular with the observations of Sars, which, in this as in all the other investigations of that most distinguished naturalist, are singularly clear and faithful.

I was fortunate, however, in selecting for study a species in which the provisional absorbent and respiratory vessels are much more fully developed than in *Echinaster sanguinolentus*.

The whole organism seems to be paler and more transparent, and the relations and development of the internal organs are accordingly more easily traced. My results are, to a certain extent, at variance with those of some later writers, and particularly with those of Dr. W. Busch. I must state, however, that the plasticity of the tissue of which these temporary embryonic appendages in the Echinoderms are formed seems to be almost infinite. So capricious are the variations in a structure essentially the same in all, that it is impossible to anticipate its form in any particular case from the analogy of even the most closely allied species.

Early in December of the present winter I procured several specimens of *Asteracanthion violaceus* (L.) (Pl. VII), in the peculiar pregnant condition so graphically described by Sars. The disc was raised into a hump, and the rays drawn closely together at the base, to form over the mouth of the star-fish the "marsupium" for the protection of the young, diverging at the tips, to attach themselves to a stone or to the glass wall of their prison. All the eggs or embryos in a single marsupium were nearly at the same stage of development. In the least advanced the eggs were undergoing the later stages of yelk-segmentation, while in others this process had been completed. In other individuals the embryos were partially or fully formed, while in the most mature the outline of the five-rayed star was perfect, and the echinoderm structure well marked by the development of the oral ring of the ambulacral system and of the rudiments of the vertebral (ambulacral) and dorsal calcareous plates.

Impregnation seems to take place before the eggs are placed in the pouch.

I placed a specimen in whose marsupium a goodly mass of eggs, sixty to eighty in number, were least advanced, in a separate jar of water, and examined the embryos at first daily, and afterwards at intervals of one or two days, checking my observations on this brood by the examination of many other individuals in all stages, the progeny of two or three other mothers of the same species which were bringing up a numerous family in another vessel.

Segmentation appears to take place in this species in the way usual in the class, and to involve equally the whole yelk. I had no opportunity of observing the earlier stages or of determining the presence of the so-called "directing cells; these, however, probably exist, as they are very evident in some other Echinoderms. After segmentation the embryonic mass is at first spherical, finely granular, and still invested by the vitelline membrane. The membrane soon disappears, and within a few hours the embryo seems perfectly homogeneous, regularly oval, and of a delicate flesh colour. I could not detect the slightest trace of cilia on the surface. Four or five hours later the oval form is still more marked, one end has become slightly dilated, and towards this end there is an accumulation of the denser part of the granular substance. The whole embryo is now invested by a delicate, structureless, gelatinous layer, which is thinner and less apparent towards the narrower and more transparent end of the oval; at the broader end it invests a dark, consistent granular layer, of considerable thickness, formed of oil-globules and compound granular masses and cells, which lines a central cavity filled with a clearer granular semi-liquid, in which there are traces of molecular or ciliary motion.

The embryo now becomes club-shaped, and there is a decided aggregation of the great mass of the granular matter to the thick end of the club, whose transparent investing membrane becomes still more distinct, and the internal granular layer thicker.

The transparent investment of the narrow end protrudes one and then two more tubercles, which rapidly declare themselves as three transparent tubular processes, two turned in one direction, narrow, four or five times longer than their width—the other turning in an opposite direction, shorter and thicker, and probably, from its form and its tendency to divide at the extremity, representing a second pair. The investing membrane of the tubes is transparent, delicate, transversely wrinkled, and highly contractile. Each tube is dilated at the free extremity into a slightly opaque, rounded tubercle, which at length takes the form of a sucker, undistinguishable from the ambulacral suckers of the young star-fish. The dark granular fluid of the embryo still passes freely into the tubular processes, through their wide, common base.

This common base now contracts somewhat, and lengthens, and this narrower portion of the clavate embryo is separated by a distinct line of demarcation from the broader mass, which gradually assumes a still more rounded and definite form. The whole embryo, during all these changes, increases rapidly in size, partly by the imbibition of water through its walls, and partly by the assimilation of organic matter through its general surface.

The dark upper part of the embryo is now rounded or rudely pentagonal; a thin, transparent, structureless layer, with scattered oil-cells and bodies resembling endoplasts, covers the whole surface; a dark granular band lines the transparent wall; and the central space, lighter in colour and more transparent, is filled with a mucilaginous liquid, turbid with oil-globules, granules, and compound granular masses. The lower end consists of a wide, transparent, contractile tube, prolonged inferiorly into three, or sometimes four, wide tubular branches; and in the centre of the common peduncle, between the branches, there is a whitish tubercle, resembling in structure the substance of the suckers, and which certainly has no central orifice.

The peduncle and tubular appendages now assume their definite and final form; all the specimens resembling one another closely, except in the form of the thickest tube foot, which is sometimes bifid at the point, that is to say, provided with two suckers, and rarely bifid through nearly its whole length. A slight constriction cuts off the peduncle into which these processes unite from the main embryonic mass. The contents of the peduncle and tubes become more and more transparent, till they consist merely of a clear, colourless fluid, in which chyle-corpuscles, of the usual form, move and circulate, with the motion peculiar to such particles in the vessels of the Echinoderms, and which would seem to be produced by cilia, though the cilia themselves have not as yet been detected.

The embryo adheres to a foreign body by the suckers at the end of the tubes, and moves along in a peculiar uncouth manner, by the contraction and expansion of the three feet. At this stage the peduncle is attached to the lower surface of the pentagonal rudimentary star-fish, slightly excentrically and midway between two of the projecting angles. The star-fish, though now only about once and a half the size of the peduncle, has asserted distinctly its echinoderm character.

The angles of the pentagon project still further, forming the rudimentary rays. The transparent external layer becomes thicker, and its scattered oil-cells and endoplasts more numerous and distinct. The inner organized granular layer increases in thickness till only a small central space is filled with granular fluid, while between it and the external layer, or in the external layer itself, small plates of the characteristic calcified areolar tissue are irregularly scattered. The star-like form now becomes still more distinct, a regular series of calcareous plates are developed on the dorsal surface, one large and rapidly expanding plate at the end of each ray, and a smaller one at each of the re-entering angles. On the lower surface, a pair of plates, each with a concave edge towards the point of the ray, and a convex one towards the centre of the star, are formed at the base of each arm, so that the two plates of a pair unite in the centre of the ray, while their free ends meet the free ends of the adjacent plates of the next pairs, forming a calcareous inter-radial angle, projecting into the central space. These plates are rapidly followed by a double row of almost linear plates with double concave edges; which extends towards the point of the ray, leaving between every two pairs, two opposite apertures for the passage of the pedal vesicles.

While these plates are being developed, a tubercle appears on the oral surface at the base of each arm, and a delicate circular vessel forms a slightly raised ring round the centre. This ring, in one part of its course, passes under or blends with and is lost in the base of the peduncle.

The tubercle at the base of the ray now takes a crescentic form, and shortly the crescent resolves itself into three tubercles, two opposite and occupying either side of the median line of the ray, the other in the centre of the ray and connected with the circular ring by a delicate straight tube. This central tubercle next becomes slightly crescentic, and resolves itself into three tubercles, which arrange themselves like the first three, and in this way a central vessel, proceeding from the ring, follows the development of each ray, with a row of tubercles on either side. These tubercles are shortly developed into suckers like those of the tubular feet of the peduncle, and supported by precisely similar transparent contractile tubes, filled with the same fluid, in which chyle-globules revolve and circulate in exactly the same way. During these changes the peduncle remains unaltered. The embryo stands upon its three feet like a miniature threeclawed drawing-room table. Circulation of granules takes place rapidly in the peduncle and appendages, but pressure applied to the star-fish will no longer send the granular contents of the disc into the peduncle, while pressing the peduncle does not inject the general cavity of the star, but only renders turgid the circular canal and the radial ambulacral vessels. A change now begins to take place in the peduncle. It becomes more flaccid, and frequently portions of the tubular feet are separated by deepening constrictions, and shortly all that remains is an inflated sac hanging to the under surface of the disc. The further development of the disc, however, has in the mean time made the connections of this sac more apparent. The integument has been inverted in the centre of the disc, and the inversion, gradually deepening, has formed a mouth communicating with the digestive cavity, and the vascular ring surrounding the mouth has become more distinct. Five well-marked vessels branch from this ring, each to the end of a ray, and the sac is distinctly seen to join the ring between two of the radial vessels.

A delicate opaque thread may be traced along the inferior surface of the circular and radial vessels, and to end near the point of each ray in a bright-red, double granular spot.

I have mentioned before that early in the development of the star-fish, five small plates make their appearance at the re-entering angles of the rays on the apical surface of the disc. These plates, without extending much in diameter, increase in thickness by the development of an irregular upper layer of calcareous tubing, so as at length to form five porous calcareous masses. No difference is perceptible at this stage in the structure of the five masses. Tufts of paxillæ appear at the ends of the arms and above the axillary and central calcareous plates, and the rows of spines begin to be developed, which afterwards fringe and fold over the ambulacral grooves. Up to this period the integument of the dorsal surface, between the calcareous plates, is continuous, and uniformly granular. There is no anal aperture, and there are no apparent respiratory pores. The five inter-radial plates appear to rise through the membrane, and I imagine they allow the water to filter through them into the general cavity of the body. It is not till long afterwards that one of these plates is developed into the madreporic tubercle, and becomes connected by a special membranous tube with the central ring of the circulating system.

It is difficult to form an accurate idea of the length of time occupied by this process of development. In the of one brood, reared in a jar in a warm room, the temporary appendage entirely disappeared, the rudiments of the principal plates on both surfaces of the embryo assumed a definite arrangement, and the permanent mouth of the star-fish was formed between a fortnight and three weeks after the segmentation of the yelk. In other instances, however, development took place more rapidly, the greater rapidity depending, I believe, upon a more plentiful supply of organic matter in the water. All the broods reared in the house left the marsupium early, while the peduncle was still attached; but in other specimens which I have procured from time to time from pools at low-water mark, the pouch has been filled with fully formed embryos with the peduncle entirely gone, six sucking feet on each ray, and the permanent digestive system of its normal character.

It would appear from the foregoing observations, that the first step in the development of this form of Echinoderm embryo is the differentiation of a portion of the yelk into an investing layer of structureless "sarcode;" that the layer gradually increases in thickness; and that, finally, from one part of its surface a branched peduncular process is produced as an extension of the same transparent structureless material. The branches of this organ are terminated by suckers, and serve, among other functions, as organs of locomotion. When fully formed they are undistinguishable in structure and function from the ambulacral feet of the star-fish; a fluid undistinguishable from the chylaqueous fluid of the ambulacral system moves in them with the same characteristic motion. The peduncle is closed externally, no communication except by transudation existing between its cavity and the surrounding medium. At first it communicates with the general cavity of the embryo, but afterwards it becomes connected with, and part of, the ambulacral circulating system. When the ambulacral vessels and suckers of the young star-fish become fully developed, this provisional vascular tuft withers and disappears, leaving no apparent scar.

In the species described, the peduncle is not connected in any way with the madreporic tubercle, which is not developed till long after its disappearance, and then on the opposite surface of the body.

I believe this peduncular appendage to be essentially a provisional development of the ambulacral vascular system, and to be functionally analogous, not to the vitelline sac, but to the omphalo-mesenteric and umbilical vessels of the higher groups.

I believe, however, that it is endowed with a greater amount of versatility of function, corresponding to that of the vascular system of which it is a part, and to a great extent dependent upon the peculiar vital properties of the substance entering into its structure. The provisional assimilative appendages are formed upon a type essentially lower than that of the permanent digestive system of the Echinoderms, and to understand their relations fully, I believe we must keep in view the mechanism of nutrition in the classes inferior to the Echinoderms in the zoological scale.

In the sub-kingdom *Protozoa*, the entire body consists solely of "sarcode," a gelatinous substance which, though apparently structureless, possesses active vital properties. "Sarcode" alone, then, without the differentiation of any special tissue or organ, may perform effectively the functions of assimilation, respiration, and of voluntary motion; and consequently a layer of this substance investing the germ of a higher organism, or an appendage formed of it, might answer the same purpose, though, perhaps, in a lower degree, as if the germ were provided with special provisional organs for the performance of these functions.

I shall confine my remarks at present entirely to the Echinodermata; though I believe they would apply with equal justice to some other invertebrate groups.

In the Echinoderms the eggs are extremely small, provided with only a thin layer of albumen—frequently with none at all. Segmentation of the yelk is complete; the whole substance being reduced to a smooth granular mass, which is moulded into the form of the embryo, or of the embryo with its temporary nutrient appendages. A considerable time elapses before the differentiation in the embryo of the permanent assimilative tract; yet during this period the embryo increases rapidly in size, frequently attaining ten or twenty times its original dimensions. In many cases this increase seems to take place by simple absorption of organic matter through the entire external surface of the embryo; but, in order to the temporary performance of this function with such unusual activity, the structure of the surface undergoes a remarkable modification. The entire embryo is invested with a thin layer of "sarcode."

In some cases the sarcode merely forms a thin continuous layer, ciliated either generally or in bands or patches, over the entire surface of the embryo. In others, as in the case of *Pteraster militaris* (M. and T.) and of the Crinoids, the ciliated layer investing the embryo is locomotive and respiratory; while at one point a ciliated oral aperture opens into a short digestive tube, passing through the substance of the sarcode, and indicating a surface especially dedicated to assimilation.

By a third modification, of which *Asteracanthion violaceus* is an example, a portion of the sarcode layer is developed into a group of transparent tubes, which act as a temporary assimilative and respiratory apparatus; and in a fourth series, *e.g.* in the species producing the "Bipinnaria" and "Brachiolaria" larvæ, the whole of the segmented yelk, or the whole with the exception of a small granular nucleus, is shaped into a mass of sarcode, which forms a complicated organ provided with locomotive and respiratory appendages, a mouth, and short intestine; eventually, however, this organism declares precisely the same relations to the embryo as in the former case, withering finally, as a cast-off provisional appendage of its ambulacral system.

Regarding the embryonic appendages in the Echinoderms as a provisional development of the ambulacral vascular system, the analogy between them and the embryonic vascular appendages of the vertebrata becomes extremely simple. In the higher group, simultaneously with the first appearance of the embryo, a temporary system of vessels is produced for its nourishment. These vessels originate round the outer edge of the area vasculosa, at some distance from the embryo and quite distinct from it, though in a continuation of the same layer of segmented yelk (the germinal membrane). They then approach the embryo, uniting and forming two or more symmetrical vascular trunks, which at first seem to open into the general cavity of the embryo, but afterwards coalesce with its special vascular system.

The minute linear embryo presents at this time a form quite as anomalous as that of the most aberrant Bipinnaria or Pluteus; flanked on either side by a large, crescentic, vascular lobe. As development advances, the vessels are carried backwards from the embryo with the nascent germinal membrane till the whole yelk is inclosed is a delicate, anastomosing, absorbent network; other vessels and tissues are subsequently formed, but it is unnecessary here to trace their complicated morphology.

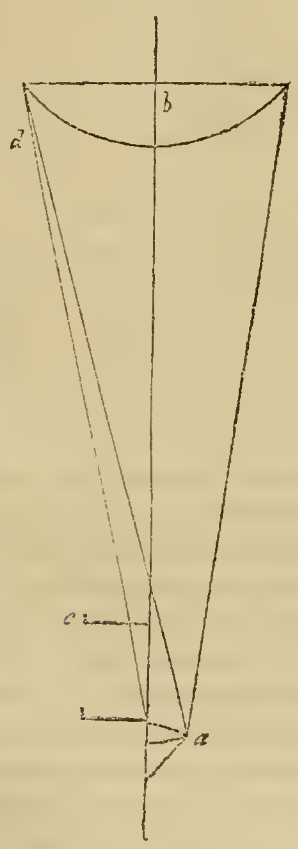
With reference to the earliest stages it has been already shown that almost the same language would apply to Echinoderm development.

Remarks *on the* Binocular Microscope.

By F. H. Wenham, Esq.

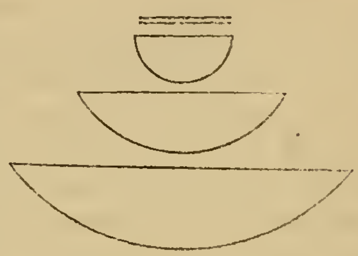
I have been frequently asked why I have not termed my binocular the "Stereoscopic Microscope?" I may reply that the prevailing idea of stereoscopic vision is more connected with the combined effects of two separate objects, or pictures, than the solid appearance of a single body, having bulk or thickness. What I should term a "Stereoscopic Microscope" would be literally two microscopes, with their object-glasses, placed side by side, like an opera glass, with similar adjustments for the distance between the eyes. If such an instrument were furnished with erecting-glasses and draw-tubes, for varying the magnifying power, only one power of object-glass would be requisite, and I have no doubt that in many applications it would be found serviceable, as for the detection of forged trade-marks, &c., and irregularities of pattern. Two single lenses, of about 1½-inch focus, afford some curious results. Taking for example such objects as the similar titles of two different advertisements from a newspaper, or the headings from the various pages of a book in large type, the letters will appear in some places to rise up hill, and in others to fall away, or lay all aslant in a most fantastic manner, indicating that the type has not all been cast in the same matrix, and that the spaces are irregular, both in parallelism and thickness. Two postage-stamps also afford good objects. Many will be found so nearly alike that their combined images appear quite flat, but very frequently the head appears like a bust, either above or below the matted ground, accordingly as they are transposed either to the right or left, thus showing that there is considerable irregularity either in the plates or the mode of printing.

The numerous microscopes that have been altered into binoculars in accordance with my last principle, and also the large quantity still in the course of manufacture, will, I think, justify me in making the assertion without presumption, that henceforth no first-class microscope will be considered complete unless adapted with the binocular arrangement. Taking this for granted, it will be to the interest of our best makers to get up their object-glasses in future so as to give every possible advantage to the requirements of the principle. There have been some complaints that, with the highest powers, as the $\frac{1}{12}$th and $\frac{1}{8}$th, and in some instances (but not always) the $\frac{1}{4}$th or $\frac{1}{5}$th, a portion of the field of view is obscured, rendering it almost impossible to use the two highest powers. This does not arise from any defect in the principle or in the construction of the prism, for this, if neatly and properly made, divides the pencil with a knife-like precision and with no appreciable loss, for the total reflection is perfect and effective quite up to the sharp edge. The obscuration of part of the field is caused by the long distance of the back lens from the prism, and it will be found experimentally that when this distance is increased by adapters, or otherwise, a still greater portion of the field is lost. In the low powers, including the $\frac{4}{10}$th, the posterior or conjugate focus is long, and the back combination of large diameter; consequently, in a relative sense, the prism is comparatively much closer to the back lens, and any small section of the field cut off is beyond the limits of the lowest eye-piece. The annexed figure will demonstrate the reason of this dark portion appearing, as it does, more or less with the highest object-glasses. *a* is the object-glass of a compound microscope taken as a semilens for the simplicity of the illustration. The rays from this half, if unimpeded, will fill the whole of the field-lens (*b*) of an ordinary Huygenian eye-piece, but supposing a stop on the prism (which acts precisely as a stop for either half) bisecting the aperture be raised from contact with the back of the object-lens to the position *c*, it then appears that the rays from the diameter cannot reach the side of the field-lens at *d;* and as we continue to raise the stop, with its edge to the axis, more and more of the field of view and of the object is cut off, and finally, when the prism arrives close to the eye-piece, we should get merely half the field of view and half the object in each eye, and in this position it would be impossible to see the same spot in the object, with both eyes at once, with any of the object-glasses; the object being simply divided into two separate portions.



It is obviously impracticable to bring the lower face of the prism quite close to the back of the object-glass; but I would earnestly recommend the makers to construct the settings of the highest powers in future as short as they safely can, in order to obviate this want of field as far as possible. I can offer no other suggestion, and the remedy is solely in *their* hands.

I have before stated that the employment of a strong direct light should be avoided for the illumination of objects observed with the binocular microscope, as direct rays tend to destroy the stereoscopic effect. For this reason I recommended the use of diffused light. The annexed figure shows a form of illuminator that has been found to give an excellent effect. It



consists of three plano-convex lenses of the diameters and radii shown; it condenses a very large *area* of light, and consequently gives great intensity. The final emergent pencil has an angular aperture of 170°. Just above the top lens of the combination there is a sliding-cap, the crown of which contains the diffusing film. For this I have had some difficulty in finding a perfectly white and homogeneous, and at the same time partly transparent, material. What I now employ is the beautiful snow-white powder obtained from turning glass with a diamond turning tool. This may be procured from the opticians, and should be well washed, to free it from the larger particles. A thin film of this impalpable powder is then compressed between two discs of thin glass, and fixed in the top of the sliding-cap, which is to be raised or lowered till the most intense light is obtained on the film. This illuminator is employed in the position of the achromatic condenser. I generally place a disc of slightly coloured neutral tint glass below the bottom lens, as it increases the purity of the light, and gives greater distinctness to objects. The effect of this diffusing film is sometimes enhanced by condensing light down on the object from above as well as below. In fact, in the use of the binocular microscope, I am constantly in the habit of placing the light so as to illuminate both as a transparent and opaque object at the same time, so that each method is ready to be used separately or together as may be found requisite.

On Nobert's Test-Plate *and the* Striæ *of* Diatoms.

By W. S. Sullivant and T. G. Wormley.

(From the 'American Journal of Science and Arts' for January, 1861.)

The limit of the resolvability of lines, or how small a space can exist between lines and still admit of their being separated under the microscope, appears to be an undecided point. Professor Queckett ('Treatise on the Microscope,' 3d ed., p. 238, 1855) asserts that "no achromatic has yet been made capable of separating lines closer together than the $\frac{1}{75000}$th of an inch." In the same work, p. 245, it is stated that Mr. Ross found it impossible to ascertain the position of a line nearer than the $\frac{1}{80000}$th of an inch. We find also on p. 512, that Mr. De la Rue, in his extended examination of Nobert's test-plates, was unable to resolve any lines closer than the $\frac{1}{81000}$th of an inch. In Professor Carpenter's work ('The Microscope,' 2d ed., p. 189, 1859) this sentence occurs: "The well-defined lines on Nobert's test-plates have not yet been resolved when they have approximated more closely than the $\frac{1}{85000}$th of an inch."

From the foregoing it appears that actual experiment fixes the limit of resolvability at about $\frac{1}{81000}$th of an inch: this does not, as is said, vary widely from the deductions of Fraunhofer and others, based on the physical properties of light. In this connection the remark (op. cit., p. 47) of Professor Carpenter may be cited, "there is good reason to believe that the limit of perfection (in the objective) has now been nearly reached, since everything which seems theoretically possible has been actually accomplished."

On the other hand there are authorities who assert that lines much closer than the $\frac{1}{85000}$th of an inch are resolvable. A few years since Messrs. Harrison and Sollitt published ('Microscopical Journal,' vol. ii, p. 61, 1854) their measurements of the striæ of several diatoms, assigning to *Amphipleura pellucida* striæ as close as the $\frac{1}{120000}$th to $\frac{1}{130000}$th of an inch. These measurements have recently been repeated, and with exactly the same results, by Mr. Sollitt alone ('Mic. Jour.,' viii, p. 51, 1859), who furthermore expresses the opinion that striæ as close as the $\frac{1}{175000}$th of an inch can, with proper means, be seen. Mr. Sollitt's measurements have been adopted in the 'Micrographic Dictionary' (1860) and most of the modern works on the Microscope—no one, Professor Carpenter (op. cit., p. 188) excepted, suggesting a doubt as to their accuracy; on the contrary, their correctness seems to be expressly recognised by Dr. G. C. Wallich ('Ann. and Mag. Nat. Hist.' for February, 1860).

Such being the conflicting testimony and opinion of distinguished microscopists on the capacity of the modern objective for separating lines, it is somewhat surprising—in view of the high state of perfection now attained by the microscope—that so few experiments have been made bearing on this interesting point.

As a contribution toward that object, we propose to offer presently an analysis from actual measurements, as far as we were able to carry them, of one of those "marvels of art," Nobert's test-plates. In such investigations the quality of the instruments used being all important, we would state that the optical apparatus at our command was ample, consisting of a first-class Smith and Beck microscope-stand, a Tolles' $\frac{1}{30}$th objective of 160° angular aperture—an objective of rare excellence in all respects—besides $\frac{1}{12}$ths and $\frac{1}{16}$ths of other eminent opticians, both English and American; also a solid eye-piece micrometer by Tolles, and an improved cobweb micrometer of Grunow's accurate workmanship. Smith and Beck's stage scales furnished the standards for fixing the micrometrical values of the eye-pieces. By means of Tolles' amplifier, an achromatic concavo-convex lens between the objective and the eye-piece, an amplification (by the standard of 10 inches) as high as 6000 times was obtained. This high amplification, with sunlight variously applied after passing through a small achromatic lens of long focus, was effective in resolution, and essential to the distinct counting under the micrometer of the lines of the test-plate. The test-plate used consisted of thirty bands of lines, each band varying but little from the $\frac{1}{2000}$th of an inch in width, and having its lines a uniform distance apart. On one end of the plate is engraved by Nobert, in parts of the Paris line, the distance apart of the lines composing the first band, and thence on, the distance between the lines of every fifth band, as in the 2d and 5th columns of the following table:

Band.	Par. line.	English inch.	Band.	Par. line.	English inch.
1	0·001000	$\frac{1}{11248}$	20	0·000167	$\frac{1}{67413}$
5	0·000550	$\frac{1}{20471}$	25	0·000143	$\frac{1}{78737}$
10	0·000275	$\frac{1}{40943}$	30	0·000125	$\frac{1}{90074}$
15	0·000200	$\frac{1}{56297}$			

We add the 3d and 6th columns, giving the distances in parts of the English inch found by multiplying the decimals in the 2d and 5th columns by ·088815.

Analysis of Nobert's Test-plate of Thirty Bands.

Bands.	Lines in each band.	Parts of an English inch.	Bands.	Lines in each band.	Parts of an English inch.
1	7	$\frac{1}{11110}$	16	30	$\frac{1}{57519}$
2	8	$\frac{1}{13062}$	17	31	$\frac{1}{58623}$
3	9	$\frac{1}{15372}$	18	32	$\frac{1}{62153}$
4	10	$\frac{1}{17950}$	19	33	$\frac{1}{63328}$
5	12	$\frac{1}{20224}$	20	34	$\frac{1}{66947}$
6	13	$\frac{1}{23287}$	21	36	$\frac{1}{68047}$
7	15	$\frac{1}{27705}$	22	37	$\frac{1}{71960}$
8	17	$\frac{1}{32250}$	23	38	$\frac{1}{73190}$
9	20	$\frac{1}{37792}$	24	40	$\frac{1}{74256}$
10	22	$\frac{1}{40636}$	25	41	$\frac{1}{76200}$
11	24	$\frac{1}{43063}$	26	42	$\frac{1}{78106}$
12	25	$\frac{1}{47331}$	27	43	$\frac{1}{81213}$
13	26	$\frac{1}{50000}$	28	44 ?	$\frac{1}{83917}$
14	28	$\frac{1}{52610}$	29		$\frac{1}{86334}$
15	29	$\frac{1}{55900}$	30		

The figures in the 3d and 6th columns, showing the distance apart of the lines in each band, are the mean of numerous and slightly variant trials, particularly on the higher bands. Up to the 26th band there was no serious difficulty in resolving and ascertaining the position of the lines; but on this and the subsequent ones, spectral lines,* that is, lines each composed of two or more real lines, more or less prevailed, showing that the resolving power of the objective was approaching its limit. By a suitable arrangement, however, of the illumination, these spurious lines were separated into the ultimate ones on the whole of the 26th, and very nearly on

* The tendency of lines near the limits of the objective's resolving power to run into each other, and produce spectral or spurious lines, is readily shown by a low objective on the lower bands. Hence the mere exhibition of lines is not always conclusive evidence of their ultimate resolution. A practised eye will generally distinguish the false from the true. Recourse to a higher objective often accomplishes the same; but when these fail, the micrometer only, together with a previous knowledge of the actual position of the true lines, can determine whether the lines exhibited are real or spurious. A 1-12 or 1-16 will show the 3 or 4 highest bands on this plate regularly and beautifully striped with lines much coarser than the true ones; the same with the 1-30 on the last band.

the whole of the 27th band; but on the 28th, and still more on the 29th, they so prevailed, that at no one focal adjustment could more than a portion (a third or a fifth part) of the width of these bands be resolved into the true lines.

The true lines of the 30th band we were unable to see, at least with any degree of certainty; still, from indications, we have no doubt they are ruled as stated by Nobert.

It will be observed that our measurements of the lines on the 1st, 5th, 10th, 15th, 20th bands vary somewhat from Nobert's registration on the plate as given in the first table above. Such discrepancies are to be expected, and by microscopists familiar with operations of this kind are looked upon as unavoidable; but that on the 25th band is rather large to be accounted for in this way. We are unable to explain it, and can only say that our repeated measurements of it were very carefully made.

These experiments, together with those of others before noticed, induce us to believe that the limit of the resolvability of lines, in the present state of the objective, is well-nigh established; but that this limit may be carried somewhat higher we are not prepared to doubt, since the handsome advance lately achieved by Mr. Tolles in his $\frac{1}{30}$th—combining wide aperture, fine definition, and high amplification—shows that the objective had not, as we were inclined to think, reached the stationary point.

The theoretical view of this question, that is, what may be the closest approximation of lines consistent with their separation under the microscope, we leave to those competent to the task, by whom, it is to be hoped, we may be favoured with further information on this point.

With regard to the striation of diatoms, an opinion generally prevails that the number of striæ on a given portion of a frustule varies among individuals of the same species, within wide extremes. This opinion is probably traceable in part to one of the earlier publications on the subject, the paper of Messrs. Harrison and Sollitt before referred to, wherein (as in the more recent paper of Mr. Sollitt) measurements of several diatoms are given showing great variableness in their striation. To these gentlemen much credit is due for their discovery of high markings, before unsuspected, on certain diatomaceous frustules; their measurements, however, and the alleged variableness of these markings, we have not been able to verify, as will be seen by the following extract from our paper published (this Journal, March, 1859) on the subject;

	Number of striæ in ·001″.		
	H. and S.	Sm. Syn.	S. and W.
Navicula rhomboides	60 to 111	85	70
Pleurosigma fasciola	50 to 90	64	52 to 56
Pleurosigma strigosum . .	40 to 80	44	42
Nitzschia sigmoidea	105	85	70

Many frustules of these species, from different localities, have been measured by us, and always with the same results. *Pleurosigma fasciola* has been specially designated by Mr. Sollitt, and also by Dr. Wallich, as very inconstant in its markings. Of this diatom we are fortunate in being supplied with abundant specimens, from various localities in England, particularly from the neighbourhood of Hull. Several hundred valves, not a few under $\frac{1}{300}$th of an inch in length, were measured, and on no one were found striæ less than 52 or more than 56 in ·001″, much the larger number being 54. A similar uniform striation has always been observed among the individuals of many other species examined by us.*

To such uniformity of striation *Amphipleura pellucida* forms as yet no exception; this diatom is still a "res vexata" among microscopists; neither the striation nor the structure of its frustule is at all satisfactorily understood. The record of its striation is found to be thus:—In 1854 Messrs. Harrison and Sollitt's measurements made its striæ 120 to 130 in ·001″. Prof. Carpenter (1856) first suggests the probability of some error in these measurements; the writers of this paper declared themselves (this Jour., March, 1859) unable to "glimpse" the striæ. Mr. Sollitt ('Mic. Jour.,' Oct., 1859) measures them again, and finds them still as low as 120 to 130 in ·001″, but gives it as the opinion of Mr. Lobb that "even those figures are too low, and that they ought to be set down at 140 in ·001″." In the same number of the 'Microscopic Journal,' Mr. Rylands sees "striæ, but much more distant than the 130 in ·001″ of the Hull microscopist."

* It is well known that among individuals belonging to the same species, and on the same slide, some are much more difficult of resolution than others. This is owing to the position of the valves, thickness of covering-glass, depth of balsam, &c., and not to a supposed difference in the number of their striæ, as the micrometer will readily demonstrate.

Estimates of the number of striæ based on a visual comparison with the known striation of other species are seldom reliable: instances of the vagueness of this method are seen in the valuable paper of Dr. Donkin on Northumbrian Diatomaceæ ('Mic. Journal,' 1858), where adopting *Pleurosigma angulatum* as a standard, he estimates the striæ of his *Pleurosigma lanceolatum* at about 70, and those of his *Toxonidea insignis* at about 75 to 80 in ·001″, whereas in both cases actual measurements show the striæ (transverse and diagonal) to be only 57 in the same space.

Lastly, Mr. Hendry states ('Mic. Jour.,' July, 1860) that he has "come to a satisfactory conclusion, that it is a sad misrepresentation to set down the lines so high in the scale as 130 in ·001″, and that on a few shells lines may be counted at 42, and many at 60, 70, and 80 in ·001″." A perplexing record, truly!—reminding one of the celebrated Torbane Hill coal case ('Mic. Jour.,' ii, p. 64).

It is our impression, notwithstanding these conflicting statements, that the diatom before us presented to all these gentlemen the same appearances, but their interpretation of these appearances have been widely different.

The testimony of our objectives, as we understand it, seems to indicate that this diatom has a minutely and irregularly broken-up surface, which even on the *same valve* can be made to show an apparent striation, varying from moderately coarse to extremely fine, according to the obliquity or intensity of the illumination, and to the grade, whether low or high, of the objective used, thus proving beyond question that the exhibition is illusory. In numerous trials, particularly on fine English specimens from Hull, sent us by Mr. G. Norman, we have entirely failed, with glasses too of unsurpassed excellence, to bring out *regular, distinct,* and *unmistakeable* striæ such as would be at once so recognised by an eye practised on the striæ of other diatoms.

After all, it is not improbable that true striæ, yet unresolved, may exist on the valves of this species; and furthermore, that the apparent striæ of different observers may be similar to the spectral or spurious lines before noted as occurring on the bands of Nobert's test-plate, when examined by an objective incapable of resolving them.

A summary of the foregoing may be briefly stated thus:—that our experiments lead us to believe—

1st. That lines on Nobert's test-plate, closer together than about the $\frac{1}{8700}$th of an inch, cannot be separated by the modern objective.

2d. That no *true* striæ have yet been seen on the valves of *Amphipleura pellucida.*

3d. That the alleged variableness in the striation of diatoms among individuals of the *same* species has been greatly exaggerated; on the contrary, we find a remarkable uniformity, thus sustaining the opinion of Prof. Smith ('Synop. Br. Diat.,' v. 2, Introd., p. 26), that for characterising species "striation is the best guide."—Columbus Ohio; Nov. 1860.

TRANSLATIONS.

New Experiments *relating to what is termed* Spontaneous Generation. By M. L. Pasteur.

(‘Comptes rendus,’ Sept. 3, 1860, p. 348.)

Since the author's last communication to the Academy on the subject of the origin of "ferments," and on what is termed "spontaneous generation," his attention has been directed to several points of particular interest in the question, and which are still attended with great difficulties, although their explanation is comprised in his previous labours.

Moreover, so long as the doctrine of spontaneous generation can present a single serious objection to the opposite doctrine, we may expect to find it constantly reappearing; for it maintains its hold over our minds, unknown to ourselves, from its relation with the impenetrable mystery of the origin of life on the surface of the globe. It is one of those questions which may be compared to the fabled monster whose many heads were unceasingly renewed. They must *all* be destroyed.

An essay of the celebrated Gay-Lussac, now become quite classical, has exerted a singular influence upon the minds of men, on the subject now under consideration. Having been charged with the examination of the methods of preserving provisions of Appert, which were nothing but the industrial application of the experiments of Needham and Spallanzani on the so-termed spontaneous generation, Gay-Lussac uses these expressions:—"It is evident when the air in the bottles in which the substances have been well preserved is analysed, that it no longer contains oxygen; and consequently, that the absence of that gas is a necessary condition for the conservation of animal and vegetable substances."

In the same work Gay-Lussac relates the experiment since so frequently cited, of grapes which, having been crushed under mercury, did not undergo fermentation unless they were brought into contact with pure oxygen or with common air, even in a scarcely perceptible quantity.

These experiments, which have only a comparative exactness, have never been contested. By degrees, without bringing to these delicate researches all that critical precision which they demand, authors have extended the principles of Gay-Lussac to the organisms which arise in infusions; and at the present day, every one, partisan or opponent of spontaneous generation, admits that the smallest possible quantity of common air brought in contact with an infusion causes, in a short time, the birth of *Mucedineæ* or of *Infusoria*.

This opinion has always been sustained, at any rate indirectly, by the habit followed and considered indispensable by observers, of preventing, with infinite precautions in all their experiments, the access of atmospheric air. Sometimes they recommend its calcination; sometimes its subjection to the most active chemical agents; frequently they begin by passing it through the vapour of water at 212°; lastly, they operate at other times with artificial air: and should it happen, under any one of these various conditions, that the experiment results in the production of organisms, they do not hesitate to affirm that the experimenter has been unable completely to avoid the introduction of a small quantity of common air, however minute it may be. Whence the partisans of spontaneous generation hasten to remark, and not without reason, that if the minutest portion of ordinary air develops organisms in any kind of infusion, this must arise, if the organisms are not spontaneous, from the circumstance that the minute portion of air in question contains the germs of a multitude of different productions; and lastly they say, if this be the case, the atmospheric air, to use M. Pouchet's expression, must be loaded with organic matter enough to render it foggy.

This reasoning, it must be confessed, is very sensible, and the more so since all the lower species which appear to be distinct seem really to be so, and consequently to be derived from different germs. Here then we are met with a serious and, to all appearance, a real difficulty. But is it not an exaggeration, and a deduction from facts more or less erroneous? Is it true, as is presumed since Gay-Lussac, that the cause of the so-termed spontaneous generation is constantly in operation in the atmosphere? Is it quite certain that the smallest quantity of common air does suffice for the development of organized productions in any kind of infusion? Lastly, what amount of confidence can be placed in Gay-

Lussac's results, or rather in the interpretation of them that has been given, and which has been not only accepted, but exaggerated?

The following experiments answer all these questions.

In a series of flasks containing 250 cubic centimètres, the author introduces the same putrescible liquid* in quantity sufficient to occupy about a third of the total volume of the vessel. The necks of the flasks are drawn out in the spirit-lamp, and the liquid is made to boil, the slender extremity of the neck being closed during the ebullition. A vacuum is thus produced in the flask. He then breaks off the points in a given locality. The air enters with violence, drawing along with it all the dusty particles it may hold in suspension, and all the principles, known or unknown, associated with it. The flask is then immediately closed with the blowpipe and placed in a stove heated to 20° or 30° C., that is to say, in the best conditions for the development of animalcules and *mucores*.

The results of the following experiments are not in accord with the principles generally admitted, but they are perfectly in agreement, on the other hand, with the idea of a dissemination of germs.

In most cases, in a few days the liquid begins to decompose; and in the flasks, although they may be placed in identical conditions, organisms of the most varied kinds will be seen to arise—far more varied, in fact, especially as regards the *Mucedineæ* or *Torulaceæ*, than would have been produced if the liquids had been exposed to the common air. But, on the other hand, it often happens several times in each series of experiments that the liquid remains absolutely unaffected, whatever may be the duration of its exposure in the stove, and just as if it had been filled with air that had been exposed to a red heat.

This sort of experiment appears to the author as simple as it is unobjectionable, in order to demonstrate that the atmosphere is far from constantly affording the cause of the so-termed spontaneous generations, and that it is always possible to procure in a given locality, and at a given moment, a considerable volume of common air which has undergone no sort of physical or chemical change, and which is nevertheless wholly incapable of giving rise to *Infusoria* or *Mucedineæ* in a liquid which undergoes decomposition very rapidly, and invariable when in free contact with the atmosphere. The partial success of these experiments shows sufficiently well also that, owing to the movement of the atmosphere, there will

* Albuminous water from the yeast of beer; albuminous water containing sugar, urine, &c.

always reach the surface of a liquid, placed whilst boiling in an uncovered vessel, a quantity of air sufficient to convey to it germs fitted to become developed in the liquid in the space of two or three days.

It has been said that the organisms produced are more varied in the flasks prepared as above than if the contact with the atmosphere had been freer; and nothing can be more natural than that it should be so. For when the quantity of air admitted at one time is limited, and the admission is repeated a number of times, the atmospheric germs are caught, as it were, in all the varieties under which they exist in the air.

The small number of germs contained in a limited quantity of air are not hindered in their development by other germs, either existing in greater numbers or gifted with a more precocious fecundity, and capable of occupying the whole field, and leaving no place but for themselves. It is for this reason that *Penicillium glaucum*, whose spores are vivacious and widely diffused, appears alone, at the end of a very few days, in the same liquids not enclosed, which, when exposed to limited quantities of air only, would, on the contrary, have afforded a great variety of organisms.

Lastly, the author cannot omit noticing the differences which are observed in the number of negative results in these experiments, according to the varying conditions of the atmosphere; a circumstance which affords a striking confirmation of his opinions.

Nothing, in fact, is more easy than to augment or diminish either the number of flasks in which organisms are produced, or the number of flasks in which they shall be totally absent.

The author confines himself to the relation of experiments which he was enabled to undertake in the vaults of the Paris Observatory.

In this place, as the vaults are situated in the zone of equal annual temperature, the perfectly calm air would evidently allow every particle of dust to fall to the ground, in the intervals of the disturbances which might be caused by the movements of the observer, or by the objects introduced by him. Consequently if every precaution be observed when the experimenter enters the vault to procure portions of the air, the number of flasks which will ultimately afford no organisms ought to be considerably greater than in the case where they may have been filled, for example, with the air in the court of the Observatory. This is what takes place; and the conclusions to be drawn from the results of experiment, from the agreement it shows with nature, or the multiplicity greater or less of the precautions taken to avoid the accidental introduction of foreign dust, compel the admission that if the flasks were opened or closed in the vaults, without the oporator being obliged to carry them thence, the air in the vaults would invariably prove to be as inactive as air heated to the temperature of red-hot iron. This does not arise, however, from the circumstance that the air itself, and owing to the conditions under which it is placed, has a special inactivity. On the contrary, it being saturated with moisture, and the lower organisms not requiring light for their existence, this air has always appeared to the author more fitted than that on the surface of the ground for the development of those organisms.

In conclusion, we find that the ordinary atmospheric air only here and there, and without any constancy, presents the conditions necessary for the first existence of the so-termed spontaneous generations. In one situation germs exist; close by, none at all; at a greater distance, some of a different kind. They are abundant, or the reverse, according to the locality. Rain lessens their number. In summer, after a succession of fine days, they abound; and in places where the atmosphere has been perfectly calm for a long time, the germs are entirely absent, and putrefaction does not take place, at any rate in the liquids upon which the author has experimented.

But how is it, it may be asked, that in Gay-Lussac's experiments with grapes, *Torula cerevisiæ* is produced by the introduction of a very minute quantity of air; and that if the same experiment be repeated with different infusions, we see these undergo decomposition in contact with the smallest possible quantities of air, and more than that, on the introduction of air hat has been heated or artificially made; for the experiments of M. Pouchet in the mercurial bath are exact, whilst those of Schwann, of the same nature, are almost always erroneous? This arises simply from the circumstance that the mercury itself is profusely filled with germs. This fact the author has already stated with reference to experiments which will be detailed in his memoir; but in the present communication he contents himself with giving a proof of this assertion which, he says, will astonish every one.

He takes some mercury which is poured without any particular precautions into the bath, in any laboratory; and, in the mode described in a former part of his memoir, he introduces, in the midst of an atmosphere of air which had been heated to redness, a single globule of this mercury, about the size of a pea, into the decomposable liquid. Two days afterwards, in every experiment he has made, organisms of various kinds have been produced. But if the same experiments be repeated, conducted in a similar manner, and without any change in the manipulation, and with a portion of the same quicksilver, but which has been *previously heated,* not a single living organism will be produced.

On the Anatomical Constitution *of the* Nerves *of* Sense *in the* Genus Aplysia. By M. Martini.

('Comptes rendus,' Oct. 22, 1860, p. 635.)

It is well known that the integuments, tentacles, and mouth of these Gasteropods are extremely sensitive to the least mechanical stimulation. I have also noticed the effects of a weak galvanic current applied to the organs of sense; the excitation of two closely approximated points, beyond the œsophageal ring, induces the contraction of nearly the entire muscular layer of the integument and foot. This fact shows that not only the ganglia of the œsophageal ring, but the other ganglia also are capable of reflecting centripetal into centrifugal actions, and of becoming the central pole of a nervous circulation, as has been proved by M. Flourens from physiological proofs, and by M. Jacubowitsch from anatomical facts.

Moreover, the nerves of the organs of sense, that is to say, in *Aplysia,* the nerves of the integument, of the tentacles, and of the mouth are furnished with numerous ganglionic enlargements. In the cutaneous nerves these are found at almost every point of the ramifications and anastomoses, and in the nerves of the tentacles also in the course of the branches and of the extreme filaments.

The ganglionic enlargements are of considerable size, relatively to the branches of the nerve. They are of a yellow colour, and composed of ganglionic cells, which are, for the most part, unipolar.

It should be remarked, that in the nerves of the tentacles ganglionic cells are always present, even in nervous filaments in the centre of the fibres; and that the terminal nervous plexus is formed chiefly of multipolar cells. Lastly, the ganglionic structure extends to the primitive fibres of the sentient nerves, which are furnished from point to point in their length with nucleated cellular enlargements. It should be stated that these ganglionic enlargements do not exist in the nerves which are distributed to the muscles of the foot.

On the Terminations *of the* Nerves *at the* Periphery *and in the different* Organs, *or the* Terminations *of the* Nervous System *in general.* By M. N. Jacubowitsch.

('Comptes rendus,' May 7, 1860, p. 859.)

I. If a portion of the mesentery of the cat, with the Pacinian corpuscles contained in it, be placed for twenty-four hours in some of Moleschott's solution (alcohol and acetic acid), and then spread out upon glass, and submitted to the microscope under a magnifying power of from 180 to 200 diameters, it will distinctly and clearly exhibit not only the Pacinian corpuscles, but also the vessels of every kind surrounding them, as well as the cellular-tissue-corpuscles with their nutrient vessels; in fact, the whole of the histological elements composing the mesentery will be seen. The Pacinian corpuscles are composed of two capsules, an external and an internal. The nerve itself usually divides, before entering the corpuscle, into several branches, which retain their medullary substance and their neurilemma until they reach the corpuscle, and even until they have penetrated the external capsule and reached the internal, whence the axial cylinder, now completely isolated, continues its course to the summit, where it terminates in a very distinct cell, and even into the nucleolus itself of the cell. In one case I was fortunate enough to witness the rupture of the internal capsule, and the escape of the cell with its membrane and contents—the nucleus and nucleolus,—a fact which establishes in an evident manner their existence as a termination of the nerve. Moreover, I would farther remark, that in many preparations I have seen not one cell only forming the termination of the nerve, but even several.

II. *a.* When the *corpuscula tactûs*, properly so termed, are treated with Moleschott's solution, they not only become transparent, but the elements of which they are constituted are disintegrated. Thus, in the frog's thumb, we see elongated, fusiform, distinctly nucleated cells, in the form of a cup, into which the nerve enters, losing its medullary substance on its entrance, and retaining, as in the case of the Pacinian corpuscles, only its axial cylinder, in order to terminate in a nerve-cell, and, as in that case, in the nucleus; and in such a way as to show the existence of an essential analogy between the Pacinian corpuscles and the *corpuscula tactûs*.

b. The nerve having entered the *cutaneous papillæ*, after dividing several times, turns upon itself among the blood-vessels, and again quits the papilla, in order to join the nervous plexus, which I am about to describe.

c. The *nervous plexus* is constituted in the following manner:—The bundles of nerves with a double contour (motile), as well as those with a simple contour (sensitive), which run beneath the integument in various directions, divide several times, and then their primitive fibres become slenderer and slenderer, so that, at last, they come to resemble axial cylinders, which are interlaced, so as to constitute a true nervous plexus. The loops which enter the cutaneous papillæ, and which I have just adverted to, enter into the composition of this plexus. I would designate this peculiar distribution, this peripheral expansion of the motile and sensitive nerves, under the name of *peripheral capillary nervous plexus.* It corresponds, in all respects, with the plexus which we find at the periphery of the cerebrum and cerebellum, and must be regarded as a special peripheral termination of the nerves. A similar condition of parts is readily seen in the tongue and on the nipples; on the one the termination of the nerves of taste being in the nucleus of nerve-cells, and in the other the peripheral capillary plexus being continued into the muscles existing in the part.

III. The *retina.*—The first and innermost layer is the peripheral nervous expansion of the optic nerve, in which this peculiarity may be remarked—that the nervous fasciculi end in becoming confounded with the axial cylinders which terminate in the nucleus of a nerve-cell. The second layer is the cellular layer, properly so termed; it is formed of several superimposed layers of cells. The form of these cells is more or less rounded or oval, and they vary much in size. The external and superior are the largest, whilst the inferior cells are no bigger than the nuclei of those placed more superficially. In this layer it may be seen how the axial cylinders are curved at the horizontal surface, in order to reach the neighbouring cells, and thence the more remote cellular layers, until they attain to the third layer (nuclear layer), which is next in order. With higher magnifying powers there may be seen in this layer double nuclei, and even farther subdivision of the nuclei, as has been also noticed by other observers as well as by myself, at the periphery of the cerebrum and cerebellum, and especially in the optic thalami. From this circumstance I have been led to regard this last layer of the retina as the site where the evolution of the cells takes place, that is to say, as a situation where the nuclei must be regarded as future nerve-cells, and, consequently, as being the place where new cells are continually formed and developed. With respect to the *cones*, I regard them simply as axial cylinders of the optic nerves, bent round so as to terminate in nerve-cells, and which become the more apparent and the longer in proportion as they penetrate more deeply into the inferior layers; whence it arises that their form and length are more or less variable.

As regards the bacillar layer, it does not constitute an essential part of the nervous elements, properly so termed, of the retina; but is rather to be regarded as belonging to the pigment-cells, of which it is the direct continuation. In the eyes of fish and of frogs it may be readily separated and obtained in horizontal, lateral, and transverse sections.

IV. In the *heart, lungs, kidneys*, and in the submucous layer of the bladder and intestine, there may be distinctly and clearly observed in the course of the nervous fasciculi groups of nerve-cells, which, from their form, I take to be ganglionic cells; and in which the axial cylinders may be distinctly seen to terminate, not, in this case, in the nucleus of the cell, but in the body of the cell altogether.

Thus, in recapitulating the results of my researches on the peripheral nervous system, I arrive at the following results:

I. That every nerve, of whatever kind it may be, originates from a nerve-cell in the central organs of the nervous system, and terminates at the periphery or in the interior of an organ—

a. Either in a nerve-cell, and, in the case of the nerves of sense, in the nucleus itself;

b. Or in the body of a cell, in the interior of the organs, in the case of the ganglionic nerves; or, lastly,

c. In the formation of a capillary nervous plexus, in which the anatomical differences disappear, the axial cylinders mutually running into each other and becoming confounded together.

II. That the nervous system—both central and peripheral—constitutes a whole, which, like the circulating system, pervades every part of the organism, forming a web as it were among the different parts, and thus reaching the ultimate elements of the tissues, without, at the same time, becoming lost in a vague and confused manner.

III. That the nervous elements—the cells as well as the axial cylinders—are always in a course of development both in the central organs and at the periphery.

IV. That the office of the nerve-cells, at the periphery or in the interior of the organs varies: they either preside over special functions, as those belonging to all the organs of sense, or subserve the proper conservation of the organs themselves, as the nerve-cells of the glandular organs, and of the mucous membranes; whilst the physiological functions, properly so termed, of the organs, depends upon the connexion of the nerve-cells with the central portions of the nervous system.

V. That although anatomical differences disappear in the peripheral capillary nervous plexus, from the circumstance that the axial cylinders become fused together, this is not the case with their physiological distinctness, which remains unaffected; a condition similar to that which exists in the capillary blood-vessels.

REVIEWS.

Compendium of Human Histology. By C. Morel. Translated and Edited by W. H. Van Buren, M.D. New York: Baillière Brothers.

The original of this work is written by Professor Morel, of Strasburg, and translated by Dr. Van Buren, Professor of Anatomy in the University of New York. It has been selected for translation by the latter on account of its conciseness and the excellence of the plates with which it is illustrated. These plates, twenty-eight in number, are certainly got up in a very superior manner, and the original plates are reproduced in the American edition. They have been drawn by Messrs. Morel and Villemin, and lithographed with great care and accuracy by M. Simon, of Strasburg. We have carefully looked over them, and although we cannot observe any addition to our knowledge of the intimate structure of the organs of the human body, we can cordially recommend these illustrations as more carefully engraved in their details than any continuous series on the same subject with which we are acquainted.

The text of the work is really little more than an extended description of the beautiful plates. At the same time we think it may be found more useful for the student attending lectures and demonstrations than the more diffuse treatises, in which elaborate discussions are entered into, and which are better adapted for the advanced student or teacher. Dr. Van Buren is, however, well posted up on the subject of histology, and in the notes which he has added has supplied the student with copious references to original papers and the larger works of Kölliker, Todd and Bowman, and others.

Catalogue of Transparent Injected Preparations. Sold by Smith and Beck, London.

Messrs. Smith and Beck having sent us up a selection from the transparent injected preparations which they now have on sale, we feel we shall be doing a service to our readers by calling their attention to them. We believe these preparations are not made in this country; but from whatever part of the world they are obtained, they claim the merit of being the most successfully mounted microscopic preparations that have yet been offered to the public for sale. In the catalogue the preparations are arranged under distinct heads, according to the part or organ of the animal system from which they are obtained; and, perhaps, we cannot give our readers a better idea of the nature and variety of these preparations, than by referring to them under the various subdivisions adopted in the catalogue.

Nervous system.—In this series we have sections of various parts of the nervous system. A highly interesting and instructive series is one of six transverse sections of the medulla elongata, from its commencement up to its union with the corpora quadrigemina. These are made from the rabbit. There are also preparations of the human brain and of the human optic nerve. It must, however, be borne in mind, that in these preparations the principal part of the structure elucidated is the distribution of the smaller blood-vessels. It is, in fact, in the extraordinary delicacy of the injections that one of the great merits of these preparations exists.

Eye.—The whole series devoted to the eye are exceedingly delicate and beautiful. It begins with several preparations of the human eye, as the eyelids, the cornea, sclerotica, and conjunctiva, the iris, ciliary processes, and choroid. The preparation of some of the structures of the eye *in situ*, as illustrated in the preparations from the rat, are very instructive. In one of these the distribution of the various branches of the posterior ciliary artery, and of the circular artery of the iris, is seen; whilst in another the whole of the ramifications of the capsular artery on the posterior surface of the lens is exhibited. In another preparation from the rabbit, the whole of the vascular part of the retina is given. Dissections of the new-born cat's eyes display the pupillary membrane. These preparations of the eye will be found exceedingly valuable to the student, as supplying to him for permanent observation those parts in the structure of the eye, which cannot be seen at all except by those who have the power, which but few possess, of making injections for themselves.

Skin.—The preparations of the skin are not numerous. They are entirely from the human subject, and present sections from the head, showing the hair-follicles. These might be increased with advantage. Examples of the perspiratory glands, with the capillaries of the true skin, and of follicles with Demodex *in situ,* would be interesting, as supplying objects not always easily obtainable at present.

Tongue.—These preparations consist of several sections from the human tongue, and that of the rabbit, cat, and mouse. They are interesting as exhibiting the lingual gland and the constitution of the blood-vessels in this organ.

Organs of digestion.—In this series we have no preparations from the human body. There are, however, very instructive sections from the stomach of the mouse and rabbit, and also preparations exhibiting the structure of the mucous membrane in the large and small intestines of the guinea-pig, the rat, the mouse, and the cat. We have seen but one preparation of the liver, and that from the rabbit. There is also mentioned in the catalogue the spleen of the rat, exhibiting a longitudinal vertical section, with the vessels of the Malpighian bodies and of the pulp.

Urinary organs.—These all come out very beautifully. In the human kidney the relation of the glomeruli to their capsules is seen. In the kidney of the rabbit, the rat, the mouse, and the snake, very interesting varieties of structure are seen.

Organs of respiration.—The lungs afford a very fine opportunity to the maker of these preparations, and in the perfection of the injection of the vascular network in the air-cells we have seen no better illustration than these. It is probable that a larger stock of these than the two mentioned in the catalogue—the rabbit and the mouse—may be in the possession of the preparer, and we should think a series of these would be highly interesting to the general or professional student.

Reproductive organs.—Of these there is also a deficiency in the catalogue. The only two mentioned are the human placenta and the corpus luteum of the pig. A large series of these would be highly instructive if prepared as carefully as the parts we have already commented on.

Development of the organs.—The parts of animals representing the states of organs at different periods in their developmental history are always most difficult to procure. In these preparations different portions of the embryo of the sheep, the cat, the rabbit, and the rat, are exhibited. In only one instance do we find the age of the embryo mentioned. This is a matter of importance, and, if possible, should be attached to the slide. An experienced observer would undoubtedly be able to make out the age of the embryo from the structure of its organs; but as these preparations are mainly intended for students, this is an important point to be attended to.

Pathological anatomy.—The principal subjects illustrated under this head are epithelial cancer, the granulating surfaces of ulcers, and the cicatrices of united wounds.

Such a collection of anatomical preparations as these are very suggestive of the applications of the microscope. Here in these few slides we have a perfect museum of histological structures, and the student with these at hand and his microscope can form a better idea of the nature of an organ, and the functions it possesses, than if he spent years amongst preparations in spirits with nothing but his eye to direct him. This is even more remarkably the case with pathological specimens. The mere superficial examination of a morbid part with the eye can furnish but little real information with regard to the nature of diseased structures, but let the microscope be applied and the distinctions and resemblances become obvious at once which had before been hidden.

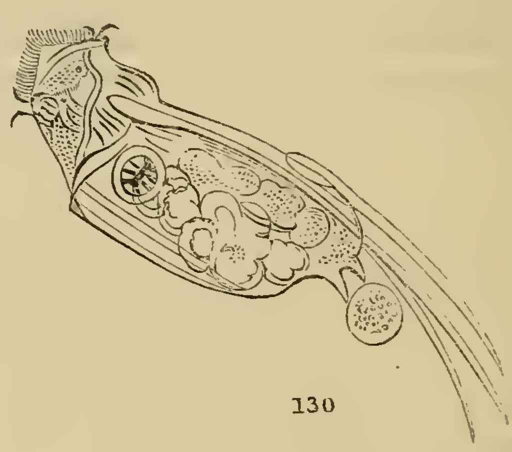
With regard to the series of preparations before us, we would suggest that it would be very desirable that the specimens should be mounted on slides which will fit our English cabinets. None of them require the clumsy width of glass which they now occupy, and would be much improved for examination if they were on narrower slides. We would also suggest to Messrs. Smith and Beck that they should get some one to translate the contracted Latin in which the names of the specimens are written on the slides, into English. It is not very easy to make out the Latin always as their catalogue indicates, but it would be worth an effort to make these beautiful preparations as widely useful as they deserve.

NOTES AND CORRESPONDENCE.

Gutta-percha Troughs.—In case it should be thought worth notice, I beg to offer the following suggestion.

In Mr. James Smith's paper "On a Dissecting Microscope," in the last number of the 'Journal' (Trans., page 13), it is remarked that different-sized objects would require the slips of glass at the bottom of dissecting troughs to be of different widths, and therefore necessitate the employment of several troughs, or else a glass trough furnished with several false bottoms of gutta-percha, fitted with various-sized slips of glass. I would venture to suggest that one gutta-percha trough might suffice, if the aperture and glass fitted into it were made *wedge-shaped* instead of paralled-sided, thus presenting various widths at different points. An opening, an inch and a half long, diminishing from half an inch in width at one end to nothing at the other, would accommodate various-sized dissections, and admit, if required, of their being operated upon the same time.—G. Guyon, Richmond, Surrey.

Microscopical Notes.—I inclose sketch of a *Triarthra,* of which I found several in a duck-pond at Chipstead, in Surrey, last



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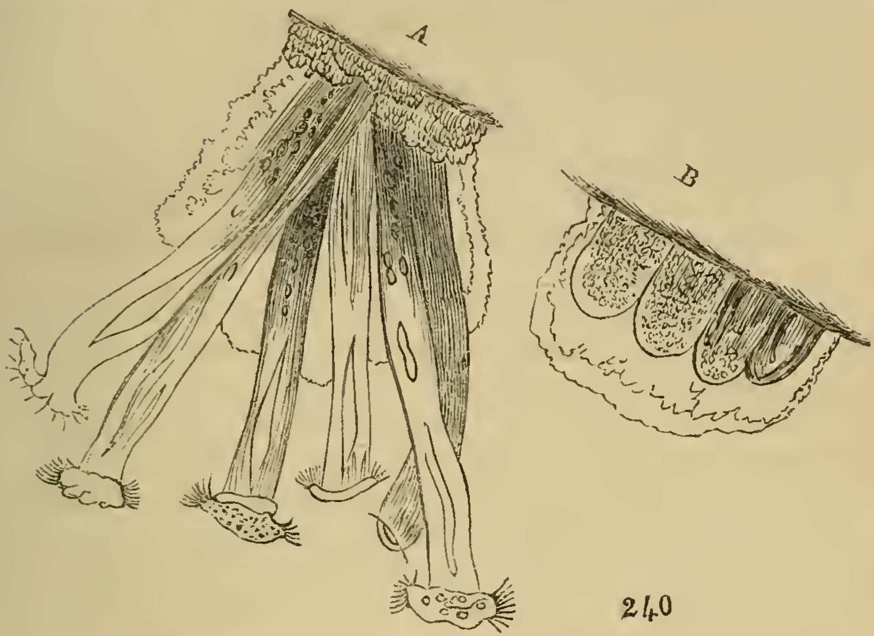
August. As nothing like it is described in the 'Micrographic Dictionary,' nor in the last edition of Pritchard, it may be new.

The other sketch represents a group of *Vaginicolæ* (?), of which several were found in a glass trough; but they con-



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tradict the assertion that *Vaginicolæ* are *solitary* or merely *double*. The gelatinous case in which these were lodged was very irregular, and with no trace of separate cells.—Henry J. Slack, 34, Camden Square.

An Astronomer's Protest.—When Mrs. Malaprop said that "comparisons were odorous," she only gave ungrammatical enunciation to a truth which must be admitted by everybody; and the recognition of which might have spared us from Mr. Henry U. Janson's peroration in his "Further Notices on Finders," in your last number. Had that gentleman ever read Arago's 'Popular Astronomy,' he would have learned that the determination of the exact tint of a star may lead to the resolution of very remarkable physical questions; while the study of the works of the two Herschels would have shown him that upon the sudden or gradual condensation of a nebula may hinge the interpretation of cosmical phenomena so stupendous that the most brilliant discoveries of the microscope pale in insignificance before them. I yield neither to Mr. Janson nor to any one else in my appreciation of the instruction and amusement to be derived from the microscope, but must protest against such a comparison as he makes, even though he may shield himself behind a parade of Dr. Goring's ignorance of astronomy.—A Fellow of the Royal Astronomical and Member of the Microscopical Societies.

The Binocular Microscope.—Having, in my desire to keep up with the progress of improvement, procured a microscope constructed on the principle of Mr. Wenham's last invention (Transactions, p. 15), I feel it my duty to declare that I have fully verified every statement made in the paper alluded to with regard to "the new combined binocular and single microscope." I should call it an *under*-statement. In short, all I said of the former one (Memoranda, p. 66) will apply to the latter with redoubled force. *That* was excellent, but *this* is *super*-excellent!

The microscopic world is deeply indebted to Mr. Wenham; but he very liberally awards me a share in the merit; for, in a letter to me, he says:—"Whatever I may have done in the invention, great credit is due to you for having started the thing, and brought it into notice; for, such would have been my own apathy, and that of the makers, that probably the only one ever made would have been that in my own possession. There is not one person out of a thousand that would have had the 'pluck' to order a thing of this kind that he had never seen!"

Mr. Wenham's account of his instrument (in the January number) is so complete, that very little remains to be said in the way of explanation; nevertheless, I should like to add a few words for the benefit of those who may not perfectly understand why the last Binocular Microscope is so decidedly preferable to the former ones. Mr. Wenham has explained the reason to be that, instead of the whole light having to undergo prismatic refraction, as in the former instruments, one half is now simply transmitted in the usual manner; but probably very few, even of experienced microscopists are aware how very nearly the half of an object-glass comes up to a whole one in actual performance, especially in the lower powers. This is beautifully illustrated by an eclipse of the sun; for it has been truly observed, that though a *total* eclipse is everything, a *partial* one is nothing. Even when a full half or more of the sun's disc is concealed, no one would suppose, from looking at the prospect around him, that anything was wrong with the sun. This may also be shown in the case of "the combined binocular and single microscope," by the following experiment.

Get some friend, for the *first* time, to look through the Binocular, having previously placed a small opaque disc beneath the cap of the left-hand eye-piece, the prism being withdrawn. He will then see the object, whatever it be, in the *usual* way; and will probably say, "Beautiful!" "splendid!" or words to that effect. Then, while he is looking, with an instantaneous touch of the finger you slily *pop in* the prism. "*Now*, how does it look?" he will probably say. "Oh! just the same; unless that I *think* you have slightly altered the light." "True; but you see every part of the object *as well defined* as before?" "Yes, *quite* as well; and I should say even more *agreeably*, for I fancy there is not *quite* such a *glare* of light." "Ah! then you will not readily believe that I have actually *cut off* one half of the entire disc of the object-glass." "You don't say so!" "Perfectly true, however." The next step is to remove the opaque disc, and, for the first time in his life, submit to his astonished gaze—BINOCULAR VISION! the double ray uniting in the *cerebrum*, to form one distinct and beautiful image, exhibited, moreover, with the most marvellous stereoscopic effect!

I assure you it actually compels people to *shout* with amazement!! "Well, I never beheld anything equal to that! It is most magnificent! I seem to see part *behind*, part in real perspective!" (This effect, by the way, is admirably shown by a *good* specimen of hypersthene, with a 1-inch objective and Lieberkuhn reflector.) Now, the best part of the practical joke remains. After allowing your friend to *luxuriate* for some time over this gorgeous spectacle, and while he is still earnestly gazing at it, you suddenly *withdraw* the prism; when he will probably as suddenly withdraw his head, exclaiming, "Dear me! how is this? Why, I appear suddenly to have lost half my eyesight. How very unpleasant! What *have* you done?" "Done, sir; why, I have merely brought back the microscope suddenly to its *ordinary* state. Can you, now, believe it?—*that* is really the way you have been using the instrument all your life!"

And now a few parting words on another topic. My last communication on the above subject was, by some trifling editorial inadvertence, I suppose, headed "Further Notes on Finders;" which, I have been informed, puzzled a good many. But I must take the present opportunity of confessing my error in supposing myself like Columbus (No. xxxii, p. 201), for I have since had the mortification of finding myself forestalled; for the "double nose-piece" is recommended as a finder by Dr. Carpenter, in his excellent work, 'The Microscope and its Revelations,' paragraph 51. I was utterly unaware of this when I sent the communication, No. xxxii, p. 198. But I do not regret having done so, as it has been the means of drawing the attention of many to the subject. Moreover, every microscopist may not have a copy of the said work, though every one ought. My opinion still remains the same. The Maltwood finder works tolerably up to one eighth; but, with a sixteenth (which I chiefly use with the Diotomaceous tests), the figures become so fearfully diluted and nebulous that *they* require a finder, *i. e.*, lower power, to find them!

I have recently discovered another useful application of the nose-piece. It does admirably for *comparing* two achromatics of the same power, in order to ascertain which is the best. The ordinary tedious mode of screwing and unscrewing is very objectionable, as so much time is lost that the observer cannot satisfactorily *bear in mind* the two effects. With the nose-piece the change is made in an instant; both are brought, as we may say, *close together*, and may thus be very accurately estimated.

In this way I have been carefully comparing two *recent* 1½ inch achromatics by two of our first makers; and the result is, that no perceptible difference can be detected: which shows, by the way, how wonderfully our opticians *work up* to each other. On the other hand, if we thus compare an achromatic of the present day with another of the same power and maker, but constructed, perhaps, only a year or two ago, it strikingly shows the rapid *improvement* made in achromatics; every slight alteration of curve, density of glass, variation of combination, &c., having been productive of more or less benefit. When *shall* we get to the *top?*—HENRY U. JANSON, Pennsylvania Park, Exeter.

Binocular.—In answer to numerous private inquiries for advice, and a recommendation of the makers who will apply my binocular adaptation to microscopes generally in the best and most efficient manner, I have to state, that after a careful examination of the instruments of the three who have, up to this time, professed to construct them, I can pronounce the definition of the binocular arrangement equally good in all; and as each is determined in making the new instruments as perfect as possible, I feel assured that I cannot do better than strongly recommend parties requiring their instruments to be altered to send them to the *original makers*, who will certainly be best qualified for applying the binocular arrangement to their own particular instruments. I am sure this will be most satisfactory in the end to microscopists, as well as the opticians, and prevent the possibility of any invidious comparisons being set afloat at the expense of other instruments, for the purpose of obtaining business by a self-assumed superiority of construction; a course of proceeding, which, I take it for granted, none of the opticians with whom I have at present the pleasure of being acquainted would wilfully pursue.—F. H. Wenham; *March 20th*, 1861.

Histological Lectures.—The Royal College of Physicians of London is about to open its halls for evening instruction. A short course of lectures on the Structure of the Tissues of the Human Body, with observations on their growth, nutrition, and decay, is announced for delivery by Dr. Lionel Beale, the Professor of Physiology at King's College. These lectures will be delivered on Monday evenings, at half-past eight o'clock, commencing on Monday evening, the 8th of April. It is very gratifying to find the College of Physicians thus endeavouring to meet the spirit of the age, and it is to be hoped that such encouragement will be given to this course of lectures as to induce some of the other distinguished members of that body to give the result of their experience in the form of short courses of lectures.

PROCEEDINGS OF SOCIETIES.

Microscopical Society, *January 9th*, 1861.

R. J. Farrants, Esq., in the Chair.

John Mackrell, Esq., A. J. Dumas, Esq., and Alfred Aubert, Esq., were balloted for and duly elected members of the Society.

Mr. H. Deane made some observations in reference to some new diatom discs exhibited in the meeting, which had been forwarded from an old member of the Society, Mr. John Coates, now resident and in medical practice at South Yarra, near Melbourne, where the siliceous shells had been found.

In the course of some works, in which a swamp emptying itself into the River Yarra had to be crossed by an embankment, the soft, boggy earth in which the shells were found was brought up from a considerable depth. Dr. Ralph first found therein many infusorial organisms, which led this gentleman and Mr. Coates to work at them together very actively. Mr. Coates read a paper on the subject to the Royal Society in Melbourne, and exhibited some beautiful preparations of the objects in the microscope. The bog is estimated to be sixty feet deep; but it has not been determined how low these organisms extend.

Among the forms, there is found in great abundance a disc apparently new, which Mr. Coates proposes to call *Coscinodiscus Barklyi*, after the governor of the district, Sir H. Barkly; who is the President of the Royal Society in Melbourne. They found, also, three kinds of Pleurosigma, three of Campylodiscus, several Naviculæ and Pinnulariæ, and Surirella in abundance.

Mr. Coates had found Melosira half a yard long in the River Yarra; and expected, as the season came round, to find the new disc also, in a filamentous condition, in its early states of growth.

February 13*th*, 1861.

ANNIVERSARY MEETING.

Dr. LANKESTER in the Chair.

Reports of the Council and Auditors of the Treasurer's Accounts were read.

An address, drawn up by the President, showing the progress of the Society during the past year, was read by the Chairman.

F. Bezant, Esq.; J. H. Brown, Esq.; G. H. Lewes, Esq.; W. H. Westwood, Esq.; Charles Gilbertson, Esq.; Charles Fox, Esq.; E. W. Jones, Esq.; J. B. Winslow, Esq., were balloted for, and duly elected members.

The annual ballot for Officers and Council then took place, when the following were declared duly elected:

President:—R. J. Farrants, Esq.

Treasurer:—N. B. Ward, Esq.

Secretaries { G. G. Blenkins, Esq.
M. J. Legg, Esq.

Four Members of Council.

H. Perigall, Esq.	Rev. J. B. Reade.
J. N. Tomkins, Esq.	F. H. Wenham, Esq.

in the place of

Dr. L. Beale	R. J. Farrants, Esq.
J. R. Mummery, Esq.	Dr. Wallich,

who retire in accordance with the regulations of the Society.

March 13*th*, 1861.

R. J. FARRANTS, Esq., *President*, in the Chair.

E. C. Buckland, Esq.; Wm. Emmens, Esq.; and J. T. Tapholme, Esq., were balloted for, and duly elected members of the Society.

The following papers were read:—"On a Species of Coccus infesting Oranges," by R. Beck, Esq.

"On some new Species of Diatomaceæ," by Dr. Greville. (Trans. p. 39.)

The President announced that the *soirée* had been fixed for Wednesday, April 3d.

Upon subsequently applying to the authorities at King's College, it was found that, in consequence of another engagement, the rooms could not be obtained on that evening. The *soirée* was therefore unavoidably postponed until Wednesday, April 10th.

Islington Literary and Scientific Society.

Microscopical Class.

November 24th, 1860.

Mr. Noble in the Chair.

Mr. T. W. Burr read his second paper, "On the Entomostraca," in which he continued the detailed account of some of the families of these animals, describing particularly the *Branchipus stagnalis*, a beautiful shrimp-like creature, one inch long, found in fresh water, and the very similar but smaller *Artemia salina*, which inhabits the most concentrated brine collected in the salterns of Lymington and Hayling Island, in Hampshire, and other analogous salt-making works; specimens of which had been brought from Hayling Island by the author, and studied by him during the six weeks they continued alive. The paper next dealt with the well-known family of the Daphniæ, of which the common *Daphnia pulex*, or water-flea, had its organization, habits, and peculiarities of structure minutely described; further details of the Entomostraca being reserved for another communication. The paper was illustrated by the exhibition of living Daphnia, mounted specimens of the other animals referred to, and diagrams.

January 26th, 1861.

Adjourned Annual Meeting.

Mr. Noble in the Chair.

The report of the Committee was read and received.

The following officers were elected for the year:—President, Charles Woodward, Esq., F.R.S.; Secretary, Mr. T. W. Burr, F.R.A.S., F.C.S.

Committee: —Messrs. Harker, Hislop (F.R.A.S.), Mestayer, Reiner, and Thomson.

After the usual votes of thanks, the business of an ordinary meeting commenced.

A paper, by Mr. Legg, Secretary of the Microscopical Society of London, "On the Foraminifera," was then read by the Secretary, in which, after adverting to the beauty of these objects, he mentioned that at one time they had been included in the Mollusca, but had now, in consequence of the discovery of their true character, been reduced to a much lower class; their animal structure consisting of a simple mass of "sarcode," or animated slime, exhibiting no trace of digestive apparatus or reproductive organs; and their position, according to the latest authorities on the animal kingdom, being that of Rhizopods closely allied to sponges. The calcareous skeletons common to these animals having been noticed, the various systems of classifying them were referred to, and the orders into which they are divided by D'Orbigny, dependent on the forms of the shells, detailed, and a minute description of the animals taken from his works given, attention being directed to the modes of growth of the shells in segments, their being pierced for filaments or tentacles, and their material being sometimes opaque and sometimes transparent. The paper concluded with an account of the various localities in which these organisms are found in the recent or fossil state; the sea-sands and bed being covered with the former, and large tracts of the latter existing in Italy, America, and other places. The author also recommended sponge-sand, as containing enormous numbers of Foraminifera. Mr. Legg subsequently gave an oral description of a great number of diagrams and specimens, and explained his method of separating the shells from sand by sifting through wire gauze of different degrees of fineness.

Literary and Philosophical Society, Manchester.

Microscopical Section.

December 17*th*, 1860.—Letters were read from Sir Leopold Mc. Clintock, Mr. J. W. Read, of the Admiralty, and Dr. Wallich, who accompanied the former in the *Bull Dog*, in the late expedition to the North Seas. Dr. Wallich kindly presented to the section a few copies of his pamphlet on "Life in the Deep Sea," now circulating amongst the members.

A letter was also read from Captain M. F. Maury, of the U.S. Navy, promising to supply envelopes for soundings amongst the sperm whalers and other vessels trading to the Pacific Ocean, &c.

Specimens of incrustations from the boilers of the steamer *Edinburgh*, trading from Glasgow and Liverpool to New York; from the steamer *Rhone*, from Liverpool to Venice, Trieste, &c.; and from the steamer *Minho*, from Liverpool to Lisbon and Oporto, were received from Mr. W. A. Hayman, of Liverpool. The incrustations are as hard as marble, breaking with a crystalline fracture, and showing, by different-coloured strata, the crust obtained from harbours and from the open sea. Mr. Dale stated that the component parts of the incrustations are sulphates of lime, magnesia, &c.; he recommended maceration in bicarbonate of ammonia to obtain calcareous shells, and in weak acids or muriate of barytes to obtain siliceous shells. Various members took specimens for examination.

A letter was read from Captain Anderson, of the Cunard steamer *Canada*, from Liverpool to New York, accompanying specimens of the soundings taken during his last voyage across the Atlantic. Captain Anderson was kind enough to send the soundings by post from Queenstown, by which means they arrived just before the meeting.

Mr. W. H. Heys, of Hazel Grove, exhibited his newly invented Kaloscope, by means of which he obtains refracted and reflected light of different colours at the same time upon objects under the microscope, producing beautiful effects in some cases.

January 21*st*, 1861.—Letters were read by the Secretary from Professor Huxley and from Mr. W. K. Parker, respecting soundings.

Mr. Heys, of Hazel Grove, read a Paper "On the Kaloscope," his newly invented instrument for the use of coloured light in the examination of objects under the microscope. This the author effects by two sets of four discs each of differently coloured glass, 2½ inches in diameter, mounted on a stand 12 inches high, one set of which is placed between the light and the bull's-eye condenser, and the other between the light and the mirror underneath the stage, each disc having an independent motion, so that the light can be transmitted through one or more of both sets at the same time; when the object appears of the colours refracted and reflected through the discs.

One of the important uses of the instrument is the protection of the eye from injury occasioned by the use of common artificial light.

Many objects which do not polarize, by the kaloscope are made to disclose the beauties of polarized light; for instance, the anthers of the mallow, with their pollen, when viewed by means of red light below the stage, and at the same time green light (the complementary colour) through the condenser, appear of a beautiful green colour on a red or crimson ground.

The author observes that some objects, viewed by means of the kaloscope, appear in such relief that they might be supposed to be seen through a stereoscope; these are anthers, jointed hairs, oil-glands, and vegetable sections in general. The calyx of the moss-rose is alluded to, under ordinary illumination, as a mere entanglement of fibres with dark beads; but by this method it is transformed into a stereoscopic branch, with glittering glands at its extremities.

Sections of wood, spines of echini, &c., will be found as beautiful as with the polariscope; but, by another arrangement, details are brought out not observable with the latter instrument. A black surface being placed below the stage, coloured light is thrown very obliquely from the mirror, and the complementary colour through the condenser; hairs on the edges of leaves, petals, and filaments of stamens, &c., then appear illuminated by the light of the condenser of one colour, and fringed with the opposite colour on an intensely black ground. The author gives a list of the botanical names of objects advantageously illuminated by this method. A single-coloured disc may be also used to advantage with white light from the bull's-eye lens. Details of structure are observable by means of this instrument, which the author observed are inconspicuous without its aid, and thinks that its efficacy in connexion with such a variety of purposes cannot fail to render it of value to the scientific observer.

The reading of the paper gave much satisfaction to the members of the section, and it was resolved to communicate the same to the Society, with a recommendation that it should be printed *in extenso* in its Memoirs.

The Secretary read a paper, "On Preparing Objects found in Soundings."

Having suggested the means of obtaining soundings from commanders of vessels, by distributing envelopes for their preservation and transmission, the next point to be ascertained is the simplest and most effectual method of separating the objects sought, from the tallow in which they are usually imbedded and brought up from the depths of the ocean.

Mr. Dancer's paper on this subject, read at the November meeting of this section, describes an excellent method of so doing, by melting the tallow in hot water; skimming it off when cold, and repeated washings with hot water and ammonia; but it appeared desirable, if possible, to discover a simpler plan, and one which should secure the preservation of the smaller organisms, which are so liable to be lost amongst the tallow and in the repeated washings. It occurred to me that the melted tallow could be passed through filtering-paper; and this I effected by means of a jet of steam from a common kettle, furnished with the necessary tubes, soldered into a tin lid, for ingress of water and egress of steam, with distilled water into the filter, in which was placed the mass of tallow with its contents; the tallow was immediately melted, and rapidly passed through the paper, leaving, however, a small residue, which, even with the assistance of alkalies, could not be entirely removed; traces of grease or soapy matter obstinately adhering to the particles, and preventing free separation from each other.

To obtain a better solvent, I consulted one of the members of our Council, whose practical chemical knowledge and inventive genius are perhaps unequalled, and he at once suggested the plan I now describe; which, for novelty, simplicity, and effect, will, no doubt, prove to be all that can be desired. Time and experience are, however, required to test the fact; only one operation on Friday last having been effected.

Mr. John Dale, "On a Process for Tallow Soundings."—It is now well known that one of the products obtained from the naphtha of coal tar is a volatile, oily substance, termed benzole (or by French chemists, benzine), whose boiling point, when pure, is about 180° Fahr., and is a perfect solvent for fatty substances. In a capsule, previously warmed on a sand bath, Mr. Dale mixes with the tallow soundings benzole, whose boiling point may be about 200°, until sufficiently diluted as to run freely, pressing the lumps with a glass rod until thoroughly mingled; the solution and its contents are then poured into a paper filter, placed in a glass funnel; the capsule is again washed with benzole, until the whole of the gritty particles are removed into the filter. A washing-bottle is then supplied with benzole, and the contents of the filter washed to the bottom until that liquid passes off pure—which may be tested by placing a drop from the point of the funnel on a warm slip of glass or bright platinum, when, if pure, the benzole will evaporate without residue or tarnish; if grease be present, the washings must be continued until free of it; and after rinsing through weak acid or alcohol for final purification, the calcareous forms will be ready for mounting.

The filter and its contents may be left to dry spontaneously, when the latter can be examined by the microscope. Should time be an object, rapid drying may be effected by any of the usual methods; one of which, recommended by Mr. Dale, is to blow a stream of hot air through a glass tube held in the flame of a Bunsen's burner. The lower the boiling point of the benzole, the more readily can the specimens be freed from it. A commoner quality may be used, but is more difficult to dry afterwards.

Pure benzole being costly, this may appear an expensive process, but, with the exception of a trifling loss by evaporation, the whole may be recovered by simple distillation. The mixture of tallow and benzole is placed in a retort, in a hot water, a steam, or a sand-bath; the benzole will pass into the receiver, and the tallow or other impurities will remain in the retort. When the whole of the benzole has distilled over, which is ascertained by its ceasing to drop from the condenser, the heat is withdrawn, and the retort allowed to cool, before the addition of fresh materials. Half a dozen to a dozen filters, each with its specimen, can be in process at the same time; and the distillation of the recovered benzole progresses as quickly as the filtration, which was practically proved on the occasion named. Great caution in the use of benzole is to be taken in the approach of lights to the inflammable vapour.

After the Foraminifera and calcareous forms have been removed, the residue may be treated with acids and levigation in the usual manner, to obtain siliceous forms and discs, if any; but to facilitate their deposition, and to avoid the loss of any minute atoms suspended in the washings, I would suggest the use of filtration. The conical filter is unsuitable, as the particles would spread over too great a surface of paper; but glass tubes, open at both ends, such as broken test-tubes, will be found to answer; the broad end covered with filtering-paper, and over that a slip of muslin tied on with thread, to facilitate the passage of the water, and prevent the risk of breaking the paper; suspend the tube over a suitable vessel, through a hole cut in thin wood or cardboard; pour in the washings, which can be thus filtered and then dried. The cloth must be carefully removed, the paper cut round the edges of the tube, and the diatoms on the paper disc may be removed by a camel-hair pencil or otherwise, ready for mounting. Thus many objects may be preserved which would be either washed away or only be available by a more tedious process.

Mr. J. B. Dancer, F.R.A.S., "On Cleaning and Preparing Diatoms, &c., obtained from Soundings."—The first operation generally required is to separate the soundings from the tallow or fatty matter which has been employed to bring them up from the bottom. I may here mention that Lieutenant Stellwagen, an American officer, has invented a sounding-lead which does not require grease. It has a trap at the bottom for collecting the soundings. I am sure our section will join with me in the wish that the soundings which our worthy Secretary hopes to receive from various parts of the world may be collected with an apparatus of this kind. The grease involves a considerable amount of trouble, and some loss. The mass of soundings and grease is to be placed in a basin or an evaporating-dish, and boiling water poured on it; the melted fat rises to the surface, and when cold can be easily skimmed off. This operation may be repeated until the sediment appears free from grease; to insure this, draw the water carefully from the sediment, and pour liquor ammonia on it; I prefer it to potass or soda; this will combine with the grease, if any remain, and form a soapy solution. This may now be treated with hot water for the final washing. The sediment must be allowed to settle quietly for an hour or two each time before the water is carefully decanted or drawn off with a syphon; otherwise the minute forms of Diatomaceæ will be lost, and the operator greatly disappointed in the result of his labour. Having now cleared the soundings from all extraneous matter, the next operation is to ascertain, by the microscope, the nature of the objects thus obtained. Take up with a glass tube some of the sediment, draw the contents of the tube along a slip of glass, and examine it with a low power. If Foraminiferæ or large Diatomaceæ are present, they may be removed by means of a split hair or a bristle from a shaving-brush, gummed or fixed in a cleft in a slip of wood, and then placed on a clean slip of glass for further examination. If you have a considerable quantity of mud or sand under the operation, with an abundance of Foraminiferæ, as is frequently the case, they can be separated by first drying the soundings, and scattering them on the surface of water in a basin; the heavy particles of sand will sink, but the light Foraminiferæ will float for a time, and can be easily collected. Another mode is to stir up the sediment, and then pour off the lighter articles into test-tubes or wine-glasses. In this manner, by having a number of glasses, you can separate the varieties according to their specific gravities. If the Diatomaceæ obtained are recent and abundant, they should be separated from the calcareous portions of the soundings, and boiled in hydrochloric acid; and if not sufficiently cleaned, they may be boiled in nitric acid. The contents of the diatoms can be removed by burning them. Place them between two thin pieces of talc, and submit them to the flame of a spirit-lamp. Some use thin glass to support them when cleaning a quantity. I have burnt them in a small platinum crucible with success. It is advisable to mount specimens dry, and also in balsam, for careful microscopic examination. Those mounted dry show the markings most distinctly. There is one difficulty which the slide-mounter meets with on his first essay, and which I will briefly allude to, viz., retaining the object in its proper place on the slide whilst the thin glass is being pressed down on the balsam. Some operators place the thin glass on the objects, and allow the balsam to flow gradually between the glasses by capillary attraction. Professor Williamson employs a little gum in the water which contains the Diatomaceæ; this fixes them when dry, and the balsam does not remove them. Some objects, such as Foraminiferæ, require a long soaking in spirits of turpentine to displace the air from their chambers. By using an air-pump this process is much facilitated. A solution of balsam in chloroform will doubtless be an improvement in mounting this class of objects. It is needless to take up the time of the section by entering minutely into the details of mounting all the various objects which may be met with in specimens of soundings. Those interested may consult Quekett, Carpenter, and Hogg's works on the microscope; and Smith on Diatomaceæ. I must now apologise for taking up so much time on a subject which many present may be conversant with.

P.S.—Since the above was written, several engravings, with descriptions have appeared in the 'Mechanics' Magazine,' December 28, 1860, of the deep-sea-sounding apparatus invented and used on board the *Bulldog* during the sounding expedition in the North Atlantic Ocean, under the command of Sir F. L. M'Clintock, with one of these machines. Twenty-four ounces of ooze was brought up from a depth of 1,913 fathoms.

Mr. Brothers presented to the section a very old microscope, date unknown; he also exhibited the *Actinophrys Eichornii*, a species of *Melicerta*, sea weed with Lepralia, &c.

Mr. Hardman, of Davyhulme, presented three mounted specimens of the wire-worm, and a number of dissecting-needles for the use of the members; he also exhibited a mounted fly, one of the Panorpidæ, which he states feeds upon leaf-rolling caterpillars. The proboscis and feet of the insect are peculiarly adapted for dragging its victims from their concealment and holding them whilst extracting their juices, the feet being provided with combs similar to those of the spider.

Mr. R. D. Darbyshire presented a quantity of mud, &c., from the washings of shells from the raised sea-bottoms at Uddevalla, in Sweden.

Mr. Dancer exhibited a new 3-inch object-glass, with a large and flat field of view; also specimens of gold quartz from Wales, large Curculia, and other objects.

Mr. Whalley exhibited some specimens of injections obtained from Germany, which were considered the best yet exhibited.

Mr. Latham exhibited various specimens of sand and mud from the East Indies, portions of which were distributed amongst the members.

February 18th, 1861.—Letters were read from Captain Andersen, R.M.S. *Canada*, and from Dr. Wallich, respecting the pamphlet, 'On the Presence of Animal Life at Vast Depths in the Sea.'

Mr. Sidebotham described his experience in mounting Desmidiæ, and the difficulty he found in discovering a suitable medium for their preservation. He had tried syrup, Goadby's fluid, and a number of other chemical preparations; but the specimens, in course of time, were spoiled from one cause or other. The fluid which has best withstood the effects of time is simple distilled water; the cells being made of gold size and Japan black. Mr. Sidebotham exhibited Desmidiæ, mounted in distilled water, in the years 1842 to 1846, in which the chlorophyll is comparatively little altered.

Professor Williamson observed that Dr. Carpenter had mounted starfishes in glycerine, and had found the colours were well preserved. He himself had used a mixture of glycerine and distilled water for volvox, and had found it to answer well.

Mr. Sidebotham also exhibited specimens of Diatomaceæ, mounted in 1844. The specimens (*Isthmia enervis*, *Biddulphia*, &c.) were obtained fresh, immersed in spirits of wine to absorb the water, and mounted in balsam; the green colour of the cell-contents is yet perfectly preserved.

Professor Williamson exhibited some scales of fish, prepared by Dr. Kölliker, of Warzburg, containing remarkable examples of fusiform lacunæ. He also pointed out how these and other similar discoveries, to which he referred, confirmed his previous conclusions in the 'Philosophical Transactions,' viz., that fusiform laeunæ were not characteristic of reptilian bones, as some had supposed, but that they existed in many fishes; he especially referred to the Salmonidæ as presenting this oblong form of bone-corpuscle.

Mr. Brothers exhibited a modification of the kaloscope, and objects to illustrate the same.

Soundings were received from the steamers *Canada*, from New York; *Armenian*, coast of Africa; *Tagus*, from Lisbon; and from several vessels of war, from different parts of the world; which were duly acknowledged. Incrustations from the boilers of several sea-going steamers were also presented by Mr. W. A. Hayman, of Liverpool.

March 18th, 1861.—Mr. Arthur M. Edwards, of New York, presented several papers on Diatomaceæ and other microscopieal subjects, published by the Boston Society of Natural History, &c. Mr. Edwards's kindness was duly acknowledged.

A communication from Captain Anderson, R.M.S. *Canada*, written at sea on his homeward voyage, excited considerable interest. He states that Dr. Wallich's pamphlet would be communicated to the Boston Society of Natural History, by Professor Agassiz, who was particularly interested in the Ophiocoma found at so great a depth. The Professor is now engaged in preparing a work upon the natural history of that class of Echinoderms, which he has studied for many years, and claims to have the finest collection of these animals in existence, made on the coasts from Greenland and Labrador to Mexico, and round Cape Horn to California. Since the publication, in 1848, of 'The Principles of Zoology,' by Agassiz and Gould (a copy of which is presented to the section), the Professor has ascertained that the system of tubes or water-pores, described at page 123, exists in all animals, which much vary their depths of water in the sea; and in the herring, they may be seen with the naked eye along the side of the neck. With reference to the removal of tallow from soundings, Dr. Hayes, the assayist for the State of Massachusets, stated to Capt. Anderson that heated turpentine poured amongst the soundings will remove all the tallow with it through filtering-paper; the operation should be twice repeated, and the residue finally washed with sulphuric ether.

The Boston Society of Natural History presented to the section, through Capt. Anderson, a copy of its proceedings for 1860, and expressed great willingness to interchange information and specimens.

Dr. J. Bacon presented a copy of his report upon the chemical composition and microscopical characters of the Pearl said to have been formed in the interior of a cocoa-nut at Singapore, in the possession of Frederick J. Bush, Esq., and exhibited by Dr. Winslow.*

Capt. Anderson, in a very able manner, gives the outline of a plan which has occurred to him for rendering available to science the services of commanders of merchant vessels and seamen generally, in collecting scientific information and specimens of natural history, for which they have such facilities in all parts of the world, for the use of those scientific institutions which may desire to join; and also with a view to elevate the mercantile marine of England in the social scale, by stimulating a taste for knowledge amongst seafaring men. The consent and co-operation of shipowners will, of course, be necessary; and Capt. Andersen seeks to obtain also the additional influence of merchants and scientific bodies. The subject met with the unanimous approval of the members present; and it was resolved that the portion of Capt. Andersen's letter relating to it should be published at the expense of the section, and circulated, for the purpose of eliciting opinions upon the feasibility of the scheme, and upon the best practical method of carrying it into execution.

Commander M. F. Maury, of the U. S. Navy, forwarded a copy of a letter from Lieut. John M. Brooke, the inventor of the detaching deep-sea-sounding apparatus, enclosing a number of soundings for the section, which were obtained with small twine and

* Page 290, vol. vii, 'Proceedings of the Boston Society of Natural History.'

spherical weights of about 70 lbs., which were detached and left at the bottom of the ocean. Lieut. Brooke observes, "that nine consecutive casts (soundings), varying from 2000 to 2900 fathoms, were made with the same piece of twine and detaching apparatus, which last weighed less than 1 lb. *As the specific gravity of a wet flax line is nearly that of water, a line that can be pulled down by a weight may be pulled up by hand, provided the weight be detached at the bottom.* One of the specimens obtained in 3030 fathoms, nearly 3½ miles, in the Pacific Ocean, is the greatest depth from which material has yet been brought up from the ocean bed. A few specimens were taken in shallow water on the east coast of Niphon, Japan, by Lieut. Brooke, during his boat voyage from Simoda to Hakodadi, in 1855, under the orders of Commander Rodgers.

Mr. Binney described to the section the appearance of certain nodules found in the middle of a seam of coal in the lower part of the Lancashire coal-field, which are composed of fossil wood associated with marine shells. Specimens of the former were exhibited to the members; the most perfect of which was that of Sagenaria, the old *Lepidodendron elegans*, in transverse, parallel, and tangential sections. The marine shells associated with the fossils belong to the genera Aviculopecten, Œthoceras, Nautilus, &c.

Mr. Brothers exhibited a section of pearl, *Isthmia nervosa*, infusoria, &c.

Mr. Whalley exhibited living Diatomaceæ from Southport.

Bedford Microscopical Society.

This Society was established some months ago, and based upon the plan of the Wakefield Society. For the advantage of any other societies about to be established, we forward the twelve rules which have been adopted, and found to be very simple. In the Wakefield Society the possession of a first-class achromatic instrument is a *sine quâ non* of membership; but in smaller towns it will probably be found desirable to dispense with this rule.

RULES.

1.—The Society shall be called the "Bedford Microscopical Society."

2.—The object of the Society shall be the cultivation of those branches of science which require the aid of a microscope.

3.—The election of members shall be by ballot, the candidate to be proposed at one meeting, and balloted for at the next; the election to be unanimous.

4.—Any member, unable to attend a meeting, may send his vote in writing to the Secretary.

5.—The number of members shall be limited to twelve.

6.—Meetings shall be held on the third Friday evening of every month, at the residence of each member in rotation. Tea to be provided by the member at whose house the meeting is held, which shall be placed on the table at six o'clock, and removed at seven precisely; the business of the meeting to close at half-past nine.

7.—The expenses of the Society shall be defrayed by equal contributions from each member as required.

8.—The business of the Society shall be managed by a secretary, who shall send out notices to each member, stating where the next meeting will be held, the subjects to be discussed, the names of any candidates to be proposed for membership, and the names of candidates to be balloted for. The secretary shall also keep a minute-book, in which shall be recorded the proceedings of each meeting of the Society.

9.—Each member shall be expected to bring his microscope to every meeting, together with any illustrations he may possess relative to the subject of inquiry for the evening.

10.—Notice of any proposed alteration in the rules shall be given at the previous meeting to that at which is to be discussed.

11.—The member at whose house the meeting is held may introduce friends for the evening.

12.—The member at whose house the meeting is held shall be president for the evening, shall choose the subject for investigation, and provide objects, lamps, &c., that may be necessary.

The following subjects have been investigated at successive meetings, namely, "Spiracles and Tracheæ of Insects;" "The Starches;" "Sections of Wood and Echinus Spines;" "The Ocelli of Insects." At one of the meetings an interesting specimen of a blighted kernel of wheat was exhibited. After being soaked for some hours in warm water and torn to pieces, a number of microscopic eels were seen coiled up in a membrane; after awhile the membrane burst, and the eels were observed to be moving about in a very lively manner. The subject for next month is "The *Cœnurus cerebralis*."

These microscopical reunions have not only been instructive, but also agreeable; and several visitors who have been invited have participated with the members in the advantages of the meetings.

West Kent Microscopical Society, Annual Meeting, *February 20th*, 1861.

John Flint South, Esq., F.L.S., President, of the Royal College of Surgeons, Vice-President, in the chair.

The Council's Report.—The Council of the West Kent Microscopical Society, in presenting this, their first annual report to the members, feel that they may with confidence congratulate them on the very satisfactory position which it now holds.

About a year and a half ago a few lovers of microscopical science proposed to form themselves into a society, in order to assist each other in the prosecution of their pursuits by mutual intercourse, aided by the collection of a library of reference, with the intention of holding their meetings in rotation at each other's houses. When, however, it became known that such a society was in course of formation, so many gentlemen expressed a wish to join it, that it became necessary to alter the original plan, and to find a room spacious enough to receive the increased number of members; and with this view the Blackheath Lecture Hall was engaged by the Council. So much interest has been taken in the objects of the society, that in the short period since its formation seventy-one gentlemen have had their names entered as members on its books.

The meetings have generally been well attended by the members and their friends. A considerable number of instruments, mostly of a superior class, have been supplied by the members, and the President has placed his large one, by Smith and Beck, at the disposal of the Council for the use of the Society. Some very interesting objects have been exhibited, and two papers have been read by gentlemen kindly introduced by the Vice-President. One of these was read by Sydney Jones, Esq., Lecturer on Anatomy at St. Thomas's Hospital, "On the Deposit of Silver in the Human Body, with microscopical illustrations;" the other by Thomas Howard Stewart, Esq., "On Echinida and Asteriada, illustrated by some beautiful drawings, dissections, and microscopical preparations," the conclusion of which has been, however, unavoidably deferred by Mr. Stewart's illness. A list of the different varieties of Diatomaceæ, found in this district during the past summer, was drawn up and read by Mr. Clift.

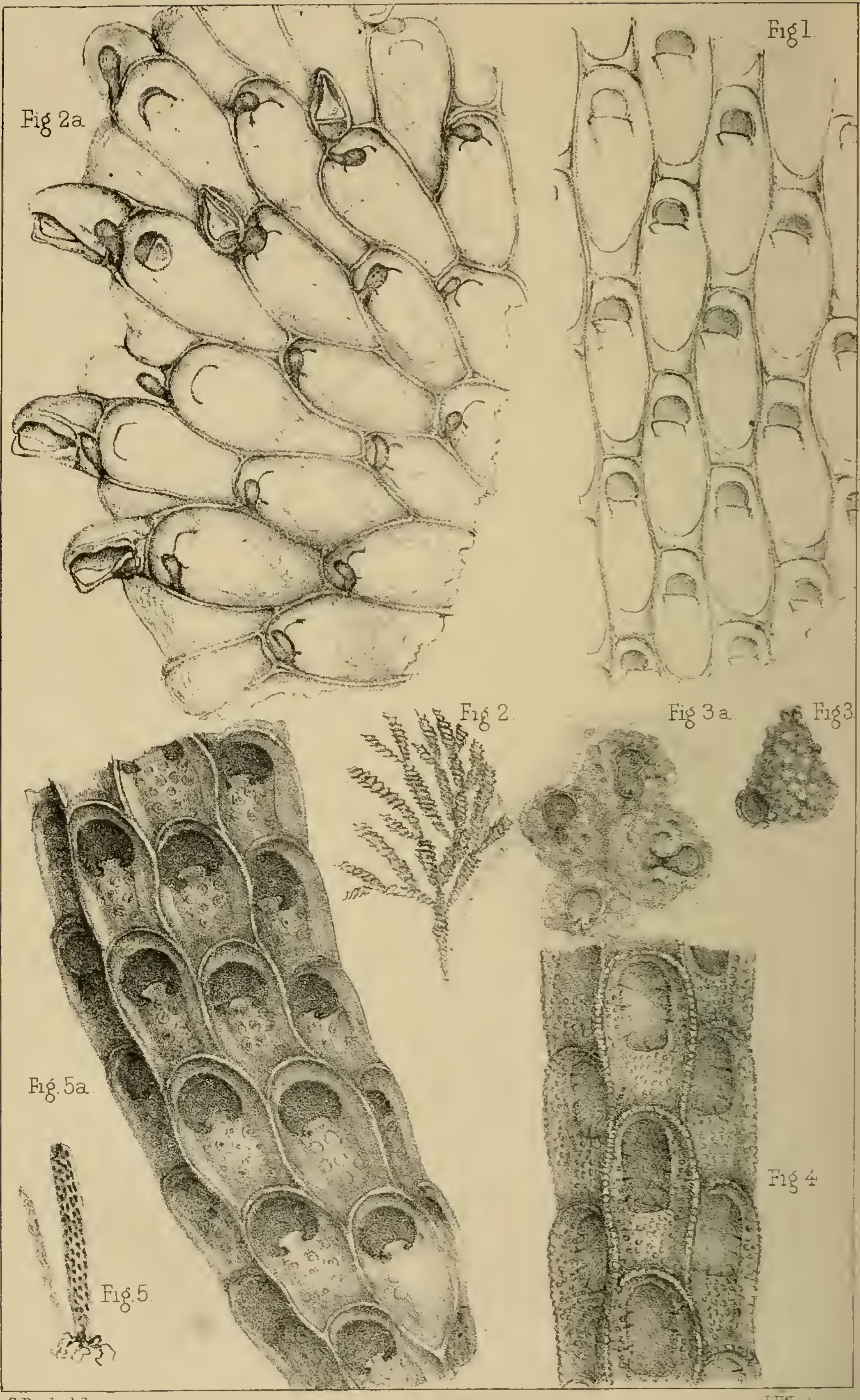
At the suggestion of several members, the Council engaged Dr. Lankester, in February, to deliver an address "On the Structure and Use of the Microscope." This meeting was very fully attended by members and their friends, and the address gave general satisfaction.

The Council, finding the Blackheath Lecture Hall by no means well adapted for their purpose, and learning that the proprietor had increased his charge for the use of it, determined to seek for accommodation elsewhere, and the Hall of the Mission School (in which the last few meetings have been held) having been very kindly offered, they at once availed themselves of it, and feel sure the members must rejoice at the change.

The Library.—The Council think they may report with especial satisfaction on the state of the library; for though of course as yet not extensive, it contains some very admirable works on microscopical science. They have received a few donations of books, and they recommend that the Secretary should subscribe to the Ray

Society for five of the past years; and by this means they have become possessed of some of the best works published by it. They hope that in the present year they may have funds at their disposal to enable them greatly to increase the library; and they would suggest to the members that, by donations of books on natural science, they will greatly aid the Society in carrying out its objects.

Plate XXXIV.



G Busk del.

W West imp.

ZOOPHYTOLOGY.

Descriptions *of* New *or imperfectly known* Polyzoa. No. 1.

1. Cheilostomata.

Fam. 1. Membraniporidæ, B.

Gen. 1. *Membranipora.* Blain.

1. *M. delicatissima,* n. sp. Pl. XXXIV, fig. 1.

M. membranacea, inermis; cellulis oblongis apertura permagna, ovali; margine tenui, lævi. Orificio semi-orbiculari.

Membranaceous, unarmed; cells oblong; aperture occupying almost the entire area—oval; margins thin, smooth; orifice semicircular.

Hab.—St. George's Sound, South Australia, on the fronds of *Amansia pinnatifida,* W. Harvey.

This delicate and elegant *Membranipora* appears to occur exclusively on the slender, ligulate fronds of *Amansia pinnatifida,* which we believe is rarely seen without its gauze-like parasitic covering.

Fam. 2. Flustridæ, D'Orb.

Gen. 2. *Spiralaria,* n.g.

Polyzoario ramoso; ramis cylindricis e lamina angustâ spiraliter contortâ constitutis. Cellulis ad faciem superiorem tantum spectantibus, marginalibus armatis.

Polyzoarium composed of short, cylindrical branches, attenuated at each extremity. The branches are constituted by a narrow lamina, twisted spirally round an imaginary axis, and having the openings of the cells on the upper surface only; the marginal cells armed with sessile avicularia.

1. *S. florea,* n. sp. Pl. XXXIV, fig. 2.

Hab.—Australia.

For this species, which is perhaps one of the most beautiful and curious of the Polyzoa, we are indebted to Mr. W. Flowers, of Croydon, whose name has suggested the specific appellation. He procured it from Australia. The light and feathery polyzoary is irregularly branched, and forms a tuft of an inch or two in height, the branches being from a quarter to three quarters of an inch or more in length, each articulated, as it were, to that from which it rises by a slender point of attachment. They are composed of a thin and narrow lamina, which is twisted spirally with the utmost regularity round an imaginary axis, and the outer or marginal cells each support a strong sessile avicularium, besides which are other avicularia scattered irregularly among the cells on the upper surface of the lamina.

The cells themselves (in *S. florea*) are irregularly oval in outline, and usually much attenuated below, and on the right-hand margin of each, close to the top, is a blunt, hollow, marginal spine, filled apparently with a granular material. No indication of ovicells is observable in the only specimen we have seen.

Fam. 3. CELLEPORIDÆ, B.

Gen. 3. *Cellepora.* O. Fab.

1. *C. edax*, B. Pl. XXXIV, figs. 3 and 3ª.

Polyzoario massivo, crasso, mamillato, conchæ parvæ turbinatæ formam gerente; cellulis ovatis, rhomboidalibus erectis seu subdecumbentibus, umbonatis, superficie scabrâ, puncturatâ. Ostio supra-arcuato, medium versùs constricto, utrinque denticulato, labio inferiori recto.

Polyzoarium forming a dense, thick, botryoidal mass, having the form of a small turbinate shell; cells ovate, rhomboidal, erect, or subdecumbent, umbonate; surface punctured, rough; mouth rounded above, contracted below, the middle, with a small denticle on each side; lower lip straight.

Hab.—Coast of Devon, on a small turrited shell. (*Fossil*) Coralline Crag, on a species of Natica and Turritella.

This curious and interesting Cellepore, which constitutes one of the links between the British Fauna of the period to which the Coralline Crag of Suffolk and Norfolk belongs and that of the present time, is described and figured in our 'Monograph of the Crag Polyzoa' from fossil specimens. We now give a figure taken from a recent Devonshire specimen, for the opportunity of inspecting which we are indebted to the kindness of the Rev. Mr. Hincks. The following observations occur in the work cited :—"This is a very peculiar and interesting form. The rather dense crust, which has a botryoidal aspect, appears to have been in all cases formed by superimposed layers of cells, covering, most usually, small, turbinate *Natica*-like shells, in most instances of the same species, but in other cases it invests a small *Turritella.* These specimens consequently are all much alike, resembling small, thick, univalve shells, with a comparatively small, circular mouth. But it is curious that it is extremely rare to find in these masses any remains of the original shell. In by far the greater number of instances this appears to have been entirely removed, the sides of the spiral canal being formed by the backs of the polyzoan cells, usually disposed in parallel rows, much as they are on the concave surface of some Lunulites. When any remains of the original shell are found, it appears to be reduced to extreme tenuity, and its outer surface to have been eaten away, as it were, by the parasitic incrustation."

The recent form presents the same aspect as the fossil, having been moulded apparently on a species of *Turritella*, which, and this is especially worthy of remark, is, so far as can be seen, as completely removed as it is in the fossil specimens.

Fam. 4. VINCULARIIDÆ, B.

Gen. 4. *Vincularia*. Defrance.

1. *V. ornata*, B. Pl. XXXIV, fig. 4.

V. ornata, B. 'Brit. Mus. Cat.,' Part I, p. 96, pl. lxv, fig. 2.

2. *V. neozelanica*, n. sp. Pl. XXXIV, figs. 5 and 5ª.

Polyzoario simplici per tubos radicales basi affixo; cellularum areis subpyriformibus; pariete anteriori perforato; marginibus lævibus; orificio supra arcuato, labio inferiori medio denticulato.

Polyzoarium simple, rooted at the base by radical tubes; areæ of cells sub-pyriform; anterior wall perforated; margins smooth; orifice arched above; lower lip with a broad central denticle.

Hab.—New Zealand, *Dr. Lyall.*

Two or three other recent species of Vincularia are noticed by M. D'Orbigny ('Voy. dans l'Amer. Merid.'), amongst which the only one with which either of the above could possibly be confounded is *Vincularia elegans*, which differs, however, from *V. neozelanica* in the absence of the median denticle on the lower lip, and of the pores in the front of the cell, as well as in its branched growth. M. D'Orbigny's *Cellaria ornata* is a *Salicornaria*, and otherwise quite distinct from *V. ornata*, mihi.

Fam. 5. FARCIMINARIIDÆ, B.

Gen. 5. *Farciminaria*, B.

1. *F. dichotoma*, v. Suhr. (sp.) Pl. XXXV, figs. 1 and 1ª.

Polyzoario dichotomo, ramulis cylindricis gracilibus; inermibus; cellulis clausis ventricosis; ostio prominente.

Polyzoarium regularly dichotomous, much branched; branches slender, cylindrical, unarmed; cells quite transparent and membranous; ventricose; orifice prominent.

Verrucularia dichotoma, v. Suhr, 'Flora,' 1834, p. 725, tab. i, fig 9, *a*, *a*.

Hab.—Port Philip (Australia), *Kirchenpauer.*

2. F. *Binderi.* Harvey? Pl. XXXV, figs. 2 and 2ᵃ.

Polyzoario irregulariter ramoso; ramis compressis, ligulatis, spinis sparsis, armatis; cellulis turgidis, membranaceis.

Polyzoarium irregularly branched; branches flattened, ligulate, furnished with scattered, horny, aculeate spines; cells bulging, wholly membranaceous.

Hab.—Sidney, *Harvey?*

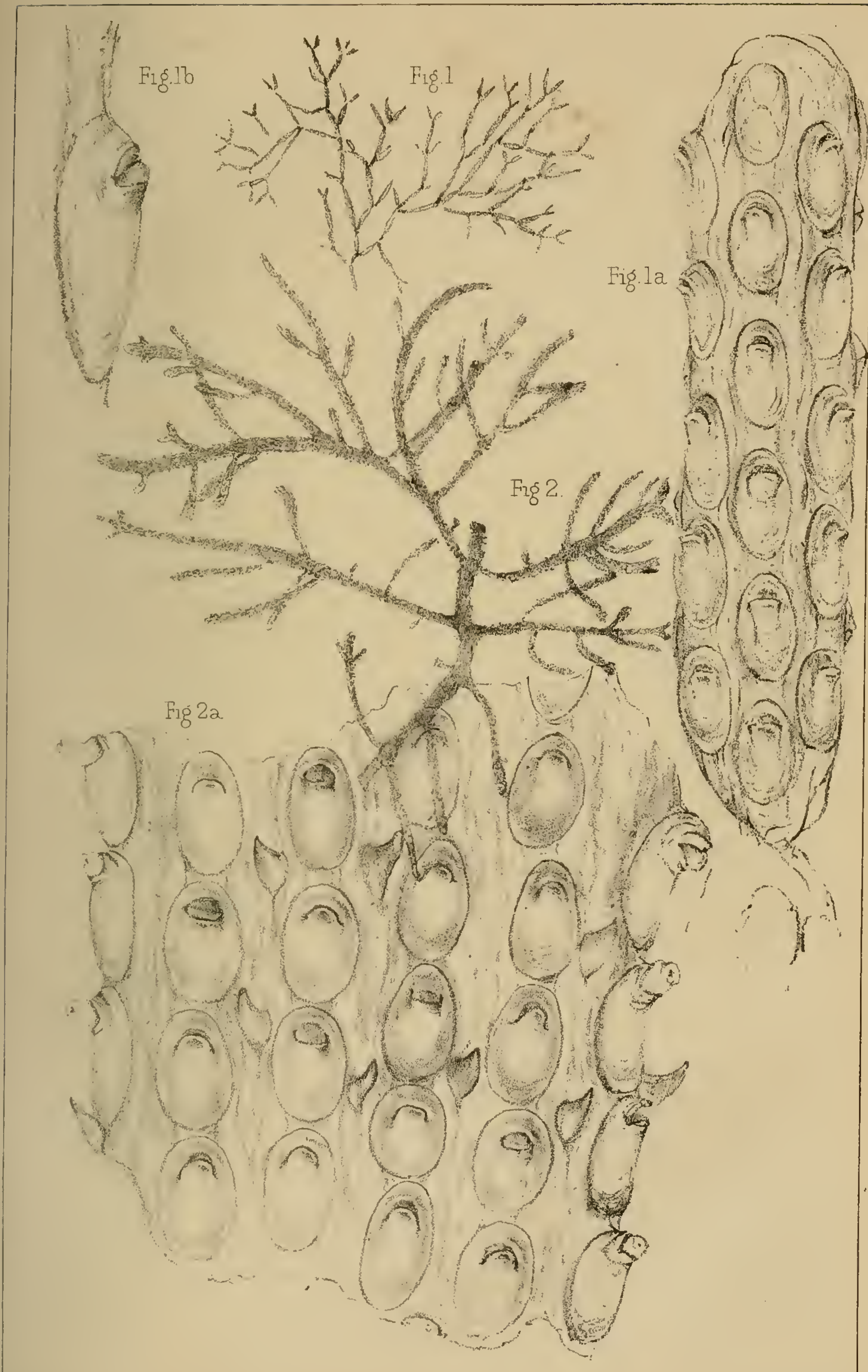
F. Binderi appears to attain a large size, spreading four or five inches in all directions, very irregularly branched, and of a deep-olive colour. The cells themselves closely resemble those of *F. dichotoma,* but the size, habit, and compression of the polyzoarium, whose branches are sometimes more than one-eighth of an inch wide, amply serve to distinguish the two at a glance.

The extraordinary resemblance to Fuci born by both these species is so very remarkable, especially in the case of *F. Binderi,* that by the unaided eye it would be almost impossible even to guess that they belonged to the animal kingdom. They appear, of all the Cheilostomata, to be those in which the tissue of the polyzoary contains the least amount of calcareous matter.

We have been long acquainted with *Farciminaria dichotoma,* though not aware till very recently that it had been anywhere described. Our knowledge of this fact and of the reference to v. Suhr's notice of it in the Ratisbon 'Flora,' as well as of the existence of the second species, we owe to the kindness of Senator Kirchenpauer, of Rützibüttel, who, among many other interesting species of Sertulariidæ and Polyzoa which he was good enough to send to us, included fine specimens of the two Farciminariæ now described. We have appended Dr. Harvey's name to *F. Binderi* on M. Kirchenpauer's authority, but are unable at present to cite the work in which that learned algologist has adverted to it.

It seems doubtful whether these two species should be referred to our genus *Farciminaria,* but we have thought it better provisionally at any rate to place them in it. Should it be thought advisable to separate them from *F. aculeata,* there appears to be no reason against the adoption of v. Suhr's name of *Verrucularia,* notwithstanding his having placed the genus among the Fuci.

Plate XXXV.



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ORIGINAL COMMUNICATIONS.

On the Diamorphosis *of* Lyngbya, Schizogonium, *and* Prasiola, *and their connection with the so-called* Palmellaceæ.* By J. Braxton Hicks, M.D. Lond., F.L.S., &c.

No one can doubt but that the present discussion on the origin and properties of species, will produce a marked benefit on the study of natural history. Already its influence has been considerable, and as the minds of naturalists more fully appreciate the points involved in the question, upon whichever side they may rally, the fruit it will produce will be much more abundant; probably beyond our present anticipations. And this effect will be exerted quite as much on the opponents of Darwin's theory, as on the supporters, not only by making them more careful to determine the amount of variation any species may permit, if it be really limited in this respect; but, also, it will urge them to the much more extended study of life-history. Thus, doubtless, many genera, and even families, will be erased, while the elevation of varieties into species will be much checked. Nothing shows the want of care in the two points here indicated more than the study of the lower forms of vegetation ; much has been done, but much yet remains; indeed, as I have already expressed myself, nearly the whole require revision by the study of their entire existence. So long as colour and size are held as specific, and even generic signs, while their diamorphoses are unnoticed, so long must the extreme confusion that meets one at every step, exist.

From what I have already brought forward regarding the passage of the gonidia of lichens into many genera of what had hitherto been classed as algæ, we might be prepared to expect that a similar condition might obtain in the gonidia of other

* It is to be noted that, when cell-formation or multiplication is alluded to, any theory as to the mode by which it takes place is not intended to be expressed. However, it may be remarked that abundant evidence exists to show that, in the subject of this paper, the presence of a nucleus is by no means necessary to the formation of a new cell.

tribes of lower vegetable life. This I have found to hold good in those to which I have more particularly directed my attention. How far upwards in the vegetable scale the gonidia-producing property is found, I cannot here say, but there is abundant evidence of its existence in mosses. Once gonidial segmentation having commenced, it may continue for an indefinite time, varying with external influences. Thus, surfaces of considerable extent may, by the continuous segmentation of the terrestial kinds, be covered with growths of cells, hitherto classed together as the Palmellaceæ.

Therefore it becomes of importance to determine what are the varieties and limits to this segmentation, and how the linear form of growth can arise from a single cell. This latter process is more difficult to decipher than the change from the linear into the single cell; but it is hoped that the observations which follow will tend to throw some light upon it. The facts brought forward below will, I hope, form an apology for so lengthened an introduction to the description of a single plant, inasmuch as the tracing the course of its development brings us to facts bearing on the principles of laws of growth and classification of the lower vegetable tribes.

The growths named in the heading of this communication, have been variously classed: the Lyngbya (Agardh) amongst the Oscillatoriaceæ; Schizogonium, or Bangia (Kützing), and Prasiola (Meneghini) as genera of Ulvaceæ. *Lyngbya muralis* is represented at fig. 1. In its active and normal mature form of growth, it distinctly shows a tubular sheath, of a diameter of about $\frac{1}{1100}$th of an inch, containing a number of cells, each with green contents, of a diameter of $\frac{1}{1200}$th part of an inch. These contents are generally granular, and in some conditions are disposed, as in many algæ, in bands of various forms, leaving colourless spaces between them (vacuoles) as at fig. 2. In other stages and conditions the cell-contents are homogeneous, and the septa of the cells are sometimes not placed directly transverse, but are more or less curved (fig. 3). Sometimes the contents are absent from one or more cells, either from injuries or other causes; the cells nearest these on either side form a rounded end, while the tube or sheath remains healthy. It is not unusual for such appearances to be present in many parts of one thread, sometimes more or less regularly intermittent. In various modes do these conditions vary, but, in all, the outermost cell, or even the last two, form rounded ends within the transparent sheath. Thus in many cases, especially where the cell has disappeared, Lyngbya seems to consist of a transparent tube containing a number of separated centres of growth. The diameter of the Lyngbya varies much even after it has assumed the mature appearance.

The formation of free gonidia from it, next claims interest. If we observe a batch of Lyngbya in its first appearance in spring, and also at other times, we shall find many of the threads throwing off from one extremity its terminal cells, which, relieved from pressure, become globular. Watching these, and carefully tracing their history by keeping them under continuous observation, I find that they undergo segmentation in the same manner as the so-called Palmellaceæ. I have represented the principal varieties of their subdivisions at fig. 4. It will be seen that this process assumes the same type as prevails in the gonidia of lichens, proceeding in various manners till, in some instances, the subdivisions are very minute. By means of this gonidial increase, considerable surfaces are covered with a palmeloid growth, and it has constituted one of the forms included under the term *Protococcus viridis;* and thus gives another example of the temporary nature of that order.

The mode by which these small cells assume the linear form of segmentation is as follows:—Generally after proceeding to their last stage, they assume an oval shape; a septum appears in the centre, and the divisions elongating form the first appearance of a thread. These two cells segment similarly in their centres, and thus a thread of many cells is produced (fig. 5). The contents are at first homogeneous, but at a very early stage they may become fasciated (as at fig. 6), or even with an apparent central nucleus (fig. 7). Sometimes the linear segmentation assumes a form very like the threads of a Nostoc (fig. 8). The length of the cells is very variable, depending upon the rapidity of the process of linear subdivision, compared with the rapidity of individual cell-growth. Sometimes the rate of the former is so much in excess that the cells are no thicker than the septa; the thread appearing to consist of alternate narrow green and colourless bands; again, sometimes the cells are three or four times longer than broad. All these various stages can be viewed at one time in different threads in such a gentle gradation as to point unmistakeably to their common origin; but, perhaps, the most powerful confirmation is, that they may occur simultaneously in the same thread.

The method above described is probably that by which all the algæ revert from the segmenting gonidial to the linear forms.

Let us now recur to the mature thread of *Lyngbya muralis.* In certain circumstances there is a strong tendency for the cell-division to extend laterally instead of linearly, so that the thread is seen dividing, as it were, into two, though still united by a transparent colourless substance, of the same nature as that of the septa. This may take place either equally throughout the whole length, or at one end first, and then gradually extend to the whole, so that the different stages can be seen at one time (fig. 9). After a time the secondary threads pass through the same change, so as to produce a band of four rows of cells; often, indeed, before the secondary rows are fully formed the commencement of their lateral segmentation is discernible (fig. 10). By the continuation of this process a band is formed, consisting of numerous rows of cells, more or less parallel, betraying, however, the peculiarity of the lyngbya-thread in the tendency to the rounding of the ends, which is observed very curiously sometimes at any point of injury (fig. 11). Sooner or later the process of sub-division assumes the quaternary form, or its multiples, and thus we have groups of 4, 8, 16, &c., indicated on the frond, by a rather broader line of intercellular substance (fig. 13). Yet, even in this state there is a general tendency to mark the original linear origin of the frond; though this is by no means constant, the quaternary, &c., form of segmentation overcoming it, so that the interspaces in some specimens are of uniform width throughout, and sometimes so narrow as to be almost imperceptible.

It is seldom that the quaternary segmentation occurs with equal rapidity throughout the band; but more particularly at one end, whereby a fan-shaped frond is produced, which, by the great rapidity and irregularity of the process, becomes waved and crumpled. Should any part be arrested in growth, then the other portion curls round so as to fill up the vacant space, producing somewhat of a radiate disposition of the cells (fig. 12). The rapid origin of a frond of 1 to 3 inches in breadth, from a thread $\frac{1}{1200}$th of an inch in diameter, is easily explained, when it is remembered that every cell in it undergoes continual segmentation in geometric ratio.

The condition of the cell-contents varies throughout the whole of these stages. As I have mentioned before in Lyngbya they are granular, possessing a few of the chlorophyle utricles (Naegele) in each cell; but as they tend towards lateral segmentation they become more homogeneous, which is generally continued through the whole period of growth of the frond. This, however, is not necessarily so, for the contents in a part, or throughout the whole, may be decidedly granular, as is shown at fig. 15.

After a certain time, and along one or more of the outer edges of the wavy frond, the cells, by the solution of the intercellular substance, become free, still preserving the tendency to segment, so that by generating the binary or quaternary form, they pass through changes which belong to the gonidia derived from the linear form (Lyngbya), and, like them, form one of the groups, classed hitherto as Palmellaceæ (fig 12 *a*). In some of them the cell-wall is well marked, the contents arranging themselves in a crucial manner, apparently indicating the future segmentation (fig. 12 *b*). Whether these revert through minute subdivision to the linear form, as I have already described in the Lyngbya (fig. 4 *a*), I am not able to say; but in their maturity they have a very strong tendency to undergo the linear form of segmentation—at fig. 14 the cells about to become free are shown in this state; some are already free and proceeding on to Lyngbya rapidly, while others are still attached to the margin of the frond. But this condition is not confined to its edge. I have seen the whole of the cells of a large portion still in position, having taken on this action to the extent of four or five cells. Considerable variety is shown in this process, and it is seldom that one part of every frond does not show some indication of it. That these threads pass to Lyngbya can be observed very readily.

Thus it will be remarked that a constant struggle is going on between the linear and lateral mode of growth; and between either of these, and the gonidial, with its changes; the balance seeming to be always uncertainly suspended between them. This power of the cells of the wavy frond to assume the linear growth should be compared with the similar condition seen in the cells of the Lyngbya, which I have drawn at fig. 16, under various aspects. The gonidia remaining within the tube, but more or less distinct from each other, have changed in precisely the same manner as shown at fig. 14.

There are some other conditions of the growth of the cells of Lyngbya, shown at fig. 17. The state indicated at *a* appears to be similar to mother-cells; the large green cell becomes free, and, I believe, gives rise to numerous small cells. In fig. 17 *b* the gonidia have segmented, and each division has increased, possibly to form mother-cells. Thus I have pointed out a series of existences:

1. The mature Lyngbya.
2. Its gonidia and their segmentation.
3. Their recurrence to Lyngbya.
4. The lateral segmentation of the cell of Lyngbya, in part or wholly, passing ultimately to the formation of broad,

wavy fronds, the cells being held together by colourless intercellular substance.

5. The formation of gonidia from these fronds, and their segmentation.

6. The assumption of linear growth by these cells.

The whole of these changes are so palpable, can be observed so constantly, and are, at the same time, so simple in their relations to one another, that one can scarcely imagine how they can have been separated, not only into distinct species but into different families of algæ. Thus the linear stage is called Lyngbya; the early stage of collateral segmentation, the Schizogonium; the adult stage, Prasiola; while the gonidial growth has been classed under Palmellaceæ. And this has been done by most algologists. Meyen, indeed, had pointed out a connection between them;* but his opinions were denied by Jessen,† and ignored by most others. It is a striking instance of the insuperable tendency of some to look upon every distinct form as a separate species.

And this tendency has in itself a power of checking further research; for as it is assumed at starting that a given form has unalterable limits, or only a definite amount of variation, of necessity all other forms exceeding those limits are excluded without compromise, and without inquiry beyond; and hence it is that life-history, and laws of variation, are frequently neglected. So easy a plan is it of surmounting the difficulties which necessarily attend such studies, that one perhaps ought not to be astonished at its prevalence; however, there can be no doubt but that it has tended very much to the confusion now existing in the simpler classes of life. Had the attention hitherto given to the multiplication of species been devoted to the study of the life-changes, the state of our knowledge on such points would have been very different to what it now is.

That these remarks may not seem out of place, and to show how unphilosophical has been the arrangement of the algæ mentioned in the heading of this paper, I adduce the following.

The characters are stated to be of—

Lyngbya.—Filaments elongated, simple, distinctly articulated (intus laxe annulata, Agardh and Lyngb.); with a distinct cellulose tube, giving off gonidia (motionless spores), capable of dividing laterally into a small expansion, by double or quadruple series (Jessen, Meyen).

* Meyen, 'Linnæa,' 1827, ii, p. 388.
† Jessen, 'Prasiolæ Monograph Kiliæ,' 1848, p. 19.

Schizogonium.—When young, filaments simple articulated, with a distinct tube. The cells subsequently by collateral subdivision, produce two, four, or eight parallel rows, formed of a single layer of cells, arranged in simple or compound lines.

Prasiola.—Fronds either filiform, formed of a single layer of cells arranged in simple lines; or membranous, formed of cells arranged in compound lines, or in groups multiple of four. Spores (gonidia) formed of the whole contents of the cells, motionless.

The only real difference between the first two is, that whereas Lyngbya is a tube containing distinct cells within, which, when old, undergo collateral subdivision, to form a band of two, four, or eight rows of cells; Schizogonium is a band of two or eight rows of cells, which when young was but a single row, contained in a tube; which is only two different ways of stating the same facts. The comparison of the last two is of the same kind. For as Prasiola, when old, is composed of many rows of cells, but which arose from a single row, there must have been a time in its life when it had two, four, or eight rows, and thus have been a Schizogonium, for there is no other structural difference between the two.

Besides, if it be granted that collateral subdivision could extend to two, four, or eight rows, why should it not be admitted, that it could by the same power, go on beyond that limit? what is there in our knowledge of cell-multiplication to form any obstacle to the supervention of quaternary subdivision, or any multiple of it, upon a binary form.

The distinctions between Prasiola and Ulva, as insisted upon by Jessen, are equally unstable, both in regard to the regularity of the areas and lines of cells; as well as to the homogeneousness of their contents. Not only may be seen in Prasiola every variety of form and arrangement of the cells, but sometimes the cells are so close to each other as to obliterate both intercellular lines and the distinction of areas produced by the kind of segmentation. I have seen the cells of Prasiola "granulated"* throughout the whole frond, as before mentioned (fig. 15), and in the cells which are about to be set free (gonidial spores). I have, at fig. 12 *c*, shown that they possess a central nucleus. The only difference that seems for the present established between Prasiola and Ulva is, the formation of zoospores in Ulva, and their mode of escape by means of openings in, and not by solution of, the intercellular substance.

* *Ulvarum* cellulæ *granulatæ; Prasiolarum* blastemate *homogenea* repletæ. Jessen, op. cit., p. 10.

I have not been able yet to observe the formation of zoospores in the Prasiola derived from *Lyngbya muralis:* still future research may be more successful. It might be a question, upon which it would be out of place to enter here, whether the formation of zoospores be a sufficient generic sign, or rather, if it should not be considered a non-essential variety of vegetative growth.

The relation of Lyngbya and Prasiola to the Palmellaceæ, by means of the gonidia and their changes, I have already pointed out; and I shall only mention that Meyen's paper* seems to have had no effect in leading to the study of the history of these simple organisms. Jessen even remarks, that if Prasiola produces *Protococcus viridus,* "*Protococcus viridus* in Prasiolam certe transit." The remarks of Itzigsohn upon some forms of these simple cells, and their relations to the lichens, have produced no effect in this country, but I hope these remarks, with those I have already brought forward in this Journal, and others I have yet to bring forward, will lead to their further study.

Thus it seems that we cannot but conclude that *Lyngbya muralis,* Schizogonium, and Prasiola, are but different stages of the same organism, which, with the segmentation of their gonidia into the Palmelloid cells, form a cycle of phases, each of which has a powerful tendency to recur in shorter cycles to the form which preceded it.

This leads one to the interesting question, which is the most perfect condition in the chain?

This can scarcely be answered till we know in what relation it stands to other plants. Is it an independent growth, or has it another origin yet unsuspected? And if we decide in favour of the former we may, I think, very reasonably ask—are there any other links to the chain? For as yet we have no sexual stage. If we conslder carefully the mode of growth we shall see there is really very little difference between any of them; the essence of all being the segmentation of the cells, linearly in Lyngbya; collaterally, and held together by cellulose in Schizogonium and Prasiola; while it is free in the gonidia. If the same processes be compared with that of the gonidia of the Lichens, shown in this Journal,* there is nothing in them that may not be included within the varieties of gonidial segmentation. Not that by these remarks I am asserting it is not a separate existence, but there seems to me to be an equal probability of its being a gonidial stage or stages. At

* 'Die Metamorphose des Protococcus viridis in Priestleya votryoides und Ulva terrestris.' 'Linnæa,' 1827.

† 'Microscopical Journal,' Nov., 1860; January and April, 1861.

all events there is nothing in it that would prevent our accepting any direct evidence on this point.

Many of those organisms, whose sexual condition is apparently wanting, must be judged of according to the number and kind of stages they are capable of passing through; in other words, according to its whole life-history, rather than by any one portion, however enlarged or apparently complicated it may be, or however persistent: for in these lower forms of vegetable life the duration of any one of the stages seems indefinite, and dependent upon outer circumstances.

In the growth of Lyngbya, here described, there are many points bearing on variation of size, and, indeed, upon the apparent essentials, not only of species, but of genera.

If we gather specimens from numerous localities, perhaps the first thing that will strike us is the variable condition of the width of the whole thread, as also of the cells individually. We shall find these differ remarkably, not only in specimens from different parts, but amongst threads of the same specimen; and, further, in different portions of the same thread. It is this latter fact which gives complete evidence of the common origin of the different forms.

The difference between specimens from different parts is sometimes so uniform, that one might at first sight be inclined to regard them as different species; yet a little care will seldom fail to supply all the gradations of growth, and in so uninterrupted a chain that there can be no doubt that they are but one form, the different ages of which will easily account for the variation of size. The same remarks will apply to the appearance of the cell-contents.

Thus, two specimens, taken from different localities in different stages, would undoubtedly be ranked as distinct species, if the specific distinctions employed by some algologists were observed. For instance, look at the growing stages of Lyngbya shown in figs. 5—8. In some the contents are homogeneous, in some granular, in some nucleated in the centre. These points cannot, therefore, be considered as of any specific value. Again, let any one refer to Kützing's and Hassal's genus Oscillatoria. What distinction is there besides that of size, and some slight variations in colour, between their numerous species? The whole question of size between these so-called species rests upon age, rapidity of growth, or external circumstances.

The relation of the length of each cell to their width depends merely upon the rapidity of linear segmentation, compared with the individual cell-growth. Thus, that a mass from one locality should vary in size from that from another is nothing more than would *à priori* have been expected; and it will be found actually to be so: the external conditions and position seem very distinctly to regulate the state of the plant.

The innate tendency of any one form to continue and to multiply in that form is well shown in all stages of this plant; whether in the free segmenting gonidial stage, in the early, half-grown, or mature linear, or later on in any stage of the collateral mode. Of this fact proofs may be obtained in every specimen. This property, probably, is possessed by most, if not all, the lower algæ; and it is this which has doubtless tended to divide into distinct species and genera forms which should have been but the links of a single chain. And the knowledge of this should have a strong influence on our manner of studying these lower forms.

Notwithstanding that this tendency is frequently observed, there is no doubt but that, the circumstances under which the plant is placed altering, a change of the kind of growth may be readily induced in it, which again will continue till other disturbing influences affect it.

In regard to the lower forms of life it may with good reason be asked, "What, then, is a species?" Before an answer can be given, another question must be answered—"Through what cycles of variation in form, colour, and mode of growth, can an organism pass?" The study of the entire life-history is the only means towards its solution of the value of "species."

On CHANGES *in the* PROPERTIES *of the* RED CORPUSCLES *of* HUMAN BLOOD *in relation to* FEVER. By WILLIAM ADDISON, M.D., F.R.S.

ALL animal secretions are produced by the agency of cells or cellular-bodies.

To establish this proposition it is not necessary to discuss the merits of the Cell Theory, to inquire whether the predominant force which determines secretion resides in the membrane, the nucleus, or granulous contents of the cell. It is sufficient, if cells or cellular bodies be absent, that secretion, and necessarily the qualities which individualize secretion, are absent too.

It has been declared upon authority that, "Epidemic, endemic, and contagious diseases are those in which the blood is, probably, in the greater number of them the primary seat of disease; and they are considered the result of specific poisons of organic origin, either derived from without or generated within the body."—*Hippocrates, Sydenham, Sprengel, Villermé, Williams, Liebig, Ozanam.* 'Registration of the Causes of Death,' General Register Office, 1843.

The smallpox disease is a contagious fever. It may arise in a healthy person from inoculation of the smallpox virus; also from inhaling an infectious atmosphere. In whichever of these ways the disease is communicated, numerous pustules appear on the body, each containing a secretion of contagious quality, viz., the smallpox virus. This secretion must have its origin in some cell-agency; the question is, to what class of cells it is to be ascribed.

Liebig's hypothesis respecting the actions which succeed the introduction of the smallpox virus into the blood is well known; he speaks of *particles* of blood undergoing transformation, but he does not specify them.

First,—As respects inoculation. A quantity of matter so small that it may be borne on a pin's point is sufficient to establish the disease. But this small quantity cannot well be supposed sufficient to infect the whole of the fluid part of the blood—the *liquor sanguinis.* Granting it is sufficient; still the main phenomenon—the reproduction of the virus—would have to be accounted for. It is not the diffusion of the virus used, it is the regeneration of it a myriad-fold which is in discussion.

It may be said the new virus is formed in the pustules; but the person suffers illness, general distress, and fever, before the pustules appear—before they contain any virus. Moreover, it is admitted that the primary seat of the disease is in the blood.

Colourless corpuscles, or white cells, exist in the blood in a comparatively very small number—too few, it would seem, to account for the very large reproduction of the smallpox virus; and in states of disease where the number of these white corpuscles has been enormously increased, the symptoms are not those of fever.

Dismissing then the liquor sanguinis, because the question entertained is the reproduction of the smallpox virus—a secretion which requires cellular action; dismissing also the cells of the pustules, because the inquiry has reference to some determinate action in the blood; and lastly, deeming the white cells of the blood too few in number to account for the large amount of reproduced virus,—we proceed to discuss the properties and circumstances of the red corpuscles of blood. And here the number of special particles corresponds with the usual severity of the disease, and with the large amount of virus reproduced. The red corpuscles exist in blood in countless millions.

For inoculation to succeed, the inserted virus must come into contact with some of the red corpuscles of blood. The point of the instrument bearing the virus must open some vessel circulating blood. On the other hand, in all examples of punctured wounds with a poisoned instrument, the probability of infection is diminished, if the flow of blood from the wound be copious. If little or no blood be lost, infection is more sure. Sucking a poisoned wound seems, on many occasions, to have prevented blood-infection. That is to say, if all the blood-corpuscles which have had contact with the inserted virus flow or are drawn away, blood-infection does not follow; but if some of them, infected by contact with the virus, continue in circulation, they carry infection with them, and communicate abnormal action to the rest of the corpuscles by contact. Some explanation of this kind may be provisionally admitted,—its value to be determined when the other facts of the inquiry have been discussed.

Secondly,—As respects an infectious atmosphere. In the lungs the corpuscles of blood come into contact with air, and with the substances in solution in the air. The change of colour which blood experiences in the lungs is from action in the red corpuscles.

In acute pneumonia the interchange between the red corpuscles of blood and elements of air is interrupted, and the symptoms are general distress, exalted temperature, quickened pulse, thirst, and delirium. The same symptoms are features of smallpox fever. And if, in two different disorders, a class of symptoms can, in one of them, be traced to a particular element of blood, it is an argument that the same element of blood stands in close relation with the same symptoms in the other.

The red corpuscles of blood are not all equally affected upon contact with injurious substances.

When observed with the microscope in contact with extraneous fluids, some of them are seen much more altered in outline and appearance than others, and some resist change altogether.

If corpuscles of blood from the same person differ in susceptibility, those of different persons must differ to the same, probably to a greater, extent.

In correspondence with this inference, it is well known that a number of persons may be inoculated with a poison, or breathe at the same time an infectious atmosphere, but only a few of them may take the specific or epidemic disease. The outbreak of smallpox fever in a particular individual is dependent not upon what is in the air, nor upon the quantity of virus inoculated, but upon some action in the blood which the poison induces. If, upon breathing an infectious air, or upon inoculation of a poison, no fever follows, the fact is explained if the blood has resisted the poison. When a poison fails to affect the person, it must have failed to affect the blood. In smallpox, should the attack be slight, the result would be so, if a majority of the elements of the blood have resisted or escaped contagious action; greater or less severity in the symptoms denoting differences in the amount of action in the blood.

We are not compelled to conclude that smallpox virus exists in the air when the disease occurs sporadically. On the contrary, the presumption is, that the aërial miasm, the action in the blood, and the matter of the pustules, are three distinct things.

There is, then, nothing in the history of smallpox incompatible with the proposition that the red corpuscles of blood are influential elements of the fever which precedes and accompanies the regeneration of the smallpox virus.

The necessity of distinguishing in pathology the fluid from the corpuscles of blood is insisted upon, because diseases of unwholesome diet are forms of local inflammation which commence and go on without fever, viz., gout, scurvy, diarrhœa, and eruptions; whereas, *diseases* of unwholesome air are *always* fevers.

All the cellular or parenchymatous elements of the body, including the corpuscles of blood, have in various degrees properties of resistance; and if, from unwholesome diet, medicine, or poisons, local effects appear before or without fever, it is because parenchymatous elements of the coats of the vessels of the affected part are influenced by change in the liquor sanguinis before the corpuscles of the blood. The weakest resistance is the soonest overcome.* But let us continue the discussion with reference to other contagious fevers.

It must be conceded that the corpuscles of blood may be

* 'Gulstonian Lectures,' 1859.

injured by contact with hurtful substances; and there are four ways or avenues by which such contact may be accomplished, viz. inoculation, respiration, circulation, and immersion in a morbid liquor sanguinis.

First, of Inoculation.—In all cases of punctured wounds, where poisonous matter is introduced into and takes effect upon the blood, forms of fever are primary, and forms of inflammation and abscess (away from the puncture) secondary results. The examples are *smallpox,* already discussed, and *traumatic fever.*

Secondly, of Respiration.—There is a special intercommunion in the lungs between elements of the air and the red corpuscles of blood; and the atmosphere is the most usual vehicle, or avenue, of fever. In all examples where a poisonous miasm in the air takes effect upon the blood through the lungs, forms of fever arise. The prominent examples in this climate are, smallpox, *scarlet-fever,* and *typhus.*

Thirdly, of Circulation.—When blood traverses places of unhealthy or degenerating disease, whether of joints, bones, or lungs—the wound of the parturient womb occasioned by separation of the placenta, or chronic ulcers in the mucous membrane of the bowel, from severe distress and privations—in all such cases the corpuscles of blood are exposed to injury from contact with putrid or poisonous matter, when passing through the diseased textures; and in all such cases forms of fever, more or less intense, are apt to arise—*hectic, puerperal, typhoid,* and *traumatic* fevers.

"Simple fever, as well as rheumatic and typhus fever, are associated with necrosis of bone; and are made to appear, as they are often supposed to be, the cause of the bone disease, instead of being regarded as the constitutional effects of the local disorder. . . . In the case I have related, the fever was at first supposed to be rheumatic, then it was regarded as typhus; but suppuration at the shoulder-joint, and the protrusion of necrosed bone, declared the true nature of the case." ("Clinical Lectures," Mr. F. Le Gros Clark, 'Medical Times,' 1861.)

"In fatal cases of ovariotomy the symptoms and condition of the patient resembled those observed in puerperal fever." (Dr. Graily Hewett, *ibid.*, 1861.)

We are not prepared with any microscopical evidence demonstrative of change in the corpuscles of blood in consequence of their passing through the vessels of diseased or damaged textures; but the absence of direct proof has not much weight against the argument, when we call to mind in all cellular bodies, which have not spontaneous movement, how impossible it is to judge by the eye of change of properties—of relative vigour or weakness, or even between life and death. But generally, as respects the association of symptoms of fever with some changed action in the red corpuscles, peculiarities in the colour of the blood (which can have arisen only from some change in the corpuscles) have been observed upon by writers on epidemic fever in all parts of the world.

Fourthly, of the Liquor Sanguinis.—In the last paper (p. 85) prominence was given to the fact that the elementary particles, or cells of different organs, have peculiar susceptibilities, whereby, of substances in solution in the liquor sanguinis, some affect specially one organ, others another organ. Mercury, opium, prussiate of potass, and several saline and vegetable solutions were brought forward as examples in point. As it is with medicines and poisons, so also with unwholesome substances taken as food; these, also, often have a local sphere of disturbance. An unwholesome but full diet occasions gout; an unwholesome but deficient diet gives rise to diarrhœa, dysentery, and scurvy. Gout, scurvy, and contagious fever are all reputed blood-diseases. But how different the phenomena! Neither gout, nor scurvy, nor diarrhœa, commence with symptoms of fever; nor do they entail the generation of a contagious virus. The explanation is, that an unwholesome diet acts first upon the liquor sanguinis. Substances taken as food impart their qualities to the fluid of the blood, and affect some local part before disturbing the normal action of the corpuscles of blood.

But the corpuscles of blood are in contact with the liquor sanguinis—they swim in it; and, though exercising a measure of resistance against injurious matter in solution in the fluid, the resistance is but limited; and when the limit has been reached—when the special susceptibility of the corpuscles becomes implicated—symptoms of fever appear. By thus keeping in view the distinction between the fluid and corpuscles of blood, we can suggest a reason why symptoms of fever supervene on disorders of diet—gout, scurvy, diarrhœa, eruptions, &c.; viz., because morbid qualities of the liquor sanguinis, first proclaimed by local disease, may at length affect the normal action of the corpuscles of the blood.

Also, it enables us to understand why forms of inflammation are superadded to fevers, viz., because the corpuscles of blood are excreting bodies, and morbid matter thrown off from them must disturb the quality of the fluid into which it passes, and altered qualities in the liquor sanguinis are causes of local inflammation.

The several ways, then, by which injurious matter may come into contact with the corpuscles of blood are all ways or avenues of fever.

Lastly,—There are some fluids which, when mingled with the liquor sanguinis, and brought into contact with the red corpuscles, cause these bodies to exude or eject matter that may be either prolonged into tails or float away from the corpuscles as molecular particles insoluble in the liquor sanguinis (*vide* experiments, p. 22, ante). In these experiments the liquor sanguinis is visibly disturbed by an action of the corpuscles. Should any action of this sort take place in the living body, any kind of matter be discharged from the corpuscles into the liquor sanguinis, and be insoluble in it, such matter must appear in the fluid as minute particles; any other form would be incompatible with the force and rapidity of the circulation.

In blood drawn by venesection from persons labouring under fever, we have seen with the microscope multitudes of molecular particles swimming in the liquor sanguinis. Two cases have been published in the 'London Medical Gazette,' 1841 and 1842, vol. ii.

It is impossible to say whether or not, molecular particles seen in the fluid of blood withdrawn from the living body, in cases of fever, come from the red corpuscles; but the behaviour of these corpuscles under the influence of certain fluids is evidence upon the point not to be overlooked.

We have said that inoculation of a poison, or a miasm of the air inhaled by the lungs, may or may not produce contagious fever; so likewise it is not every unhealthy or putrid wound, nor every degraded liquor sanguinis, that is followed by fever; and conditions which may or may not be followed by the sequent cannot be raised to the rank of antecedent. The ways by which poisons reach the blood, then, are not the antecedents of fever. The true antecedent of contagious fever must be some element of the living body; it must be of the cellular class,—of universal distribution,—and have, in a measure, properties of resistance against injurious agents. All these requirements are combined in the red corpuscles of the blood.

If we review the ways by which poisons may reach the corpuscles of blood, in other words, the avenues of fever, we shall find they may be resolved into two categories. For fever from inoculation, or from respiring a poisonous atmosphere, may occur to persons previously in good health; whereas fever occasioned by the circulation of blood through unhealthy wounds or ulcerations, or from a morbid liquor sanguinis, implies that the person, before symptoms of fever appear, is already the subject of disease. In the former examples the conditions are independent of, in the latter they are a part of the person; and as all contagious fevers observe certain times and stages, indicative of cellular action, so it is to be expected that these periods would be more marked and regular in fevers of the first class—which arise from things without, and where the patient has only the fever and its concomitants to overcome—than in fevers of the second class, which arise from things within the person, and where he has a previous disease and the fever, with its effects, to battle with. Smallpox, scarlet-fever, and typhus are more regular in their phenomena than hectic, puerperal, traumatic, and typhoid fevers; a consequence, it would seem, of the conditions upon which a proposed classification of fevers is founded.

If the proposition, that the red corpuscles of blood are special elements of fever be established, it would seem to follow that fever, from whatever source, may generate a contagious virus,—that is to say: fever from the circulation of blood through places of unhealthy local disease in one person, may originate fever in a healthy person by inoculation, or infection through the air; in other words, a fever of the second class may generate a fever of the first class. This is in correspondence with the facts, that fever (a *typhoid* fever) supervening on chronic diarrhœa, dysentery, or scurvy, occasions *typhus* in the healthy attendants on the sick; that traumatic or erysipelatous fever may give rise to puerperal fever, and that puerperal fever may be propagated amongst puerperal women.

Let us give some illustrations. In overcrowded habitations when distress or famine prevails, chronic diarrhœa, dysentery, scurvy, and other diseases from impoverished and unwholesome living, abound. The anatomical lesion of chronic diarrhœa and dysentery is ulceration in the mucous membrane of the bowel.

Under such circumstances, it is very usual for forms of fever to make their appearance amongst the sick; and if no epidemic atmosphere be present the first case of fever must be referred to the circulation of blood through the degenerating local lesions; that is to say, the avenue of fever is within the person; it is fever of the second class, and the stages or periods will probably be ill-marked and uncertain.

But if subsequently, and as a consequent of the first case of fever, fever makes its appearance among the healthy attendants upon the sick—then this second case of fever differs materially from the first case. It has arisen not from the circulation of blood through places of local disease, not by an avenue within the person, but from without; some form of inoculation, or from inhaling an atmosphere rendered poisonous by the first case of fever. This, therefore, is a fever of the first class; and the person, prior to the fever, being in good health, its stages and periods we may expect will be better marked, and its issue the more hopeful.

Again, a powerful mental shock, or some other accident, may be productive of unhealthy action in the recent wound of the parturient uterus; the discharges are offensive, and puerperal fever may follow from blood circulating through places of degenerating anatomical lesion. Upon the same principle as before, this we should consider as a fever of the second class, *complexioned* by the puerperal state. But should another case of puerperal fever follow in the same building or locality, as a consequence of the first case, this would arise not through blood infection from a prior lesion within the person, but from inoculation or through the air. The latter case would differ, therefore, in an important particular from the first case, and we should consider it under the first category.

Upon the whole subject, then, phenomena of contagious fevers corroborate the proposition in discussion. To distinguish a pathology of the fluid from disease of the corpuscles of blood, is warranted by their very different properties. It recognises the relation of the blood-corpuscles to other cellular bodies, and is a means of interpreting some of the difficulties which appertain to the consideration of blood-diseases. It gives us a clearer view of the domain of therapeutics, because it is applicable in explanation of the action of food and air—medicines and poisons upon the blood.

To recapitulate: Substances taken into the stomach—diet, medicines, and poisons—communicate their qualities to the fluid of the blood. Air, and miasms in solution in the air, affect specially the red corpuscles of the blood. Gout, scurvy, diarrhœa, eruptions, and other local inflammatory disorders without fever, occasioned by unwholesome diet, arise from changes in the quality of the fluid of the blood.

Fevers consequent upon inhaling an infectious atmosphere upon inoculation or contagion, arise from injury to the corpuscles of the blood.

Symptoms of fever are superadded to diseases of unwholesome diet when morbid qualities of the liquor sanguinis, pronounced at first by local inflammation, implicate the corpuscles of blood.

Forms of inflammation are superadded to fever, because reaction or counterworking in the corpuscles of blood, which are cellular excreting bodies, must disturb the qualities of the fluid in which they swim, and into which the morbid matter they throw off must pass.

The conclusion is that:—The generation of contagious poisons in the blood arises from reaction in the corpuscles of blood against injurious agents.

The argument and conclusion of the preceding paper are grounded on microscopical observations, therefore its publication in the pages of the 'Microscopical Journal' is considered appropriate.

Description *of a* New Microscope.

By E. G. Lobb, Esq.

A, Three strong legs, so arranged that the whole instrument is suspended by them with the most perfect steadiness.

B, Socket, in which the quadrangular bar F works, and into which at 1 slide the side reflector and small condensor.

C, Brass circle, very strong and steady, at the top of which is a plate of gun-metal, very finely graduated in quadrants.

D, Appliance for the under stage, strongly affixed to the brass circle *c*, having rack and pinion motion in connection with the milled head 2.

E, Mirror three inches diameter, plane and concave, with treble arm for oblique illumination.

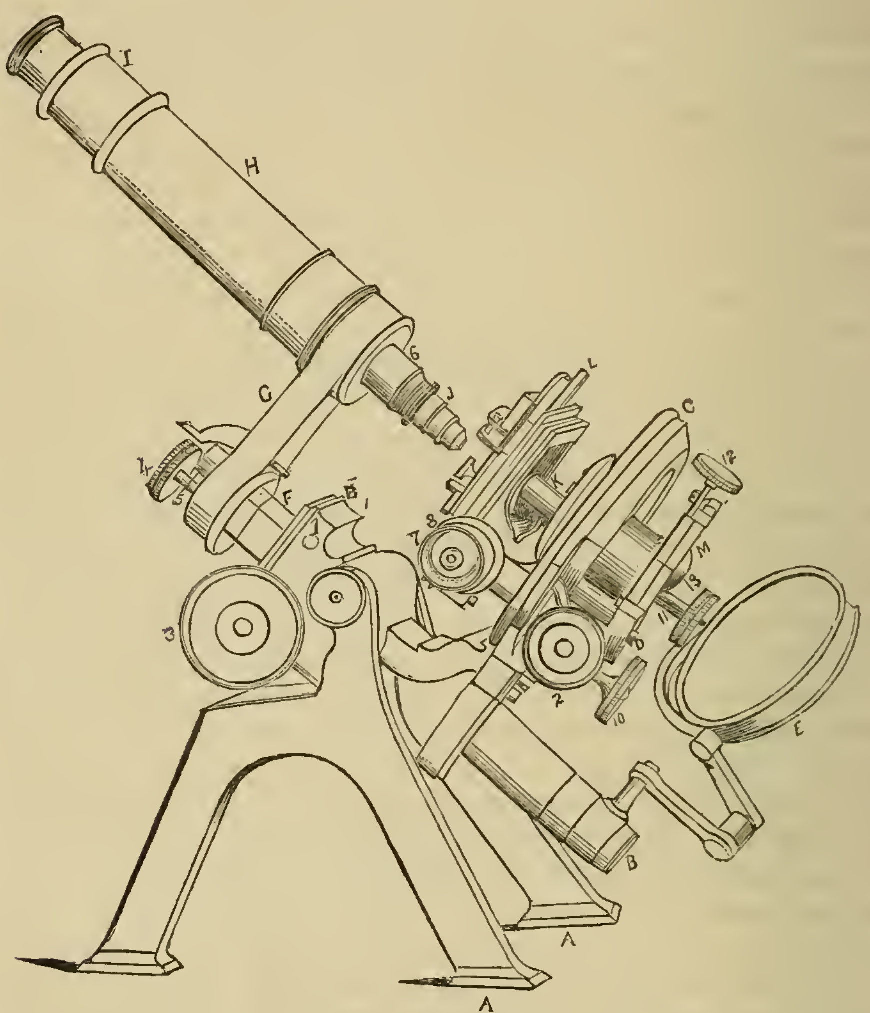
F, Quadrangular bar working in socket B, by rack and pinion motion in connection with milled heads 3, one only to be seen.

G, Arm containing the mechanism of the slow motion, worked by a very fine screw in connection with milled head 4, which is graduated, the arm itself being strongly affixed to the quadrangular bar F by the screw 5.

H, Compound body, with spring tube 6, for applying the object-glasses, and connected with the fine motion worked by milled head 4. Inside the compound body is a draw-tube graduated to four inches in the tenths of an inch, the eye-pieces sliding into the draw-tube.

I, Huyghenian eye-piece, of which five are supplied by the makers.

J, Achromatic object-glass, of which thirteen are supplied by the makers, viz., two inch, one and a half inch, one inch, two thirds of an inch, one half of an inch, four tenths of an inch, three of one quarter of an inch of varied apertures, one fifth of an inch, one eighth of an inch, one twelfth of an inch, one sixteenth of an inch.



Powell and Lealand's New Compound Achromatic Microscope.

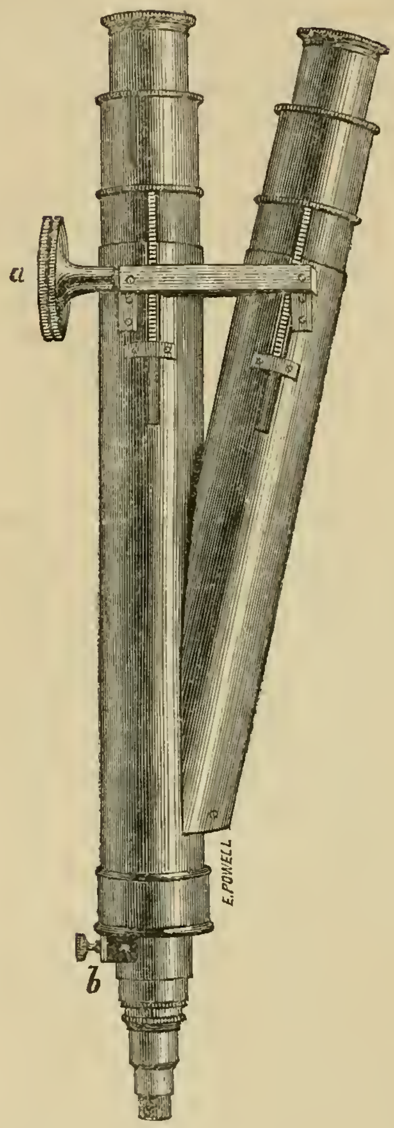
K, Axis of the instrument firmly working on the supports of the two front legs, so that the entire instrument is capable of any inclination from vertical to horizontal, remaining perfectly steady without clamping, in whatever position it may be placed.

L, Upper stage, with three quarters of an inch rectangular motion by screw and pinion connected with the milled heads 7, 8, 9, the last not seen; this stage has a sliding plate and spring clip for the objects, also a clamp to fix it, and graduated scales to act as a finder, in order to register any particular object; the rotary motion of this stage is in connection with milled head 10.

M, Under stage, with rotary, rectangular, and vertical motions; milled head 10 for rotary motion; milled heads 12 and 13 for rectangular motion; milled head 2 for vertical motion.

N, Achromatic condenser of 170° aperture, the working powers of which are admirable, easily resolving the Amician test in squares with one twelfth and one sixteenth object-glasses; it has a diaphragm with eleven apertures and three stops, capable of being placed in any position.

The object of the makers in producing the present instrument, was to make a microscope possessing a very thin stage for the oblique illumination of the most delicate diatomaceæ either by the mirror or prism, and at the same time to have a rotating stage; this desideratum they have accomplished in a very satisfactory way, and all that possess the instrument are much pleased with it, from the steadiness of its motions, its freedom from tremor, and the convenience with which all the milled heads for the various motions are placed. The stand is like those usually employed by the makers, a strong tripod, but made larger and heavier than usual to meet the requirements of the other parts of the instrument, which it bears with remarkable steadiness in whatever position it is placed. The bar that carries the compound body, instead of being triangular, is quadrangular, like that employed by Mr. Ross, but not rectangular like his, it having two obtuse and two acute angles; the makers consider this theoretically an improvement, and practically I can say that nothing can be steadier than this instrument is, even with the $\frac{1}{16}$th object-glass. The bar is worked as usual, with rack and pinion, and so nicely adjusted as hardly to require the fine movement with the $\frac{1}{8}$. The head of the slow motion is graduated as in Ross's, and Smith and Beck's. The bore of the body is $1\frac{1}{2}$ in. in diameter, which gives a very large field of view with the lower eye-pieces; it has a draw-tube, which is graduated to the extent of four inches into tenths of an inch. The brass circle which carries the motion for the rotating stage, is firmly screwed to the main part of the instrument; and at the top is attached a circle of gun-metal, which is graduated into 360° in quadrants; an index is fixed to the stage movement, and working on this gun-metal plate acts as a goniometer, and useful also in many other respects. The stage itself has all the usual movements, and is strongly screwed to that portion of a circle which works in, and entirely round the large brass circle, and this movement is so delicate that an object can be kept in the field of view during an entire revolution with the $\frac{1}{16}$ object-glass, &c.



I have had Wenham's binocular arrangement added to my microscope, by Messrs. Powell and Lealand, whose method of doing it is highly satisfactory. They remove, for this purpose, the single body entirely, and put on a double body firmly screwed together, (it does not of course prevent the single body being used when required,) this enables them to make a great improvement, which is the rack and pinion movement to the draw-tubes for adapting correctly the width of the eye-pieces to the eyes, it being essential to the due performance of the binocular microscope, that the centres of the eyes and eye-pieces should coincide, and the correction for this purpose is easily made by the rack and pinion movement; they have also retained their large field of view, which for some objects is most desirable.

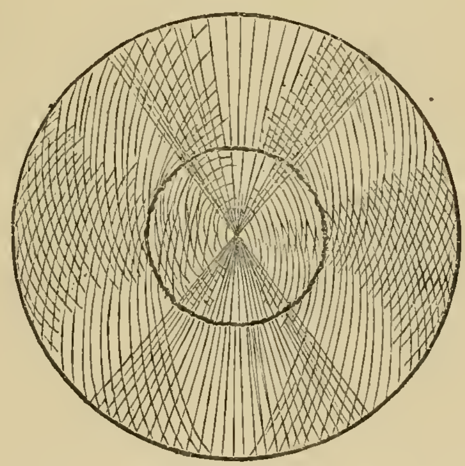
On Hyalodiscus subtilis (*Syn.* Craspedodiscus Franklini). By William Hendry, Esq., Surgeon, Hull.

Having in possession several slides of this diatom presented me through the kind liberality of Mr. Harrison and George Norman Esq., of Hull, containing entire shells and fragments of exquisite beauty, some of which constitute part of a gathering obtained from seaweed direct from the hands of the late Professor Bailey (Harrison), and having examined my entire stock with all care and attention, and under varied modes of manipulation, reversing the slides, and thus obtaining several aspects of each particular shell, so necessary in the examination of all fine and complicated striation, having also referred to Professor Bailey's published plates ('Smithsonian Contributions,' vol. vii, Feb., 1854), furnished me by Mr. Harrison, as well also to my subscription copy of Pritchard's 'Infusoria,' plate v, fig, 60, both these latter being magnified by a hand lens of $\frac{3}{4}$ to 1 inch focus, I find circumstances attending the subject which appear worthy of a more extended inquiry, and

Hyalodiscus subtilis (*syn.* Craspedodiscus Franklini).

Arc of Radiation.

Axis of Illumination and Decussation.



Axis of Illumination and Decussation.

Arc of Radiation.

to merit a rigid examination by more able and experienced microscopists than myself, who may possibly possess specimens more favorable for conclusive interpretation, than such as with the few materials I have at command, I am alone able to submit on the present occasion.

Dr. Bailey figures *Hyalodiscus subtilis* with three sets of striation, *id est*, one set radiating, and two others of contrary curvilinear description, the three sets collectively and their several intersections constituting a most rare, elaborate, and beauteous design.

Neither Bailey nor Pritchard represent any striation over the central umbilicus, but figure this portion as being merely coarsely granular, whereas I would direct more particular attention to the varied appearance of this central part under different foci and illumination, as an index to the entire phenomena throughout the disc, for just as striation is seen upon the umbilicus, whether radiating or curvilinear, so does it prove, on closer examination, indicative of the course or direction of striation found upon the outer border, and it is in a measure the varied intersections upon this part, which at times yields a comparative coarse and confused granular aspect, although the central and exterior markings will be ultimately found to be continuous, or prolongations one of the other.

The granular condition of the umbilicus contrasted with its superficial striation, would in some instances, seem to constitute a substratum; a granular condition being also frequently found to pervade the entire shell, as if arising from some abnormal development, or as having been subjected to some accidental or extraneous agency; and it is much this condition of things so frequently existing amidst these productions from certain localities, which detracts so greatly from the beauty of structure, and lessens interest attached to this peculiar diatom, or otherwise there exists other species not exhibiting the curvilinear markings of Professor Bailey.— A matter of no little importance suggests itself; do the figures represented by Bailey and Pritchard refer to the entire group of lines with their several intersections as capable of being seen under the objective simultaneously, at any one given portion of the shell, or merely as being in part and variously developed on several different portions, thus rendering it necessary, ideally to build up, by collecting or associating such diversified representations to constitute a whole? For my own part, I have not hitherto been enabled to resolve the threefold delineation completing the figure at any single point at one and the same moment, that is to say, the two diverging (decussating) and the radiating lines one and all simultaneously intersecting; but have always occasion to resort to the expedient of revolving the slide so as to present the object under different aspects relative to illumination, whereupon alone I have succeeded in obtaining a striation complimental to that previously exhibited only in part, and then with a field of decussation or intersection but *limited* in degree.

When surveying an entire shell, well calculated for observation, the following characteristic features present themselves, —the two decussating and diverging portions of the threefold series of lines are to be found ONLY in the direction of the axis of illumination, and also at the opposite extremity of the said axis, while the radiating portion of the series will be found at either extremity of a line at right angles to the foregoing, (*id est*), that each alternate quadrant of the circle is the seat of decussating or otherwise radiating portions of the series, the decussating always being on the line of axis of illumination, and the radiating at right angles to these, and upon revolving the slide through an arc of 90 degrees, the previous radiating now become decussating, and the previously decussating now become radiating, and so ringing the changes throughout the disc; the same phenomena are consequent upon manipulation with any fragment howsoever, possessing a readily visible striation, as well as upon the entire shell; indeed, for ordinary observation, I have found some fragments of greatest interest,—upon two or three of which in my possession the markings are so vividly displayed through peculiarity of shell structure, that with a Dallmeyer's $\frac{1}{12}$ inch objective of 165° angle of aperture, I am easily enabled to command any measure of amplification of the same, within the limit of four thousand diameters, (*id est*, 120 × by 30 (eye-piece objective) = 3·600 + axis extension = 4000, a fact which I hereby employ to signify the value and brilliancy of the shells in question, concluding hence that with choice of such a range of magnitude and distinction, every existing feature ought to be fully and fairly elicited,—somewhat warranting the conviction, that the previous representations of authors are exaggerated; and whatever may constitute the normal shell structure, the direction of illumination plays no unimportant part in the display of varied phenomena; nevertheless, there exists undoubted beauty, well worthy of the keenest research. Radiating lines, if these were uninterruptedly continuous from the centre to the circumference, they must necessarily diverge, and produce wider interspaces towards the border of the shell, which is not apparently the case; for some specimens exhibit a peculiar mottled appearance, occasioned probably (as seen evidently on other discoidal diatoms) by the insertion of other shorter lines, shortening still as their successive insertions approach the periphery, thus presenting a series of zones, and so occasioning the markings at the periphery in point of measure or numerical value, to be about the average or mean of these obtained on other more central portions of the disc, the value of which I have estimated at about 66 to 70 in ·001″, or much about the same as obtained on *Pleurosigma makrum,* chiefly by white cloud illumination.

Professor Bailey gives the relative proportion of the umbilicus of *Hyalodiscus subtilis* as being about one third the diameter of the entire disc. I hence subjoin a series of measures which may possess some share of utility, although great variations are found to exist.

HYALODISCUS SUBTILIS AND ITS ASSOCIATES, &c.,

Upon Four Shells of each Slide.

Slides.	From whence, associated with—	Ratio of umbilicus to entire disc in parts of an inch.					Mean.	Proportion about
		No. 1.	No. 2.	No. 3.	No. 4.	—		
1	California, Monterey, Prof. Bailey . .	311 824	292 1173	311 1677	311 1000	entire shell umbilicus	306 1169	1/3
2	Ditto ditto .	298 778	311 875	255 1077	298 737	"	290 867	1/3
3	Yarra Yarra, *Campylodiscus, Eupodiscus* .	194 378	233 350	233 400	187 378	"	212 376	1/2
4	California, *Aulacodiscus oreganis, Triceratium arcticum* .	180 400	200 400	...	...	"	190 400	1/2
5	Kotzbue Sound, *Rhabdonema Crozieri* .	280 637	233 538	156 350	233 538	"	225 516	1/2
6	Ditto ditto .	280 700	233 500	187 466	165 466	"	216 533	1/2
7	Yarra Yarra . .	236 466	264 466	311 560	254 424	"	266 479	1/2
8	California, *Biddulphia Roperi, Aulacodiscus oreganis* . .	264 583	215 480	233 500	...	"	237 521	1/2

It hence appears that *Hyalodiscus subtilis* by no means uniformly possesses an umbilicus, as formerly stated, at about one third that of the entire disc, and so far as relative proportion goes, can form no distinguishing feature from *Hyalod. lævis,* said to be about one half, see slides, 3, 4, 5, 6, 8; and that as regards a fracture-like insertion of the umbilicus, a reputed characteristic feature of *Hyalod. lævis* also, such insertion is found likewise in slides No. 3 and 7 specimens of Yarra Yarra, these are matters, therefore, for future consideration, being hitherto too speculative according to present observation.

The slides most remarkable for clear and well-defined markings are Nos. 2 and 8, which I most highly prize. I cannot, however, record the associates of No. 2, being picked out specimens, but whomsoever may possess, or be enabled to obtain *Hyalodiscus subtilis*, Californian specimen, associated with *Biddulphia Roperi*, and *Aulacodiscus oreganis*, as per slide No. 8, may account himself fortunate, and will find therein ample field for exercise both mental and manipulative, and in the end discover it hardly possible to lay the subject aside, without contemplating for what purpose the Supreme Architect of Nature builds up such inconceivably minute forms, in such vast abundance, so widely diffused, and with such superb embroidery, and yet to be almost beyond human gaze with all the resources and appliances of modern art at command. Do the lower existences behold these hidden gems, and wonder and give praise?

P. S. I must state, also, that I have satisfactorily seen the decussations &c., upon No. 4 slide, and also upon an additional slide.

No. 9, Californian, associated with Rhizosolenia.

An Abstract of DR. BEALE'S LECTURES *on the* STRUCTURE *and* GROWTH *of the* TISSUES *of the* HUMAN BODY. Delivered at the Royal College of Physicians, April—May, 1861.

LECTURES I & II.

AFTER alluding to the great interest of studying the structure and growth of the tissues, and the important bearing of this investigation on physiology and medicine, the lecturer observed that the history of the changes which occur in the tissues from the commencement of man's existence to its natural close, is a history which can never be made perfect. We can hardly hope to see the outline of such a work as this firmly established on well-ascertained facts; but how could our time be more usefully employed than in collecting and arranging materials, and urging on by every means in our power researches which may assist in furthering the progress of this never-ending but most important inquiry?

Were the elements of physical science as generally taught as the elements of arithmetic, we should not have to deplore the influence exerted by the table-turners, the spirit-rappers, and the whole class of medical impostors. These men live by flattering the conceit and fostering the ignorance of people who have never learned to think. By encouraging to the utmost of our power the study of physical science, we shall be more serviceable in protecting the public (since every man acquainted with the elements of physical science would protect himself) from imposition, than by endeavouring to increase the stringency of our laws.

Advance in medicine has at all times been so intimately associated with, if not absolutely dependent upon, the progress of certain collateral sciences, especially anatomy and animal chemistry, that it is to be regretted that these pursuits are not more generally prosecuted by physicians in this country. That scientific investigation in connection with medicine is not carried on under the superintendence of the physician to a much greater extent is, in a great measure, to be attributed to a serious defect in all our hospitals. Many physicians must have felt the want of well arranged scientific workrooms, where various microscopical and chemical investigations could be carefully carried out under their direction. It was to be hoped that the time is not very far distant when this defect will be remedied. In the minds of some persons there is undoubtedly an impression that such inquiries cannot be conducted without disadvantage to the patient; and there is a tendency in the public mind to draw a distinction between the so-called "practical" doctor and the scientific man who thinks and theorises, but is not up to the direct means of giving relief to a patient in pain. We are, however, all aware how much we have learnt during the last few years from the investigations into the secretions in health and disease, which have been lately carried on both in this country and on the continent. We should make every effort to establish such a department in connection with our large hospitals; for surely a very important part of our duty is to work out and seek to establish principles which, when acted upon, may increase the physical development and mental vigour of those who come after us.

During the last few years, the love for such work seems to have revived; and if the taste be as widely diffused and encouraged as this College desires, the position which we shall occupy in Europe and America, as prosecutors of scientific medical inquiry, will not be inferior to that which is generally accorded to us in questions relating to the practical treatment of disease.

Terms employed.—The only terms which are not generally used in quite the same sense in which they will be employed in these lectures, are the following:—

Elementary parts, into which every structure may be divided. A particle of epithelium is an elementary part. The elementary part consists of matter in two states.

Germinal matter.—Matter in a state of activity, or capable of assuming this condition, possessing inherent powers of selecting certain inanimate substances, and of communicating its properties to these, exists in all living beings, and from it every tissue is produced. It was proposed to call this *germinal matter.* A certain portion of the germinal matter of many elementary parts is comparatively quiescent, but is capable of assuming an active state at a subsequent period. These portions are the so-called nuclei and nucleoli; they are new centres of growth, and new nuclei and nucleoli will make their appearance within them when they have grown into ordinary elementary parts.

The matter on the external part of every elementary part exists in a passive state, as—

Formed material, which was once in the condition of germinal matter, but it has now ceased to be active. It cannot communicate its properties to lifeless matter. Its composition, form, and properties, depend upon the powers of the germinal matter from which it was produced, and which it often protects by its passive nature.

Secondary deposits.—These are insoluble matters which vary in form and composition in different cases, and may be considered to result from changes in *formed material* which has been deposited amongst the particles of germinal matter. Deposits may accumulate here to such an extent as to cause the germinal matter to form a very thin layer between them and the formed material.*

These were the only terms which Dr. Beale would require in describing the changes occurring during the development and growth of every tissue, vegetable as well as animal, in a state of health and in disease.

The microscope.—The arrangement of the microscope with which the tissues were to be demonstrated, was then described. The instrument was made after the manner of a telescope with draw-tubes; the object was fixed across a stage below the object-glass by a spring which pressed against the back of the slide. By this arrangement any part of the specimen could be easily placed under the object-glass, and by means of a little screw-clamp it could be fixed firmly in the exact spot which was to be examined. The object was brought into focus by screwing down the middle draw-tube to the proper position, and the more exact focussing was effected by

* See explanatory note on page 195.

drawing the tube to which the eye-piece was attached backwards and forwards. In this arrangement the preparation was held firmly in its place, and it was scarcely possible to alter its position if ordinary care were used. The apparatus enabled objects to be examined under the tenth and twelfth-of-an-inch object-glasses. The microscope was firmly fixed in a stand provided with a small oil-lamp giving a good light. The focus could be altered by drawing the tube to which the eye-piece was attached in and out, until the object was seen perfectly clearly.

Germinal matter: formed material.—In the preparations shown, the part of the tissue which is active, and which possesses the highest powers of increase, was tinged of a dark-red colour by carmine. This, Dr. Beale termed *germinal matter.* It exists in all living beings, and at every stage of their growth, but its proportion varies according to the age of the tissue. The youngest tissues consist almost entirely of germinal matter, while in the oldest textures little exists. Those tissues which grow rapidly and change much, contain a large proportion of germinal matter; while, in those which grow very slowly, comparatively little is found. The tissues which possess such different properties were all once in the condition of germinal matter, and the properties which the tissue possesses in its fully developed state, depend upon the powers of the germinal matter from which it was formed. Tissues which are remarkable in their adult state for the large quantity of so-called intercellular substance, exhibit but little during the early period of their development, while in their earliest condition there is no intercellular substance at all.

The *tissue* or *formed material* is not coloured by carmine; and, if by prolonged maceration it be stained by it, the stain may be removed by soaking in glycerine, but the tint still remains in the germinal matter. Dr. Beale believed that, in every living being, by the action of an ammoniacal solution of carmine, and subsequent soaking in glycerine, we can positively distinguish the *germinal matter* from the *formed material.*

Preparation of specimens.—In most of the preparations the capillaries have been filled with a transparent Prussian blue injection containing a little alcohol and chromic acid; so that while the vessels are filled with colouring matter, the adjacent textures become permeated with a fluid which prevents decomposition, and many transparent albuminous textures are rendered just sufficiently granular to enable their arrangement to be seen distinctly.

By these methods of preparation several minute points have been determined, such as the relation of the cells of the liver to the terminal branches of the duct; the ultimate distribution of nerve-fibres in several different tissues; the structure of the ganglia of the sympathetic; the relation of the terminal branches of the nerves to the dentinal tissues. Nerves have been readily traced and microscopical ganglia demonstrated in the fibrous tissue of the pericardium, in the submucous tissue of the epiglottis and pharynx, in the transverse fissure of the liver, and in the substance of the tongue; the formation of bone and dentine has been studied under the highest magnifying powers. The tissues may be preserved permanently, and examined with the highest powers.

The lecturer had been led to differ in opinion upon some very important questions, from many of the highest authorities; for instance, as to whether certain appearances depend upon the presence of solid bodies in the tissues, or are spaces containing fluid; whether certain delicate lines are fibres or tubes; which is the oldest and which is the youngest part of a tissue; and also as to the offices performed by tissues, &c.

He thought that many of the most difficult questions can only be solved by studying very carefully the circumstances under which the tissues in question may be examined, so as to display their characteristic peculiarities in the clearest manner possible. The following specimens were selected for illustration.

Specimens passed round.—No. 1. An injection of some simple papillæ of the human tongue under a magnifying power of 130. Three separate ones were seen. The epithelium had been removed and the capillaries fully injected with Prussian blue. Oval bodies, consisting of germinal matter, tinged bright red with carmine, passed in various directions in the papillæ, and were very numerous at the summit of each. Of these oval bodies, some were connected with the capillary vessels; but the great majority were connected with the nerves forming a sort of network lying on the surface of the capillary vessels, and imbedded in a transparent tissue. No. 2. A thin section removed from the central part of the tongue of a white mouse, prepared as the last specimen, and placed under a power of 215. The muscular fibres were observed with capillaries ramifying over them. The oval nuclei were principally connected with the capillaries and nerves. These specimens illustrated the general appearance of the capillaries when injected with Prussian blue, and the oval bodies when stained with carmine. No. 3. A thin section from the tongue of a mouse just killed, placed in a little weak glycerine, and magnified 130 diameters. The smaller vessels could not be discerned. Nuclei were seen, but very indistinctly, and in smaller number than they existed. The want of definiteness about the structure would cause one to conclude that, in this specimen, areolar or connective tissue predominated over every other tissue; and that the nuclei were connected with the fibres of the areolar tissue, although an absolute connection between the fibres and nuclei could not be seen. No. 4. Another specimen from the central part of the tongue of the mouse, from the same part as the last section, but injected and soaked in carmine. The "connective tissue" of the last specimen was seen to contain numerous capillaries and nerve-fibres. The nuclei seen in the section were clearly connected with the nerves and capillaries. Nerve-fibres, not more than the one ten thousandth of an inch in diameter, could be traced to and from the ganglion. The nuclei on the surface of the ganglion, usually considered as the nuclei of the connective tissue surrounding its cells, belonged to the nerve-fibres growing from the cells. This specimen was magnified 250 diameters.

There is, however, no organ which shows the importance of different processes of preparation in so marked a manner as the liver.

On the termination of the hepatic ducts.—Upwards of six years ago, Dr. Beale succeeded in injecting the ducts of the liver, and believed that he had demonstrated that the ducts were continuous with tubes containing the liver-cells. He regarded the liver as the most perfect type of gland, because the largest quantity of secreting structure and blood were brought into the closest relation, while they occupied the smallest possible space. The preparations proved that injection passed directly from the ducts into a network of tubes with very thin walls, which were occupied with the liver-cells. The coloured injection passed between the cells and the walls of the tube, insinuating itself through very narrow channels, but nevertheless forcing its way along for a considerable distance, and sometimes it reached the centre of the lobule. As injection could be forced thus artificially in a direction the reverse of that in which the bile flows during life, the possibility of the bile flowing between the walls of the tube and the cells was fully proved. These conclusions were published in a paper in the 'Phil. Trans.,' in 1856; and, after an interval of several years, Dr. Beale could now speak with far greater confidence.

Professor Budge, of Greifswald, has curiously distorted one of Dr. Beale's drawings. He (Dr. Beale) did not believe that any one who was himself accustomed to microscopical work would have considered that the merest tyro could have made such a mistake as the one which he was credited with by Professor Budge. He exhibited his own drawing of the specimen, and Professor Budge's inference from the drawing of the appearance of the specimen, which he had never seen, and the preparation itself. *Specimens*, No. 5, preserved for seven years was then sent round. It was magnified 215 diameters. The blue injection was shown amongst the cells in the tubes, and not the faintest indication of the tubes around each cell delineated by Professor Budge, was to be seen. No. 6. A corresponding preparation from the human liver, magnified 130, showing the ducts just at the edge of a lobule, and their continuity with the tubes of the cell-containing network.—No. 7. Also from the human liver, showed the capillaries injected blue, and the cell-containing network alternating with them, and having in all parts of the lobule exceedingly thin walls, but quite distinct from the capillaries. This preparation was magnified 215.

Perhaps, however, the most perfect demonstration of the cell-containing network, and its continuity with the ducts, is obtained from the examination of the liver in cirrhosis, in which disease the cells and tubes shrink, the change commencing at the portal aspect or circumference of the lobule, and proceeding gradually towards the centre.—No. 8. A section of a healthy liver under an inch object-glass. The portal vein was injected with carmine, and the hepatic vein with Prussian blue. The capillaries of the lobule were filled with the colouring matter—those in the centre of each lobule being blue, while those at the circumference are red. The interlobular fissures were very narrow, and in many places the capillaries of one lobule were continuous with those of adjacent lobules. The interlobular spaces were clearly destitute of any areolar or fibrous tissue. They were occupied by branches of the portal vein, and branches of the artery and duct, and lymphatics, which had not been injected in this specimen.—No. 9. A specimen of cirrhose liver in which the vessels had also been injected. Here a wide space existed between the contiguous lobules, of which but very little, and only of the central part of the lobule, remained in many cases. Vessels and tubes were observed in the substance of the tissue usually stated to be fibrous.—No. 10. A specimen of a cirrhose liver, magnified 130, soaked in carmine. The shrivelled cells could be seen within the narrowed tubes, and the network was very distinct.—No. 11. A specimen from the same liver put up in water. Not a vestige of anything but "fibrous tissue" was to be seen where we now know numerous tubes and cells and vessels are actually to be demonstrated. By immersing a delicate preparation in water, the appearance of the presence of a large quantity of fibrous or connective tissue could often be produced.

These specimens would serve to show the great importance of preparing tissues; for it had been clearly proved that many structures ordinarily invisible may be demonstrated most distinctly by certain special processes. Illustrations might have been taken from almost any other tissues of the higher animals, or from the lower animals or plants; but those which seemed to bear most directly upon that department of microscopical inquiry, which was of the greatest interest to practitioners of medicine had been chosen.

Minute size of living particles.—When we attempt to examine the structure of the simplest forms of living beings, we cannot but regard the extreme minuteness of many independent organisms which live, and grow, and increase their kind, with the utmost astonishment. So also, in all other living beings, the actual living particles by which the active changes are effected are, there is reason to believe, far too small to be seen. The smallest organisms and living particles which can be distinguished by the highest power yet made (1700 diameters) had been growing probably for a long time before they were large enough to be seen.

Structure and growth of living particles.—Of the *structure* of such organisms and particles, we have as yet learnt nothing by direct observation; but from carefully investigating the structure of larger bodies closely allied to these, as ordinary mildew, for instance, some conclusions as to the manner in which growth takes place may be arrived at.

Growth in all living structures occurs in the same manner; the matter to be animated passes in the same direction in all; the living particles invariably pass through certain stages of existence, and end by giving rise to material totally different in composition from the living particles. This may be further altered, but it cannot reassume its former characters, properties, or powers. The differences in the results of the life of different living organisms depend upon their powers, which they have derived from their predecessors.

Living particles cannot be distinguished from each other by microscopical examination, and, in consequence, it is utterly impossible, from the structure of a living particle, to predicate its office, or the results of its living, nor can we thus tell whether it has belonged to one of the lowest or highest organisms, to an animal or to a plant.

The word *living* was used in a general sense, meaning that active changes, some of which can be explained by physics or chemistry, while others cannot, are taking place, or are capable of taking place, under favorable conditions; and by *dead* was to be understood matter which had already undergone these changes, and which was brought again under the uncontrolled influence of physical and chemical forces. The shaft of a hair, and the particles of the epithelium on the surface of the cuticle, are just as dead *before* they are *detached* from the body as afterwards; but there are constituent elementary parts of every age leading uninterruptedly from these dead particles, which have no power of increase, to those which have only just commenced their existence, which are nearest the vascular surface, and are undergoing rapid multiplication. It is as impossible to indicate the precise moment at which a living particle ceases to be able to produce particles like itself, as it is to announce positively the day or hour of our lives when we cease to ascend towards the highest point of vital activity we are to attain, and begin to decline.

Structure of elementary parts.—Every elementary part consists of germinal matter, and of formed material which was once in the state of germinal matter. Just as, in the cuticle on the surface of mucous membranes, and in certain glands, elementary parts exist of every age, so every tissue and organ in the body is composed of elementary parts in every stage of existence, and arrangements exist by which the oldest *formed material* may be removed. Some formed material is resolved into simpler compounds, and removed very soon after its formation; while in certain tissues the formed material is very permanent; and it is doubtful, if, in certain cases, the formed material which now exists in our bodies will not remain in much the same state as long as we live. Most important changes may be brought about by the fluid in contact with this formed material. In health it is bathed with a fluid which preserves its integrity; but in certain cases the composition of this fluid is so altered that the formed material undergoes changes closely resembling those which may be induced in it artificially, if kept at the temperature of the body, in a fluid which will not protect it from the influence of oxygen.

Structure of mildew.—If the spore or any segment of the stem of a simple fungus be examined, it will be found to consist of an external capsule, inclosing some very transparent matter. The outer capsule is comparatively firm, and hard and unyielding; but the internal substance is soft, perhaps almost diffluent, and is easily destroyed. It may be washed away and removed; while the external capsule will retain the same characters which it possessed before it was disturbed. The new matter is certainly not added on the external surface; for if this were the case the outer membrane would increase in thickness, while the mass within would remain of the same size as when it was first seen. In some instances the outer membrane increases in thickness, and the matter within also increases; but sometimes the outer membrane remains very thin, while the matter within is seen to undergo a considerable increase. After the whole mass has reached a certain size, it divides; and the process is repeated in each of the resulting structures. Very soon, perhaps, millions of minute organisms are produced. When this division does not take place very rapidly, the external membrane of each particle is observed to increase in thickness, and generally, it may be said that the slower increase occurs the thicker this becomes.

Is the new matter added just within the outer membrane? If this were so, at one time matter like that of which the membrane is composed wonld be formed, and at another the inner soft material must be produced. It would follow, too, that in some cases the material must be entirely converted into the one substance, and in others it must give rise alone to the development of the other. The thickening of the external membrane is often produced at the expense of the germinal matter within.

Is the external hard material formed around the internal substance? This question has been already answered negatively. From a consideration of numerous observations, Dr. Beale was convinced that the new matter—the pabulum, the nutrient material—which is about to become a part of the living mass, passes through the external membrane, and amongst the particles of which the central mass is composed. He believed it passes into the interior of these particles, and, having been brought into very close contact with their component particles, becomes endowed with the powers they possess, and is then living.

Supposed structure and movements of living particles.—The doctrine which results from these observations is shortly this—that the smallest living particles of all living beings are spherical; and it is believed that these are composed of spherical particles *ad infinitum.* The inanimate matter passes into the spherical particles, and there becomes endowed with their wonderful powers—in fact, becomes living. The living spherules move in a direction from the centre towards the circumference of each spherule to which they belong. Their tendency to divide is due to the same force, which compels them to move constantly *from* the centre where they became living. Each particle is preceded by those which became living before it, and succeeded by others which were animated since it commenced to exist. This movement outwards occurs in the living particles of all living beings, and its rapidity determines the rate at which the structure grows.

The particles, in passing outwards, gradually lose their power of animating matter; and at last, having arrived at a considerable distance from the centre, where they became living, undergo most important changes, and are resolved into substances having properties very different from those which the living particles possessed during the earlier periods of their existence. The particles now cease to move; they lose their active powers, and perhaps coalesce to form a firm, hard substance, like the external membrane of the mildew; or they may become resolved into compounds which are completely soluble in fluid, which are perhaps very soon decomposed into substances of a much simpler composition. This outer substance, resulting from changes occurring in the oldest particles of the inner matter, is the *formed material;* and the living matter within, which may increase in the most rapid manner, which gives rise to every tissue, and is in fact the growing living part of every structure, from which all new structures originate, is the *germinal matter.* The characters of the *formed material* depend upon the powers of the particles of the germinal matter, and it is affected by the conditions under which these grew. The powers of the germinal matter depend upon those of the germinal matter which gave it origin. As the composition of the *formed material* depends entirely upon the properties of the germinal matter which produced it, the substances resulting from the disintegration of the formed material, and the compounds resulting from the action of oxygen on these are peculiar, and differ materially from each other, just as the properties of the *formed material* differ in the various tissues and in different living beings. It is, therefore, very doubtful if these substances will ever be produced independently of living matter. Undoubtedly, if the component elements could be brought within the sphere of each other's action under the same condition as in the living organism, the same compound would result; but, as these conditions cannot be brought about artificially, and cannot be conceived to exist except in living bodies, this is not saying much. Every living particle can alone spring from pre-existing particles; and every particle of albumen, casein, fibrine, &c., is produced under conditions which can only exist in living particles.

Of nuclei and nucleoli.—In many cases, certain of the particles of the germinal matter grow more slowly than others, and remain perhaps for a long period in a comparatively quiescent state. These masses are generally spherical or oval, and they have a power of resisting the action of external circumstances which would destroy the active portion of the germinal matter. These are the so-called nuclei, and from them new structures may spring, even if the germinal matter in which they lie be destroyed. When they become active, certain minute particles within them may become new nuclei, while the particles of the original nucleus increase and pass through the various stages of their active existence, and at last become resolved into formed material. Generally, when the conditions under which an elementary part is placed are very favorable for the growth of the germinal matter, the most rapid increase in size may be observed to occur in the particles just within the envelope of formed material; and not unfrequently numerous spherical masses of germinal matter may be seen in close contact with the membrane, and therefore as near as possible to the nutrient matter.

Secondary deposits.—In some cases, after a layer of *formed material* has been produced externally, and the whole mass has reached a certain size, certain particles of the germinal matter become resolved into *formed material,* which collects as one mass, or in the form of several separate particles, which may accumulate amongst the particles of the germinal matter. If this process continue for some time, the germinal matter forms a thin layer between this mass of formed material, which Dr. Beale proposed to call *secondary deposit,* and the outer membrane or envelope of formed material, a position in which the germinal matter (primordial utricle) of the vegetable cell and that of the fat-vesicle (nucleus) are found.

Regarding a growing spore of mildew as an elementary part, it consists externally of *formed material,* within which is the *germinal matter.* Certain portions of the germinal matter are not in a state of great activity like the remainder; and these are nuclei from which new growth may proceed, if the formed material and the remainder of the germinal matter should be destroyed. If there be no nuclei, no future elementary parts could, under these circumstances, be formed; and the death of the germinal matter renders it impossible that new structures can result from the mass.

The action of carmine on germinal matter and formed material.—Alkaline colouring matters have no effect on the *formed material,* but colour the *germinal matter* very strongly. In some very interesting specimens, coloured by immersion in an ammoniacal solution of carmine, obtained from certain fibrous textures, there is no distinct line of demarcation between the germinal matter and the formed material. Most externally is the *formed material* quite colourless; then comes a layer of very young and imperfectly hardened formed material, which is slightly tinted; next, germinal matter, darkly coloured, and amongst this nuclei most intensely coloured. The structure which is most intensely coloured is farthest from, and that which is not coloured at all in immediate contact with, the colouring matter. The carmine can be made artificially to pass through the layers of formed material, unaltered by them, to the germinal matter, where it becomes precipitated, probably in consequence of the acid reaction of the germinal matter.

NOTE.—It is desirable to state here, that it was not possible to insert in the text the terms in ordinary use, equivalent to *germinal matter* and *formed material;* because in some cases the *germinal matter* corresponds to the "nucleus," in others to the "nucleus and cell-contents," in others to the matter lying between the "cell-wall," and certain of the "cell-contents;" while the *formed material,* in some cases, corresponds exactly to the "cell-wall" only, in others to the "cell-wall and part of the cell-contents," in others to the "intercellular substance," and in other instances to the viscid material which separates the several "cells, nuclei or corpuscles," from each other. In the abstracts of the succeeding lectures these points will be fully considered, and illustrated with examples; but it may, perhaps, be well to remark at once—

That the "nucleus" of the frog's blood-corpuscle is *germinal matter;* the external red portion (cell-wall and coloured contents), *formed material.*

That the white blood-corpuscle, the lymph and chyle corpuscle, and the pus and mucus corpuscle, are composed entirely of *germinal matter*, with a very thin layer of *formed material;* the viscid matter between the mucus-corpuscles is *formed material.*

That the "nucleus" of an epithelial cell of mucous membrane, or of the cuticle is *germinal matter;* the "cell-wall and cell-contents" *formed material.*

That the 'cell-wall" of a fat-cell or of a starch-holding-cell is *formed material;* the "nucleus" of the former, and the "primordial utricle" of the latter, are *germinal matter;* while the fat and the starch are secondary deposits, produced by changes occurring in particles of germinal matter in the central part of the mass.

That the *germinal matter* is always coloured red by carmine, while the *formed material* and *secondary deposits* are not; and thus the difference between matter in these different states can always be positively demonstrated.

TRANSLATIONS.

On Gyrodactylus elegans, Nordmann. By Dr. G. R. Wagener.

(From Reichert and Du Bois Reymond's 'Archiv. f. Anat.,' 1860, p. 768.)

The curious phenomena connected with the reproductive process in *Gyrodactylus* render it a most interesting object of study to the physiologist. Till very lately, we are not aware that it was known to occur in this country; but Mr. C. L. Bradley having shown that one, if not two, species are very abundant on fish taken from the ponds on Hampstead Heath,* it will probably be found elsewhere. We have therefore thought it might be interesting to those of our readers who may meet with it, and be disposed to investigate the structure and development of this remarkable creature, to have before them the excellent account of *Gyrodactylus* given by Dr. Wagener, who has added so much to our knowledge of the subject in the present paper, which we have translated in all important particulars very nearly in its entirety.

Since the discovery, by Nordmann, of this remarkable parasite on the gills of the perch and other fish, it has been subjected to fresh examination by Creplin, Dujardin, and more recently by Von Siebold, the latter of whom more particularly has confirmed Nordmann's representations of the organization, and added observations of the most surprising nature as to the development of *Gyrodactylus elegans.*

He showed that a young *Gyrodactylus* arises in the interior of the parent animal from a self-dividing cell, that it becomes fully developed in the same situation, and whilst still itself in the embryo condition, produces a second offspring within itself. To these observations he added further statements respecting the organization of the animal, and especially pointed out the absence of any spermatic organs.

From the latter circumstance Von Siebold felt himself compelled to regard *Gyrodactylus* as a "nursing" animal; and in accordance with this view, he named the cell from

* 'Journal of Proceedings of Linnean Society,' vol. v, pp. 209 and 257.

which the "daughter" individual is developed a "germ-cell," and sought the terminal member of the series of generations among the *Polystomata*.

In the following observations the sexual reproduction of *Gyrodactylus elegans* will be proved, and, at the same time, some of the points in its organization, as described by Von Siebold, will be more fully elucidated.

Habitation.—*Gyrodactylus elegans* is found on the gills of all the *Cyprinoid fishes* brought to the Berlin market; it also occurs on the fins and abdominal surface of the fish, and may be obtained by scraping off the slime. Up to the present time, it has been found in the following species of fish:

Esox lucius	The Pike.
Cyprinus Carpio	,, Carp.
,, *Gobio*	,, Gudgeon.
,, *Brama*	,, Bream.
,, *carassius* . . .	,, Prussian Carp.
,, *phoxinus*	,, Minnow.
,, *erythrophthalmus* .	,, Rudd, or Red Eye.
,, *alburnus*	,, Bleak.
Cobitis fossilis	,, Pond Loach.
,, *barbatula*	,, Loach.
Gasterosteas aculeatus . .	,, Stickleback.
,, *lævis* . .	,, ,,

And from a drawing kindly furnished to me by Dr. Semper, a species very similar to, if not identical with, *G. elegans*, appears to occur on the gills of *Cyclopterus Lumpus* (Lump-Sucker).

Presuming that Nordmann's figure is correct, specific distinctions would seem to exist between the hooks of the species noticed by him and that which has formed the subject of my observations; but I have reason to believe that these differences arise merely from trivial inaccuracies which it is very difficult to avoid making in the representation of the hooks.

Size.—The largest individual observed by me was about $\frac{1}{2}$ mm. = $\frac{1}{100}$ inch in length, and its greatest breadth might be about $\frac{1}{8}$ mm. = $\frac{1}{400}$ inch.

Form.—The form of the animal is flattened and tongue-shaped, with rounded borders. The cephalic extremity is divided into two short, slightly ventricose lobes, and is about $\frac{1}{16}$ mm. = $\frac{1}{800}$ inch in width. To the somewhat attenuated caudal extremity is attached, obliquely, a membranous, subtriangular suctorial disc, the concavity of which is on the ventral aspect. The middle portion of the animal is usually enlarged, the enlarged portion corresponding to the situation of the *uterus*. Should this organ contain no ovum, nor any embryo, the vesicular elevation is produced by a clear fluid with which the uterine cavity is distended.

The cephalic lobes are separated from the root from which they spring by a shallow groove on the ventral aspect, which leads to and ends in the mouth. Frequently, also, a groove exists on the ventral surface, close above that border of the caudal disc which is unfurnished with hooks. The borders are continuous with each other, in the middle line of the body.

The *external integument* presents no definite structure. Occasionally, in certain states of contraction of the animal, very delicate transverse lines, formed of extremely minute points, might be seen crossing the surface at regular intervals, especially in the caudal portion. Around the mouth, when the eight pharyngeal *papillæ* are protruded, fine longitudinal folds are often visible on the ventral aspect of the cephalic extremity. Below the mouth these folds become more and more distant from each other, and gradually disappear.

Muscular system.—Three parallel longitudinal lines may be seen at the border of the body of a *Gyrodactylus*. The external and middle of these lines belong to the integument. The space between the middle and inner lines is rather the narrower, but equally transparent with the other. The innermost line represents the outer border of the visceral mass, in which delicate longitudinal lines may often be remarked, which appear to radiate into the caudal disc; and may, probably, be regarded as representing muscular fibres. A radial striation is very obvious in the caudal disc itself.

Similar fine lines may be seen entering and terminating in the lateral process or appendage of each hook. In the same way the transparent substance inclosing the central pair of hooks of the caudal disc exhibits striæ running parallel with its borders, and which are also, probably, to be referred to contractile elements.

The opening for the penis-like organ afterwards to be described, like the sexual aperture of *Octobothrium lanceolatum*, is surrounded with minute hooklets, from the base of each of which two striæ proceed, which are, probably, muscular fibres.

A very remarkable phenomenon may be seen in *Gyrodactylus*, shortly after the birth of an embryo. Folds and club-shaped *villi* arise over the whole surface of the animal, into the formation of which, besides the integument, the visceral fleshy substance of the body occasionally enters. Oil-drops of greater or less size are scattered through the entire body, and are very manifest in the perfectly fresh animal, which, in that condition, may be said to be as clear as glass. The opacity, which very soon comes on under the microscope, is connected, for the most part, with endosmotic conditions of the external integument.

The *caudal disc* presents a central and a peripheral portion. It corresponds, in every particular, with the synonymous organ of some species of *Dactylogyrus*, with the one exception that, in these cases, the points of the hooks are directed towards the dorsal, whilst in *Gyrodactylus* they look towards the ventral aspect of the body.

The *central part of the caudal disc* is constituted by a fleshy bundle, very finely striated longitudinally, which completely surrounds the large hooks with their two lateral processes. The point of each hook corresponds to an opening in this sort of cushion, and on the edge of this opening, towards the body of the animal, a slender streak, curved into the form of a V, forms a partial border to the orifice.

The hook apparatus of the central part of the disc consists of two large flat hooks, each with its two transverse lateral appendages. They lie on the edge, and are curved upon it, the base being enlarged towards the edge in an irregular way difficult to describe. On the sides of the hooks, looking towards each other, are two projecting sub-parallel folds or elevations, corresponding to which are depressions on the external surface. These folds are short, of a circumflex form, and run from behind and above, forwards and downwards. That portion of the base of the hook which *is not incumbent* is somewhat thickened, and the terminal part of the free point is curved gently upwards.

The upper of the band-like appendages, which are placed transversely above the base of the hook, is the stronger and broader of the two, and it has an irregularly undulating border. The points of these appendages are bent downwards, rather over the hooks, and are truncated obliquely from without to within. The surface is slightly plicated. The upper and under borders of the appendages are also frequently thickened, and the latter border is continuous with a broad, apron-like fringe, which gradually becomes very thin, and has a narrow edging, or hem, on both its lateral margins, and corresponds in form to the space between the hooks into which it is inserted on either side. As the hooks are curved on their flat surfaces towards each other in the form of an italic *S*, so as to inclose a heart-shaped space, the attached base of the apron-like expansion just described is necessarily wider than the free margin, which reaches almost to the point where the hooks begin to curve outwards.

The lower appendage is very narrow; its inferior border is produced into a very thin membranous fold, whose lower margin is slightly incised in a crescentic form. This appendage resembles a short curved thread or wire, resting on its free slightly ascending extremities on both hooks. The central disc presents a V-shaped transverse section, which towards the bases of the hooks expands in a single plane.

The *peripheral portion of the caudal disc* is very motile. At the periphery, except at the upper border, are placed sixteen minute hooklets, at equal distances apart; and according to the protrusion and retraction of these organs, the border of the disc varies much in appearance. When the hooklets, together with the fleshy substance in which they are imbedded, are protruded in a finger-like form, the intervals between them are often considerably retracted, each interval exhibiting two uniform incisions. On the other hand, when the hooklets are strongly retracted, the intervals appear to be slightly emarginate.

Each hooklet is individually motile. It may be retracted deeply into the finely striated fleshy envelope with which it is encompassed, so that even the very point is concealed; or it may be protruded to such an extent that the whole of the hooklet is exposed, resembling a finger armed with a claw.

In each of these little hooklets three portions may be distinguished—the hooklet itself, its stem, and an appendage, of which parts the latter two are subservient only to the motions of the organ.

The hooklet is flattened, strongly bent on the edge, and very sharp. The base is produced before and behind into two short wings, which are also placed upon the edge; the hook portion is seated upon the narrowest spot of this biscuit-shaped figure. One of the wings in question lies on the dorsal, and the other on the ventral aspect of the disc.

To the latter wing is attached, in a manner not yet ascertained, a very slender, elastic peduncle or stem, eight times as long as the hook, and slightly knobbed at the free extremity. Though often much bent by the contraction of the caudal disc, it quickly and readily straightens itself again on the cessation of the movement.

The wing corresponding to the under side of the disc serves as the point of attachment to a faintly defined elongated *appendage*, which is about half as long as the stem, and has attached to it two strong, striated, fibrous bundles, which proceeding towards the centre of the disc are there lost. How this appendage is connected with the wing is not apparent. If we suppose the peduncle to be protruded, and the appendage drawn backwards, the point of the hook, which is somewhat moveable upon both, is elevated; whilst if the stem be retracted, the hook is withdrawn.

The transverse *oral fissure*, which is placed on the ventral side of the animal, close to the roots of the cephalic lobes, leads to the *digestive apparatus*.

The *oral opening* forms the lower termination of the shallow groove between the cephalic points, and leads into a short pyriform sac, with very thin walls, in which a longitudinal striation may sometimes be perceived.

Attached to the bottom of this sac, exactly as in *Diplozoon* or *Diporpa*, lies a protrusile pharyngeal organ, which, if the examination be awkwardly conducted, may even be forced altogether out of the oral orifice. This turban-shaped *pharynx* consists of two parts.

The upper, which projects free into the oral cavity, has eight points, which, as remarked by Von Siebold, can be moved against each other, like jaws. The conical summits of these eight divisions of the pharyngeal organ is finely striated longitudinally. The small jerking movements which take place in these parts give them the aspect of hard bodies. But when they are protruded beyond the mouth, they expand into an eight-rayed star; the fine longitudinal striæ disappear, and they rather resemble a structureless, tough substance.

The lower portion of the pharynx, upon which the eight cones are seated, is of a flattened spheroidal form. It is composed of eight cell-like segments, separated from each other by as many meridional grooves. Upon each is placed a pointed process, which is also separated from it by a groove. These transverse grooves, forming a circle around the pharynx, divide it into a superior and an inferior portion. The eight cellæform bodies have fine granular contents, in the centre of which may be perceived a very clear spherical cavity filled with fluid, and containing a globular opaque nucleolus.

The pharynx of many *Distomata* is formed in a similar manner, except as regards the conical processes. Within the longitudinal and transverse striæ, which are usually regarded as belonging to a muscular structure, may also be noticed transparent, nuclear, sharply defined spaces, inclosing each a nucleolar corpuscle.

The *intestine* of *Gyrodactylus,* which is bifurcate and cæcal, communicates with the pharynx by a short œsophagus, and is of uniform structure throughout. In individuals as yet uninjured by examination, the central space of the intestine and of the œsophagus is filled with a clear fluid, by which the walls are kept asunder. I have never seen this fluid resembling blood, as it does in *Dactylogyrus monenteron.* In the large, beautiful *Gyrodactylus* of the loach, the intestine was always charged with a clear, yellowish fluid, which served the purpose of an injection in the examination; in appearance this fluid resembled the yellow, homogeneous pigment by which the integument of the fish is coloured.

Two layers may be distinguished in the intestinal tube; the outer of which is, in appearance, structureless. The inner is much the thicker, and consists of a uniform layer of a fine, granular substance, in which, here and there, transverse lines may be observed, which appear to indicate a cellular structure. In general this layer is soon broken up, and it then fills the intestinal canal. The course of the intestine is exactly the same as in many *Distomata.* It runs on the sides of the body immediately beneath the dorsal surface. The two cæcal sacculi meet in the middle line, making a short turn in order to effect the junction. The distance apart of the somewhat enlarged extremities of the intestinal canal depends upon the degree of distension of the uterus. In length it occupies about the two middle fourths of the animal. It embraces the ovum, the uterus, the testis, and rests upon the ovary; the upper enlargement of which, however, projects somewhat beyond it, on the outer side.

The *vascular system* is found not on the dorsal, but on the ventral side of the body. Its thin walls inclose a clear fluid, and the finer branches are furnished with distinct ciliary lobes. Four principal trunks may be seen lying in pairs on either side of the animal, close together, and corresponding with each other in their course.

In the caudal portion of the animal, near the upper border of the suctorial disc, and close below the ovary, the two pairs of vessels turn towards the mesial line. The two corresponding superficial vessels from each side join to form a short but not larger trunk, which bends so abruptly from the observer as to present a perfect transverse section. Whether it perforates the wall of the abdomen, or opens on the dorsal surface, as may well be supposed, could not be made out.

The other two corresponding vessels on each side, which, on the whole, are less distinctly seen, are apparently lost in more slender branches, which, together with branches from the loops, proceed towards the caudal disc. In the latter part, between the fourth and fifth hooklets on each side, and close to the border, are two very large, active, ciliary tags, whose free apices point directly inwards. It may also be noticed that an opening exists at this spot, on the somewhat swollen margin of the disc. Whether this opening communicates with a cæcal cavity or a canal remains undetermined.

The two pairs of vessels in their course towards the head make two principal curves, by which the space circumscribed by the vessels is subdivided into three portions.

The lowermost of these divisions extends from the confluence of the vessels to the lower border of the testis. At this point the vessels bend suddenly outwards, but with a rapid curve again approach each other on a level with the lower border of the uterus, then again bend a little outwards, and with a gently undulating course run immediately on the pharynx, on whose sides they continue visible as far as the oral orifice, after which they gradually diminish in size until they are lost to sight.

On the spot where the vessels override the upper border of the intestine, a couple of minute ramuscules are given off on the inner side. Another far larger branch curves outwards, and pursues a winding course upwards and downwards through a mass of cells corresponding in form to unicellular glands.

These *unicellular glands*, as they may be termed, are situated in each side of the head, on either side, constituted of a superior and an inferior collection. The upper is the smaller, and consists of from six to twelve retort-shaped corpuscles, some of which always contain a transparent nucleus, together with a corresponding opaque nucleolus.

The inferior and larger glandular mass consists of from eight to twelve far larger cells. Each of these presents a clear nucleus and an opaque nucleolus, which, as in the superior glandular mass, lies in the midst of a more or less brownish, opaque, fine granular substance, with which the entire cell is filled.

From each of these bodies proceeds a finer or coarser filament, filled with a similar material, towards the cephalic lobe on the same side, at the border of which it terminates. These filaments are not of uniform diameter throughout, having here and there enlargements upon them. The glandular bodies themselves are placed on the dorsal side of the animal; but the filaments, united into a brownish sub-spiral bundle, run on the ventral aspect. In the cephalic lobe each filament becomes much dilated. Its course may be traced through the structureless integument. At the apex of the cephalic lobe, a glutinous, viscous matter may often be seen escaping, which in appearance may be closely compared to the filaments by which the structureless integument is traversed. Immediately behind the inferior larger granular body, beneath the dorsal surface of the animal, are situated twelve to fifteen cells in close apposition, like those of tesselated epithelium, on both sides of the animal, and covering the outer side of the intestine. The uppermost of these cells are the largest, and they gradually become less and less downwards, so that it was impossible to determine the inferior boundary of the cellular layer. The nucleus and nucleolus of the cells resembled those of the glandular cells above described. The contents were quite colourless and finely granular, but very transparent.

Besides these unicellular glands, as they may be termed, three other similar, very minute aggregations of cells are placed on each side of the oral cavity, from which three brown, fine granular streaks proceed transversely to the mesial line of the animal, above or on the dorsal aspect of the oral cavity, terminating with a slight curve outwards.

On the back, rather higher than the mouth, I noticed four large, clear, fine, granular, cellæform bodies, close together, but whose nature remains quite obscure.

All these cellæform bodies, or unicellular glands, would seem to be comparable with those which are met with in the cephalic lobes of the species of *Dactylogyrus*. The four cellæform bodies last mentioned probably correspond with those lying above the mouth in *Dactylogyrus*, and which from their brown hue present a very peculiar aspect.

With them also may be associated the bodies existing in the integument of many Trematodes and Cestodes, first described by me under the name of "villi," or "villiform bodies." These also are furnished with a process filled with a brown granular material, arising from a sacculus in which a clear nucleus and opaque nucleolus may very frequently be seen, and terminating in the integument.

In the Cestodes it may be readily observed that an oil-drop is gradually formed at the spot corresponding to the termination of the cell-process in the integument, and that this drop of oil, gradually enlarging, is at last detached, a new drop appearing in the same place. The contents of the sac, in consequence of this, are rendered clearer, the number of fine granules is lessened, the nucleus appears to float loosely in the clear fluid, containing minute particles of the granular material; whilst a delicate, double contour line indicates the wall of the sac.

The *sexual system* consists of the single *testis*, and a horse-shoe shaped *ovary*.

The *testis* is a usually spherical or sometimes heart-shaped sac, the base of which is directed upwards. It is situated beneath the back of the animal, between the two branches of the ovary and of the intestine, its base reaching the horse-shoe shaped commissure of the former. Its upper wall slightly overlaps the oviduct, where the *ovum* is delayed before its entrance into the *uterus*. The wall of the *testis* exhibits a double contour line; the *vas deferens* is a short tube, which appears to penetrate the upper wall of the oviduct.

The common sexual orifice—that is to say, of the oviduct and *testis*—constitutes a *papillæform elevation*, projecting from the inferior wall of the *uterus* into its cavity.

The contents of the *testis* are sometimes composed entirely of cells; sometimes half of the sac is filled with a clear fluid containing either active spermatic filaments in tumultuous motion, or the well-known mulberry-shaded globules beset with spermatic filaments, associated also with immobile filamentary bodies. Occasionally, also, an apparently virgin *ovum* may be seen in the oviduct surrounded with spermatic filaments, some of which may likewise be now and then perceived in the *uterus* itself, before its cavity is entirely occupied by the *ovum*.

The spermatozoa themselves are simple filaments, having no distinguishable cephalic extremity, except that one end seems to be a little thicker than the other.

The *ovary* is of large size, and occupies almost the entire lower half of the animal; it is very transparent, and usually of a horse-shoe form. Its upper extremities reach above the lower wall of the *uterus*, to an extent corresponding with the degree of distension of that organ.

The length and breadth of these glandular lobes depend upon the state of development of the ovary; and the uppermost of them, occasionally slightly hollowed, expands so as to embrace the intestine which rests upon it.

The gland is situated beneath the neutral surface. It is subdivided by shallow grooves into segments, which vary in different individuals, and are probably due to the formation of the *ova*. Each segment consists of a very clear *matrix*, in which transparent *nuclei* with *nucleoli* of pretty uniform size, though at irregular distances apart, may be noticed. Near the oviduct, a portion of the *matrix* appears separated from the surrounding substance by a circular line, encompassing and concentric with a *nucleus*. The *oviduct* appears to arise from both lobes of the ovary. It constitutes a membranous canal which runs in close apposition with the wall of the *uterus*, transversely from one lobe of the ovary to the other in a straight line. The *vas deferens* as before said, appears to enter its upper wall.

The *uterus* consists of an oval cavity surrounded with a strong membrane. It lies between the limbs of the intestine, which are in contact with its walls on all sides, except the inferior, which rests upon the oviduct.

The size of the uterus depends entirely upon its contents. If it contain a fully developed embryo, it distends the entire circumference of the animal on both the dorsal and ventral aspect; and whilst pushing back the *testis* and ovary, it may reach almost the whole length of the limbs of the intestine. Immediately after the birth of an embryo it shrinks to $\frac{3}{4}$ or $\frac{1}{2}$ its former size, and remains distended with a clear fluid, which may be said to be poured out suddenly into its cavity.

This rapid emptying is accompanied with a simultaneous shortening of the animal, in consequence of which also the *testes* and ovary are made to occupy a rather higher position than before.

During the gradual distension of the *uterus* when pregnant, the *papillæform* elevation through which the *ovum* and spermatozoa enter the uterine cavity, appears finally to be entirely obliterated. After the birth this orifice is usually seen again to project very prominently into the interior, though it sometimes happens that it remains invisible among the folds of the *uterus*, so as to render its existence doubtful.

But, however uncertain the existence of a permanent orifice of this kind may be, that of an opening for the escape of the young is still more uncertain. The spot at which the birth of the embryo takes place is perfectly definite, close beneath the penis-like organ afterwards to be described, but I have not yet succeeded in detecting any special indication of an opening at this point.

Immediately after parturition, the integument is thrown into folds, and a slight opacity of the organ ensues, which renders it extremely difficult to detect the maternal orifice.*

The inner surface of the *uterus* is always covered with a fine granular layer of irregular thickness, with which the upper and lower points of the cavity are as it were, plugged. In this layer may sometimes be seen minute cellæform bodies;

* Mr. Bradley (l. c., p. 210), states that "while observing these animals with Dr. Bowerbank, they saw the young creature free itself by tearing through the parental envelope, and containing within itself the progeny of a third generation."

and during the formation of the embryo it disappears altogether.

To the *sexual system* must also be referred a peculiar *penis-like organ* which has not been noticed by v. Siebold.

It is placed close behind the *pharynx*, beneath the integument on the upper boundary of the intestinal tube; and consists of a sacculus inclosing the proper *penis*, and having attached to it three peculiar sacciform organs.

The penis-sac is of a pyriform shape, or almost spherical; and it appears to be perforated at the obtuse point by which it is in contact with the integument, and this orifice is surrounded in a radial manner with from eight to sixteen hooks, the uppermost of which is distinguished by its size and figure. The points of all the hooks are directed towards the common centre, the apparent orifice of the sac; their bases are enlarged and spoon-shaped, the broad surface being applied upon the wall of the sac; and from either side of the base of each hook a streak proceeds in a meridian direction upon and immediately beneath the surface of the sacculus.

The large hook appears to have two lateral processes, by which it is affixed upon the obtuse angle of a triangular basal portion.

On the bottom of this armed sacculus lies a minute pyriform body, perforated in its longitudinal axis, and occupying about a quarter of the sacculus, with which the middle, sacciform organ, which is distinguished by a thick membrane and opaque granular contents, appears to be immediately connected. The sacculus is somewhat convoluted, and presents a constriction such as may usually be observed in the *vesicula seminalis externa* of the *Distomatæ*.

I never noticed spermatozoa in it, nor could any channel be traced between it and the *testis*. On either side of this sacculus, which may be compared to a rudimentary *vesicula seminalis*, are placed two double follicles or sacs.

The two upper are elongated, and smaller than the two lower spherical ones. Their contents consist of a fine granular matter, and each division presents a clear *nucleus*, and opaque *nucleolus*. These organs cannot be compared to the vesicles connected with the *penis* of *Dactylogyrus fallax*, which are fitted with a viscous brown material, and situated on either side of the seminal vesicle.

The *ovum* of *Gyrodactylus elegans*, after its detachment (an act which it may be remarked has not yet been observed, owing, as it would seem, to the great slowness with which it takes place), is a transparent globule or cell with a *nucleus*, as clear as water, and sharply defined, though the nucleolus, as well as the vitellus, is slightly opalescent. In the *nucleolus* may occasionally be seen a second globular body, as clear and well defined as the *nucleus* itself, the nature of which is unknown. In the oviduct may occasionally be perceived very minute *ova* (particularly in small *Gyrodactyli*), of hardly one third the usual size. It is possible that these may grow while still in the oviduct, which never contains more than one (full sized) *ovum*.

Whilst the *ovum* is lying in the oviduct changes go on in it, which have usually been referred to the influence of impregnation. The nucleolus, at first sharply defined, loses its definite outline, and the spot sometimes noticed in it is no longer visible. As the dissolution of the germinal spot proceeds, the *nucleus* becomes more and more transparent, the space which it occupies being increased in like proportion. At length the perfectly clear nucleus of the *ovum* is rendered turbid, from the remains of the germinal spot floating about within it.

I happened, on one occasion, to observe an *ovum* in this stage make its entrance into the *uterus*.

The appearances presented in this transit may best be compared with the passage of a viscous substance through a narrow orifice. The drops of vitellus gradually increasing in size, which was protruded from the *papilla* into the uterine cavity, appeared every moment as if it would be torn off. The *nucleus* or germinal vesicle was forced towards the entrance of the uterine *papilla* by the contractions of the animal, which are, apparently, the effective agents in the process. The lower part of its periphery during this, was still surrounded with a pretty thick layer of *vitellus*. The *nucleus* or germinal vesicle thus compressed assumed every possible shape, every inequality in the pressure causing a change of form. It appeared to oppose great difficulties to the passage of the *ovum*. Suddenly it burst, and the *ovum* rushed into the *uterus*.

When the entrance was thus effected there was seen, not as might have been supposed from the violence of the proceeding, several drops of matter, or an irregular amorphous mass, but the *uterus* was occupied by a large, dark, opalescent globular body, whose perfectly uniform aspect resembled very closely the rather lighter yelk of the uninjured *ovum*. In the case in which the above observation was made the animal perished before segmentation commenced.

Thus it appeared as if the altered contents of the germinal vesicle became intimately mingled with the *vitellus*, or that the same process takes place with the germinal vesicle and *vitellus,* as previously occurs with the vesicular spot in the germinal spot and itself; and somewhat later with the germinal spot and germinal vesicle.

The following process also was directly observed. A globular body, in every visible property precisely like that just described, occupied the *uterus,* whilst almost in the middle of the oviduct, which was otherwise empty, projected a small *ovum,* still retaining its connection with the ovary. Suddenly the first segment globule [*ovum*] lying in the *uterus,* threw out an elevation on its upper side, whose base enlarging in the direction of the greatest vertical diameter of the *ovum* rapidly advanced, forming a progressive constriction, which gradually increased in size and depth. When this groove had reached the middle of the *ovum* it ceased to extend, and visibly becoming deeper and deeper appeared at last to bisect the *ovum.*

Further observation was prevented by the commencing decomposition of the animal, at the end of four hours, during which period the two coherent segment spheres remained perfectly motionless.

The further process of segmentation, as already remarked by Von Siebold, takes place with great irregularity.

Perfect cells do not appear to be formed until after this first division of the *ovum.* Whilst in other cases a *nucleus* and *nucleolus* are usually seen to be formed in the ovum or first segment-sphere, and to precede the second division, in the present instance the formation of a *nucleus* and *nucleoli* does not commence until after the first constriction has taken place.

The mode in which *nuclei* and *nucleoli* originate, is difficult to follow. It appears as if in the interior of the *ovum* a [differentiation or] separation of the fluid from the solid elements took place, since a sort of breaking up of the substance may occasionally be remarked in the interior of the substance, manifested by its coarsely granular aspect. Sometimes this appearance might be attributed to the existence of very minute, clear, closely contiguous nuclear vesicles with corresponding *nucleoli,* but sometimes this condition was not obvious.

The *nucleus* and *nucleolus,* seen in the two segment-spheres, are of very different sizes. The *nucleus* is always clear, sharply defined, occasionally round, sometimes oval, or even more or less regularly biscuit- or sausage-shaped. The *nucleolus* is only more opaque; in other respects it resembles the *nucleus* in form. When the *nucleolus* has attained a certain size it may become elongated and irregularly bent, whilst shallow constrictions on its surface plainly indicate an incipient multiplication by division.

When the number of cell *nuclei* which arise in every part of the segment-spheres, as well at the periphery as in the centre, has increased, they necessarily approach the surface, on which they cause visible protrusions. This appears to be the commencement of the exit of the cells from the segment-spheres. The *nucleus* must derive something from its nidus because bare *nuclei* with *nucleoli* are never seen attached in a very irregular manner to the segment-sphere [vitelline mass], but always *cells*. The opening through which these cells escape, owing to the viscous condition of the *ovum* above noticed, of course closes so as to be invisible.

The embryonal-cells adhere to the *ovum* only by a very small part of their periphery, although I have never seen them to become wholly detached, however active the movement of the animal might be.

The cells do not at first, any more than the segment-spheres, occupy the entire uterine cavity. Both float in a very clear fluid. At a later period the cells increase in number, whilst at the same time they diminish in size. The remains of the segment-spheres [of the vitelline masses] which are also reduced in size, retain the spherical form, until finally the cells cover them completely. The fluid at the same time disappears, and the *uterus* closely embraces its contents.

In this condition the embryo represents an egg-shaped mass of cells, which, within certain limits, are variable in dimensions, and have a very clear nucleus, an opaque, oval or rounded *nucleolus*, and equally opaque contents.

The remains of one or both of the segment-spheres, usually of both, rarely of one only, remain still visible for a considerable time. They are always found in the situation where the uterus of the embryo is afterwards formed. They are both still present, when, under a strong magnifying power, the commencement of the large hooks and of the sixteen small points around the caudal disc may be plainly seen at the lower end of the cellular and as yet perfectly oval embryo.

But this appears to be the limit to their future development. About this period one only of them is visible, surrounded with cells at its lower border, which may be distinguished from those constituting the parenchyma of the embryo by their being encompassed by a fine elliptical line. These cells are of very various sizes, representing in miniature the irregular process observed in the large segment-spheres.

At a later period the remains of the other segment-sphere also disappear, when the hooklets and hooks of the caudal disc may be viewed even with a low magnifying power, and the egg-shaped mass, now composed of uniform large cells, is seen of considerable size in the interior of the embryo.

In the further development of the embryo the cells constituting the future cephalic portion are the first to be reduced to the smallest size. A furrow which commences as a shallow lateral groove, and gradually increases in depth whilst advancing in an oblique direction from below to above, marks off the cephalic portion.

A transverse furrow indicates the boundary of the caudal disc; and fine lines mark the limits of the various organs, amongst which the ovary and the so-termed unicellular glands are distinguished by the size of the cells composing them, whilst the cells which constitute the cephalic extremity of the animal gradually lose their distinctness.

The mature embryo lies in a curved posture in the *uterus*, the head and tail being placed together, touching with their neutral surfaces.

The *uterus* of the *embryo*, even at this time, contains a second progeny in the shape of an *embryo*, whose hooklets are already pedunculate, although it still manifestly consists only of cells. The rudiments of the organs begin to be visible here and there, and the situation of the ovary is indicated by some cells remarkable for their size.

In the interior of this second *embryo*, in the situation where the *uterus* is placed, even at this time may be seen an oval aggregation of cells, which manifestly presents at its lower end sixteen radiating hooklets; behind which are visible the two points of the large hooks.

Within the second *embryo* also, with some attention will be perceived an elliptical marking, which likewise corresponds to the situation where the future *uterus* is to appear. At this spot the cells are somewhat larger, but of very unequal size.

An embryo of this kind, at the period when an *ovum* is perceptible in the oviduct, spermatozoa in the *testes*, and in which all the organs are fully formed, is ripe for expulsion. The *uterus*, whose much distended walls are no longer covered with the granular layer, embraces it closely. The act of parturition is very sudden; and the embryo escapes on the ventral aspect of the body close to the penis, through an orifice which, as before said, closes immediately.

The newly born perfectly mature *Gyrodactylus* resembles its parent in every respect, except that it is a little smaller. In its *uterus* may be distinctly seen two successive generations lodged one within the other, and easily recognisable by the hooks. In favorable cases indications of a third generation even may be perceived within the second.

From the foregoing observations it is obvious that *Gyrodactylus* produces at least one generation in the sexual way. How the second and third embryo arise has not yet been cleared up.

[To these observations succeed some remarks upon the question as to how the contained embryos of the second and third generations arise, which, however, we omit for want of space, merely stating the propositions, which appear to the author to require elucidation.

1. The second and third generations may arise like the first in which they are contained; that is to say, in a sexual manner.
2. Or it may be that portions of the original vitellus or uterine *ovum* from which the first generation was produced, remain over, which, even when contained in the embryo, repeat its formation.
3. Or the second and third generations are to be regarded as spores.

For further information respecting *Gyrodactylus*, refer to:

V. Nordmann.—'Mikrographische Beiträge,' i. p. 106; Tab. x, figs. 1, 2; 'Ann. d. Sc. Nat,' tom. xxx, pl. xix, fig. 7.

Creplin.—'Ersch and Gruber's Encyclopädie,' xxxii, p. 301; Froriep, 'Neue Notizen,' viii, p. 84; Wiegmann's 'Archiv,' (1839) p. 164. Bd. ii.

Dujardin.—'Histoire naturelle des Helminthes,' p. 480.

V. Siebold.—'Zeitschrift für Wissenschaft. Zoologie,' i, p. 347. (1849).

Diesing.—'Systema Helminthum,' i, p, 432, 641, 651; 'Fitzungsherichte der Math. Naturw. Klasse der K. K. Akademie in Wien,' xxxii, p. 375, (1858).

Wagener.—'Natuurkund Verhandeling.' Haarlem, xiii, p, 51, 54.

Van Beneden.—'Memoire couronné sur les Vers intestinaux,' p, 63.

Bradley C. L.—'Journal of Proceedings of Linnean Society,' v, p. 209, (1860).]

Researches *on the* Mode *of* Nutrition *of the* Mucedineæ. By M. L. Pasteur.

('Comptes rendus,' vol. li, p. 709.)

About eighteen months since the author communicated to the Academy an experiment on the subject of yeast, which attracted the particular attention of physiologists. When an almost imponderable trace of the yeast-fungus was sown in pure water, holding in solution certain crystallizable and, as it may be said, inorganic principles—that is to say, sugar-candy, an ammoniacal salt, and some phosphates—the minute globules of the yeast-fungus might be seen to multiply, procuring their azote from the ammoniacal salt, their carbon from the sugar, and their mineral constituents from the phosphates, the sugar at the same time undergoing fermentation. The absence of any one of the three aliments prevented the development of the yeast. Subsequently, M. Pasteur extended his researches, with the same result, to the lactic ferment.

The above experiment was conclusive as to the organized nature of beer-yeast, which Berzelius, even in his latest writings, always regarded as a chemical precipitate of a globular form. It moreover afforded a manifest proof of the concealed relations which exist between the ferments and the higher plants.

All the previous labours of the author, communicated to the Academy for some years past, concur in the establishing of the principle, that all fermentations have their origin in mycodermic plants occupying the lowest place in the scale of being. The result of the author's more recent researches now made public will add a new support to this opinion. Taken with the results of his former experiments on the subject of yeast, they will show a great analogy between ferments and the lowest as well as the highest forms of plants. The author, consequently, hopes that physiologists will find in similar researches a new method of inquiry opened to them, fitted for the rigorous and easy examination of various questions respecting the nutrition of plants.

In pure distilled water he dissolves an acid, crystallized ammoniacal salt, some sugar-candy, and the phosphatic salts procured by the incineration of yeast. He then sows in the liquid some spores of *Penicillium,* or any mucedinous fungus. These spores readily germinate, and in a short time (only two or three days) the liquid is filled with flocculi of the mycelium of the *fungus,* of which a great many quickly spread themselves on the surface of the liquid and there fructify. The vegetation exhibits no symptoms of languor. By taking the precaution of employing an *acid* salt of ammonia, the development of infusoria is prevented, the presence of which would soon arrest the progress of the little plant, owing to their absorption of the oxygen of the air (contained in the water), and which is indispensable to the well-being of the fungus. The whole of the carbon of the plant is derived from the sugar, its azote from the ammonia, and its mineral elements from the phosphates. As regards, therefore, the assimilation of the azote and phosphates, a complete analogy exists between ferments, the *mucedines,* and plants of a more complicated organization. And that this is the case, is further proved in the most decisive way by the following facts.

If, in the experiment above related, any one of the soluble elements is suppressed, the vegetation is arrested. For example: the mineral matter is that which would seem to be the least indispensable for organisms of such a nature; but if the liquid contain no phosphates, vegetation is no longer possible, whatever may be the proportion of sugar and ammoniacal salt. All that can be said is, that the germination of the spores may just commence under the influence of the phosphates contained in the spores themselves in infinitely minute quantity. In the same way, if the ammoniacal salt is suppressed, the plant is not developed at all. There is merely the abortive commencement of germination, due to the presence of the albuminoid matter in the spores, although there may be a superabundance of free azote in the surrounding air, or in solution in the liquid. Lastly, the same result follows if the sugar or carbonaceous aliment is absent, notwithstanding there may be any amount of carbonic acid in the air or in the liquid. The author has ascertained a fact, that, as regards the origin of their carbon, the mucedines differ essentially from phanerogamic plants. They do *not* decompose carbonic acid, nor do they evolve oxygen. On the contrary, the *absorption* of oxygen and the *evolution* of carbonic acid are necessary and permanent acts of their vitality.

What, then, are the consequences of the results of experiments above stated? In the first place, they afford precise ideas respecting the mode of nutrition of the mucedinous fungi, with regard to which science possessed only the observation of M. Bineau, refuted to the Academy by M. Boussingault on a previous occasion.* Secondly—and this is,

* The interesting experiments of M. Bineau show that the nitrates and the ammonia disappear from the rain-water in which they were held in solution, under the influence of cryptogamic vegetation. It is well known that rain-

perhaps, of still greater importance to remark—these results indicate a method by means of which vegetable physiology will be enabled to attack, without difficulty, the most difficult questions respecting the life of these little plants, so as to lead the way surely to the study of the same problems in the higher plants.

Even should it be feared that it may not be possible to apply to the larger plants the results afforded by organisms apparently so low, still great interest will equally attach to the resolution of the difficulties which arise in the study of vegetable life, when we commence with those plants whose less complex organization renders our conclusions easier and more certain. In their case, the *plant* is reduced in some measure to the condition of a *cell;* and the progress of science shows more and more that the study of the most complicated actions performed under the influence of either vegetable or animal life is reduced, in its ultimate analysis, to the discovery of the phenomena proper to the *cell.*

water affords nitrates and ammoniacal salts containing assimilable azote, together with salts of potass, soda, and lime, all favorable to vegetation; but another element, equally indispensable, was always found to be wanting—phosphoric acid, which, in spite of numerous researches, had not been discovered in rain-water. M. Boussingault states that this lacuna in the fertilizing elements of rain has just been supplied by M. Burral, who has recently ascertained the existence of phosphates in rain-water.

NOTES AND CORRESPONDENCE.

Micrometers.—Few subjects have been more frequently discussed among microscopists than that of the relative value of the various micrometers in common use; and, some time ago, I remember a stricture upon Mr. Quekett for having in his 'Practical Treatise,' &c., said of Ramsden's micrometer (the double cobweb) that, "as its accuracy depends entirely on that of the glass micrometer used in finding the value of its divisions, the measurements made by it are by no means so delicate as they appear to be."

There is truth in the above: nevertheless it would have been better if, instead of the word, "delicate," he had used *satisfactory*. The fact is, all micrometers on the principle of Ramsden, Jackson, &c., must remain unsatisfactory if we have no ready means at hand of *proving* the accuracy of the glass micrometer itself; for though an exhibitor may tell his friend "the divisions on this glass micrometer *are* exactly the one hundredth of an inch," nothing is more likely than that his friend will say, "But how do you *know* that?" To which we may reply, "I had the glass micrometer from a first-rate London optician, who, I am confident, would not supply a defective article," &c. But to this many would answer, "Ah! *that* does not satisfy *me*. I should like to see something like *proof*, and not mere *statement*," &c.

This is but reasonable; and therefore it is my opinion that every user of our favorite instrument, to whom expense is not an object, ought to have by him a means of proving the accuracy of his graduated glasses; and for this purpose I believe nothing is better than the mechanical stage micrometer I alluded to in the note, p. 270, in your Journal for last October. It is not only a good micrometer in itself, but it also enables us to prove the accuracy of all others. So that though I have all the micrometrical apparatus I have ever heard of—Ramsden's, Jackson's, Nobert's, &c.—and a variety of glass micrometers by various hands, yet I consider the mechanical stage micrometer as the *basis* of them all; because it is the means of *proving the accuracy* of all the rest.

Transparent Injections.—I quite agree with your remarks on "the clumsy width" of the glasses on which these injections (German, I am told) are mounted (see Journal for last April, p. 131); but I should like to be allowed to inform your readers that I have found the said objects remarkably easy to re-mount. One of them (human eyelid) having been accidentally fractured, I heated and separated the glasses, and found that the object could be re-mounted, with fresh glass and balsam, as easily as a bee's wing; which is commonly one of the objects recommended to a young practitioner, when first trying his hand at a "balsam object."

But, except in case of fracture, or when the original glass is very bad, this process is not needed; all that is requisite being to slice off, with a glazier's diamond, a piece from each side and end, so as to reduce the glass to the English standard size of three inches by one, and then polish off the edges.

These trifling operations every microscopist should be able to do; as he ought to be an illustration of old Ben Franklin's definition of a man, viz., "a tool-using animal." I have either cut down or re-mounted eight of these awkward *slabs* of glass; and they are now, as you say, "much improved for examination."

The Astronomer's Protest.—I have been told that I ought not to notice the attack in the April number, p. 133, as the writer shoots from behind a corner! But I feel it a duty to do so, on account of his depreciation of poor Dr. Goring, to whom we microscopists owe so much, and who he accuses of "ignorance of astronomy!"

A very intimate friend of his, and who is, very righteously, indignant at the derogatory remark, has just written to me that his knowledge of that science was such as to render him well worthy the name of an astronomer. It was a favorite study of his.

His astronomical apparatus was magnificent, and his largest telescope (a Newtonian of great excellence) was one of the best of the day. So much importance was attached to it that the Astronomer Royal went to see it. The Doctor also published on the subject.

Among other things he furnished a valuable paper on improvements in telescopes, to the 'Quarterly Journal of the

Royal Institution.' In short, the probability is that his knowledge of astronomy was equal to that of "A Fellow of the Royal Astronomical Society;" but he had *sensus communis* enough to know that in point of real profit (that is to say *use*) to man, the revelations of the telescope pale in insignificance before those of the microscope. And this leads me to remark that I earnestly wish some one, capable of the task, would give us an elaborate paper, in your journal, upon the subject of the really practical use of the microscope. I have met with numerous *gleanings* in various works, but we sadly want a *digest* of them all; such as its importance in diagnosis, and the determination of the nature of diseases. Its forensic importance; such, for example, as the decision of the questions, whether the red matter upon the knife with which it is supposed a murder has been committed, is or is not human blood,—whether certain fibres adhering to it are of linen or cotton, &c. At what station on the railway a box, &c., was filled with sand, after its contents had been surreptitiously abstracted; also in the detection of poisons, and various adulterations. Then its discoveries in geology, botany, and natural history in general, are immense. In short, it would require considerable space even to *enumerate* all the points of real use—the question at issue—in which the microscope beats the telescope completely out of the field!

Moreover it is really a *contracted* view that the marvels of the telescope are so much more mighty and grand than those of the microscope; for the words great and small have reference only to man's poor and finite notions. The Creator makes no such distinctions. A great authority assures us that with Him one day is "as a thousand years, and a thousand years as one day." (2 Peter iii, 8.)

And it may as confidently be stated that the sun and a monad, the planet Saturn and a diatom, &c., are the same in the great view of that Being,

> "Who sees with equal eye, as God of all,
> A hero perish, or a sparrow fall;
> Atoms or systems into ruin hurl'd,
> And now a bubble burst, and now a world."

All *equally* show creative power; for it is equally as impossible for man to *create* a single particle of sand as the whole solar system. From what I have said all really intelligent readers will see that microscopic objects are just as *great*, in the *true* sense of the term, as telescopic objects; and, therefore, have no need to "pale in insignificance" before them; and are, at the same time, of far more practical utility.—Q. E. D.

Hypersthene.—A correspondent has written me that though he has examined this object together with one of our first London opticians, yet "we could not make it that wonderful object you speak of." Very probably not; for among the different specimens I have examined, I have not seen another equal to mine; and this leads me to remark that I wish our object-preparers would turn their attention more to it; for, being of a crystalline texture, a good deal may depend on the angle at which it is cut. When it is first-rate, and exhibited as described (April number, p. 135), with inch objective and Lieberkühn (*side* reflexion will not do), and at night by *intense* lamp-light, without a "modifier," I think it stands quite at the head of what may be called "the gorgeous class" of objects; and I find it more frequently elicits that rapturous OH!!! (which sounds so delightfully at a microscopic soirée) than any other of that class; *e.g.* peacock copper, ruby copper, needle antimony, iron ore from Elba, elytron of Curculio regalis, &c. Before quitting this subject allow me to correct a slight error. Your proof-reader, by altering my *stop*, has altered my *meaning*. I wrote, "I seem to see part behind part," &c.; just as in looking at the sky we see cloud behind cloud; or, in a forest, tree behind tree, &c. This is the case more especially when we use the binocular microscope. The mention of "microscopic soirée" leads me to write a few words on the subject of the

Microscopic turn-tables, which are such an admirable auxiliary at those friendly meetings. Very handsome ones are made of iron, walnut, &c., expressly for the purpose; but, as many may not choose to incur the cost of them, it is well to mention (what may possibly not occur to every one who possesses the article) that one of the ordinary revolving tables, with drawers and knobs (without which a gentleman's library is not considered complete), answers the purpose to admiration.

The usual size admits eight sitters comfortably, and the perfection of the "round game at microscope," as I call it, would of course be to have as many instruments as there are players.

But as this would be too costly a game for many pockets (unless, as in a "pic-nic," each was to bring his own *quota*), I find it best to place the instruments (whatever number there are) at equal distances. I have three microscopes, viz., a first-rate Ross, ditto Smith, Beck and Beck; and a Powell, somewhat antiquated, but still a fine instrument. The fourth place I fill up with a first-rate table stereoscope. These are placed on the table in correspondence with the four cardinal points, with one sitter before each, and one between.

Thus there are four lookers and four waiters simultaneously. The table is turned, not by the power of "electro-biology," but in the way that Dr. Faraday would approve of, viz., by the hands applied to the drawer-knobs, which answer admirably for the purpose.

Each time a microscope, &c., passes the exhibitor he changes the object, and sends it on again.

I have found every one delighted with this new kind of "table-turning," and it is admitted to be an immense improvement upon the old "round games," where the "objects" are only ivory fish, and speckled bits of paper. I hope to live to see the game become quite common.

On one point, however, I must offer a small caution. When the microscopes used in the round-game are all "binoculars," as we hope all will be ere long, the noses of the spectators being placed between the two tubes, the exhibitor (who is, of course, the chief table-turner) must beware of applying his hands to the knobs until they (the said probosces) are all withdrawn; otherwise his friends may receive a rap on the olfactory protuberance which is anything but agreeable!

I have found the best watchword on these occasions to be —NOSES!—uttered in an *audible* manner; it acts like electricity; and the velocity with which the said projections are instantly chucked back (especially those which have had a little experience), is irresistibly ludicrous.—Henry U. Janson, Exeter.

Blood Corpuscles.—The paper in the January number of the 'Microscopic Quarterly Journal,' "On the alteration of the form of blood-corpuscles treated by certain substances," seems to offer an explanation of the cause of death from snake-bites, and other animal poisons.

The form of blood-corpuscle may be altered to such an extent by the injection of a poisonous fluid, that the circulation in the capillaries may either be stopped or seriously retarded. I offer this suggestion to those of your readers who may have an opportunity of procuring the poison of the viper, or other snakes, for experiment.—W. T. Suffolk, Camberwell.

PROCEEDINGS OF SOCIETIES.

MICROSCOPICAL SOCIETY, *April 10th*, 1861.

This evening the annual *soirée* was held, at which about 700 persons were present.

May 8th, 1861.

R. J. FARRANTS, Esq., *President*, in the Chair.

W. R. Milner, Esq., and Jas. Crowther, Esq., were balloted for, and duly elected members of the Society.

The following papers were read:—"On a new Hemispherical Condenser," by the Rev. J. B. Reade. (Trans. p. 59.)

"On the Microscopic Characters of the Crystals of Arsenious Acid," by Dr. Guy. (Trans. p. 50.)

June 12th, 1861.

R. J. FARRANTS, Esq., *President*, in the Chair.

The President announced, that Mr. Peters had informed the Council that he was willing to present to the Society his machine for minute microscopic writing, and that the Council had decided that the munificent offer of Mr. Peters should be accepted, and the warmest thanks awarded to him for his valuable present. This announcement was received by the meeting with acclamation.

John Waterhouse, Esq.; Thos. Dell, Esq.; E. B. Green, Esq.; J. R. Wells, Esq.; F. T. Griffiths, Esq.; G. G. Hardingham, Esq.; D. Pidgeon, Esq.; W. W. Collins, Esq.; Captain Lang; and Dr. W. A. Guy, were balloted for, and duly elected members of the Society.

The following papers were read:—"On the Seed of Dictyoloma Peruviana," by H. B. Brady, Esq. (Trans. p. 65.)

"On the Circulation in the Tadpole," by J. Whitney, Esq.

"Descriptions of New and Rare Diatoms," Series II and III, by R. K. Greville, LL.D. (Trans. p. 67.)

The meeting was then adjourned until the second Wednesday in October next.

PRESENTATIONS TO MICROSCOPICAL SOCIETY.

January.

	Presented by
On the Origin of Species by means of Organic Affinity. By H. Freke, M.B.	The Author.
Recreative Science, No. 18	The Editor.
Journal of the Proceedings of the Linnean Society	The Society.
Canadian Journal, No. 30	Ditto.

	Presented by
Report of the Council of the Art Union of London for 1860	The Society.
The Annals and Magazine of Natural History, No. 37	Purchased.
Six Slides of "Salicin"	Mr. J. T. Norman.

February.

Histoire Physique, Politique et Naturelle de l'Ile de Cuba. Par M. Ramon de la Sagra. With 12 Plates	M. S. Legg.
Transactions of the Tyneside Naturalist's Field Club, Vol. IV, Part 4	The Society.
Quarterly Journal of the Geological Society, No. 65	Ditto.
Recreative Science, No. 19	The Editor.
The Photographic Journal, No. 105	Ditto.
The Annals and Magazine of Natural History, No. 38	Purchased.
Ray Society. Blackwall's Spiders of Great Britain and Ireland, Part 1, 1861	Ditto.
Researches on the Intimate Structure of the Brain. By J. Lockhart Clarke, Esq., F.R.S.	The Author.
Further Researches on the Grey Substance of the Spinal Cord. By J. Lockhart Clarke, Esq., F.R.S.	Ditto.
Three Slides of Foraminifera and Infusoria	J.R.Freestone,Esq.

March.

United States Exploring Expedition—Botany. By W. S. Sullivant, Esq.	The Author.
Nobert's Test Plate and the Striæ of Diatoms. By W. S. Sullivant, Esq., and T. G. Wormley, Esq.	Ditto.
On some Oceanic Entomostracæ, collected by Captain Power. By John Lubbock, Esq.	Ditto.
On Sphærularia Bombi. By John Lubbock, Esq.	Ditto.
On Cystic Entozoa of the Human Kidney. By T. H. Barker, Esq., M.D.	Ditto.
Severe Urticaria, produced by some of the Setaceous Larvæ. By T. H. Barker, Esq., M.D.	Ditto.
Observations on the Genus Unio. By Dr. Lee. Vol. VIII, Part 1.	Ditto.
History of Infusoria, including the Desmidiaceæ and Diatomaceæ, British and Foreign. By Andrew Pritchard, Esq. Fourth Edition	Ditto.
Die Gattung Cornuspira unter den Monothalamien und Bemerkungen über die Organisation und Fortpflanzung der Polythalamien. Von Prof. Max Schultze.	Ditto.
Smithsonian Contributions to Knowledge, Vol. XI	The Society.
Canadian Journal of Industry, Science, and Art, No. 31	Ditto.
Proceedings and Progress of the Academy of Natural Sciences of Philadelphia	Ditto.
Annals and Magazine of Natural History, No. 39	Purchased.
London Review, Nos. 32 to 36	The Editor.
Journal of Dental Science, Nos. 54 to 56	Ditto.
Twenty-four Slides of Diatomaceæ from Warwick	J. Staunton, Esq.

W. G. Searson, *Curator.*

Manchester Literary and Philosophical Society.
Microscopical Section.

April 15th, 1861.

Mr. Joseph Sidebotham in the Chair.

Mr. Beck, of London, exhibited two of his binocular microscopes on Mr. Wenham's principle; also a great variety of first class objects.

The members were struck with the advantages of the binocular system for low and medium powers, and the manner in which it presents in full relief the various parts of objects; they were also pleased with the beauty of certain injected preparations—as the eyes of small animals, sections of tongues, &c.; the binocular displaying the variety of structure and the smallest blood-vessels filled with a bright red, and transparent injected substance—*in situ*—distinctly to be traced one above another, instead of appearing, as with the single microscope, a tangled mass all in the same plane. These instruments and objects strongly mark the rapid advance microscopy is making at the present day.

Mr. Hardman, of Davyhulme, presented a number of dissecting needles with turned handles, which were thankfully accepted by the members.

Mr. Mothers exhibited infusoria of various kinds from his aquaria.

May 30th, 1861.

Annual Meeting.

Professor Williamson in the Chair.

The third annual report of the section was read and approved.

The following officers were elected for the session 1861-2:—President, W. C. Williamson, F.R.S.; Vice Presidents, Edward W. Binney, F.R.S., F.G.S., J. B. Dancer, F.R.A.S., Joseph Sidebotham; Treasurer, James G. Lynde, F.G.S.

Of the Council:—Joseph Bexendell, F.R.A.S., John Dale, James Dorrington, Arthur G. Latham, J. W. McClure, T. H. Nevill, R. A. Smith, Ph. D., F.R.S., F.C.S., S. W. Williamson; Secretary, George Mosley.

Professor Williamson called the attention of the meeting to the structure of the Cælorhynchus from the older Tertiary strata of England and America. This structure he had already described in a paper published in the 'Philosophical Transactions,' (part ii for 1849, p. 471), and in a second memoir (part ii for 1851, p. 667), reasons were advanced for concluding that the fossil was the dermal spine of one of the Balistinæ of the family of Ostraciont Fishes. Subsequently, at a meeting of the Geological Society of Manchester, Professor Williamson advocated the same views, basing his arguments on physiological data; nevertheless the fossil still appears in the latest edition of 'Lyell's Manual of

Geology' as the "prolonged premaxillary bone, or sword, of a fossil sword-fish." Professor Williamson showed that the Cælorhynchus consisted wholly of a pure form of dentine, without any Haversian canals or other indications of bone-structure; whilst the premaxillary bones of the sword-fish consist entirely of the same membraniform bone as is seen in other parts of the endo-skeleton of that fish; and besides this special discrepancy, he suggested, *that there was no instance of an osseous element of the endo-skeleton being replaced by one consisting wholly and entirely of dentine.* They were frequently in juxta-position, dentine being developed upon an osseous basis, but if the prevailing opinion respecting Cælorhynchus be correct, the anomalous admission must be made *that pure bone may be replaced in the endo-skeleton, by equally pure dentine*—a conclusion which physiology does not appear to sustain.

Professor Williamson having recently called the attention of Dr. Kolliker, of Wurzburg, to this question, quoted the following extract from a letter he had recently received from that distinguished physiologist.

"With regard to Cælorhynchus, I am quite and decidedly of your opinion. I examined carefully the accompanying sections which I got from you, and compared the structure with that of the spines of the Balistini, and convinced myself that the structure of both is the same. I am therefore quite of the same opinion as you, and have not the least objection, if you should find it necessary, to make this, my adhesion to your views, publicly known."

Mr. Sidebotham exhibited a new binocular microscope, by Dancer, which in several respects was considered superior to any binocular yet exhibited here.

ANNUAL REPORT.

The third annual report of your Council presents an opportunity for congratulation upon the steady progress of the Section, especially on the more regular attendance at the meetings, and the more interesting nature of its proceedings. The difficulties attending its establishment appear to be overcome, and a career of usefulness is opening to it, which may prove important to the progress of microscopical investigation.

During the past year two members have been removed by death, Mr. Thompson and Mr. Long. The former had few opportunities of attending the meetings of the Section, but he took great interest in its proceedings. Mr. Long was a member of your Council; he was an ardent follower of scientific pursuits, and his loss is deeply felt by all who knew him. One resignation has been accepted. Three new members have been elected. Several gentlemen have become members of the Parent Society in order to be qualified for joining the Section, and the names of six candidates are now before you for election.

Your Secretary has been elected a member of the Council of the Parent Society, which may be regarded as a compliment to the Section and a proof of the estimation in which it is held.

The Treasurer's report for the year commences with a balance in hand of £7 0*s*. 2*d*. The receipts were £14 0*s*. 0*d*.; the expenditure £17 8*s*. 4*d*.; and there is now a balance in hand of £3 11*s*. 10*d*.

During the session the Section has held two summer and eight ordinary meetings, at which several papers have been read, much valuable information communicated, and many specimens exhibited. A pleasant excursion was made to Croft's Bank, at the invitation of Mr. Hepworth, whose kind reception, display of objects, and solid microscopical knowledge, will long be remembered by those who partook of his hospitality.

Papers have been read by Mr. J. B. Dancer, F.R.A.S., "On cleaning and preparing Diatoms, &c., obtained from soundings." Mr. W. H. Heys, "On the Kaloscope." And by your Secretary upon "Mr. Dale's process for the separation of tallow from soundings."

Addresses have been given on important subjects by your President, by Mr. Binney, Mr. Sidebotham, and others. Many contributions have been received from gentlemen who take an interest in the prosperity of the Section; amongst whom may be named Capt. M. F. Maury and Lieut. Brooke of the United States Navy, Capt. Anderson, Mr. W. K. Parker, Dr. Wallich, Professor Agassiz, Dr. Bacon, Mr. Edwards of New York, Mr. Hepworth, and other distinguished scientific men, whose assistance has been highly valued and duly recorded.

The thanks of the Section are due to Mr. Dancer for the unremitting kindness with which he has provided microscopes and objects for use at the meetings; and the Council wish particularly to record their appreciation of his valuable assistance.

Your Secretary has originated a method of collecting specimens of the sea-bottom obtained by captains of vessels from the soundings they take in ascertaining their position on approaching land; and many shipmasters have been furnished with envelopes in which to preserve those specimens for this Section. The plan promises to be highly successful; upwards of eighty specimens have been received from different parts of the world, such as the English Channel, Mediterranean and Red Seas, Coasts of Portugal and Brazil, deep Atlantic and deep North Pacific, Coasts of Japan, &c., &c. Amongst those of the Pacific Ocean are the deepest soundings from which material has yet been brought up from the sea-bottom, say 3030 fathoms, or nearly 3½ miles; the quantity of material is necessarily small; and so far as yet examined, in this specimen no trace of organic bodies has been found. Arrangements are in progress for the scientific examination and mounting of these soundings, some of which will be laid before you this evening. About 1200 envelopes have been distributed, mostly amongst captains now out on distant voyages, to the East and West Indies, Coasts of Africa and Australia, as well as to some of the Pacific and Sperm whalers and traders; a few of which may in time be returned with interesting material. It is encouraging to know that other societies are following this example, so that our knowledge of the sea-bottom will soon be vastly increased.

Results of unexpected magnitude are likely to follow these humble efforts to obtain specimens from the deep sea. Amongst those captains who were solicited to preserve their soundings was Captain James Anderson, then of the Cunard steamer "Canada." In the course of correspondence with your Secretary, this enlightened sailor developed a long thought-of plan for the social advancement of his fellow-mariners, to induce them to study natural science in its various branches, and to render their assistance available to scientific institutions throughout the country. Captain Anderson asked for your assistance to carry out his views. All who heard his letter read were so convinced of the importance of the project that it was unanimously determined, as a first step, the letter should be printed and circulated at the expense of the Section. This has been done to a limited extent, and in consequence a meeting of a few friends was held in the Liverpool Town Hall on the 30th ultimo. The Mayor, R. S. Graves, Esq., presided. There were present Colonel Wm. Brown, Dr. Collingwood, Captain Anderson, Mr. Rathbone, Mr. Mackay, and other eminent shipowners and gentlemen favorable to the scheme. After Captain Anderson had explained his views, your Secretary endeavoured to point out how societies in interior towns could contribute to its success, and participitate in its advantages; how shipmasters would improve themselves by the collection of specimens, and the study of the natural sciences in general, but more particularly that of meteorology, to enable them to shorten voyages, and to reduce the losses shipowners and underwriters now constantly suffer. All were deeply impressed with the advantages to be derived if a good working plan could be organised. None could at once be formed without some objectious; but a committee was appointed to take the subject into consideration, and report thereon.

It will be a source of gratification to this Section if, through its instrumentality, the first steps were taken to commence a work the importance of which, if thoroughly carried out, will be considerable. To promote scientific research amongst a numerous class of men and youths whose opportunities of collecting specimens, and making scientific observations in all parts of the world are unequalled, is an object worthy of our attention; and although another generation may be required fully to develop its usefulness, some good may be done even in our day.

With such purposes in view, the future prospects of our Section are encouraging; and although in the highly scientific branches of microscopical research we have done but little, it is to be hoped that our professional members may, from their stores of experience and study, contribute more liberally to the general fund.

Before the next session is far advanced the members of the British Association and many distinguished foreigners will be amongst us, and it behoves one and all of our members to make every exertion that this Section may worthily represent the microscopy of the day, and the city to which we belong.

The following circular has been issued by the Microscopical Committee on the prospect of the meeting of the British Association for the Advancement of Science at Manchester.

Sir,—This sub-committee, having been charged with the organization of a *Soirée*, to be given to the members of the British Association, in the Free Trade Hall, on Thursday evening, September 5th, will feel obliged if you will forward to the Secretary a list of the microscopes, microscopical drawings, and special objects you may be willing to place at the disposal of the sub-committee for selection and exhibition on that evening.

Loans of microscopes and microscopic gas lamps are specially requested for the evening, and the greatest care will be taken of them whilst under the charge of the sub-committee.

It is particularly requested that replies may be sent in on or before the 20th July.—I am, Sir, yours respectfully, George Mosley, Honorary Secretary of this sub-committee.

Microscopical Society of Newcastle-on-Tyne.

In October, 1859, a few gentlemen interested in microscopical pursuits formed a class in this town for mutual improvement in the use of the microscope. Thirty-eight ladies and gentlemen were enrolled members; the class met weekly for twelve weeks, and, at the close of that period, the members resolved upon the formation of a Microscopical Society. Eighteen members were enrolled, out of which number an executive *pro. tem.* was selected, and provisional rules passed. The Society, with eighteen as a nucleus, met fortnightly in its rooms, 79, Clayton Street, Newcastle-on-Tyne, and, at the termination of the first year of its existence, seventy-four members had been entered on the books. At the first anniversary, held on Tuesday evening, January 15, 1861, Dr. McNay, the first year's President, occupied the chair, and twenty-four members were present. On that occasion the Secretary read a report of the proceedings of the past year, of which the following is an abstract. After alluding to the recent formation of the Society, and the interest now felt in microscopical studies, he stated that the Society met fortnightly, that it numbered seventy-four members; the average attendance of whom at each fortnightly meeting having been twenty; that a large number of excellent works had been purchased during the year for the use of the members, and that papers had been read or addressed, delivered by the following members of the Society, on the subjects annexed to their respective names.

Mr. Mason Watson, "The Microscope as an instrument of research, and as a means of detecting Adulterations in Food."

Mr. Joseph Davidson, "Fresh-water Animalcules."

Mr. John Brown, "Polarized Light."

Mr. Geo. Hodge, "The Zoology of Seaham Harbour."

Dr. Donkin, "Mounting of Microscopic Objects."

Mr. John Brown, Sen., "The Microscope and its Appendages."

Mr. Murray, F.R.C.S., "Cells and Ciliated Epithelium."

Dr. McNay, "The Eye."

The Treasurer's report exhibited an increase for the first year of £15 5*s*., and disbursements amounting to £13 12*s*. 7*d*.

The following gentlemen were elected the executive for the ensuing year:

President, Dr. A. S. Donkin; Vice-President, Mr. D. H. Goddard; Treasurer, Mr. Joseph Davison; Secretary, Mr. T. P. Barkas, 49, Grainger Street; Committee, Mr. John Brown, Mr. Ellis, Mr. M. Watson, Mr. W. W. Proctor, Mr. Davis, and Mr. B. Proctor.

The Society held its annual *soirée* and *conversazione* on Tuesday evening, March 19, 1861, in an elegant suite of rooms in Welckes' hotel. Twenty-seven microscopes were exhibited, and one hundred ladies and gentlemen attended the reunion.

The admission was by ticket, and tea, coffee, and other refreshments, were provided. Miss Harbutt kindly gave her services at the piano-forte, and, at intervals during the evening, played excellent and elaborate pieces of music. The whole proceedings passed off to the entire satisfaction of the executive, and of those who were present. The Secretary will be glad to receive contributions of books and slides for presentation to the Society.

Islington Literary and Scientific Society.

Microscopical Class.

February 23*d*, 1861.

Dr. Camplin in the Chair.

Mr. W. Hislop read a paper on fresh water Polyzoa, in which, after some remarks on the extensive distribution and graceful forms of the Polyzoa in general, he mentioned that the fresh water species are less striking in appearance, and less known, than the marine forms. There are 21 species of fresh water Polyzoa, 16 of which are British, 1 Belgian, and 4 North American, being all found in the north temperate zone. They are usually found in shallow water not exceeding four feet in depth, and attached to stones or floating bodies, and while some prefer sluggish or stationary waters, others are found in swift rivulets and clear lakes. They generally shun the direct rays of light, and with one exception (the Cristatella), are incapable of locomotion. The remainder of the paper consisted of a minute description of the typical form and internal organization of these animals, and a detailed account of the genera and species, and was illustrated by a number of photographs enlarged and shown by the lime-light lantern.

April 27th, 1861.

Dr. Camplin in the Chair.

Mr. Slade read a paper on the Confervæ, in which, after referring to these plants as the tangled masses of bright green threads, so common in aquaria and other collections of fresh water, he mentioned that their name is derived from Conferruminare, to consolidate, and that the ancients considered them useful in healing fractured limbs. The filaments are of indefinite length and unsymmetrically branched. Under the microscope they are seen to consist of long cells, containing numerous green granules and some colourless larger ones. The number of species is very considerable. Henfrey forming two natural orders out of the genus, and Lindley numbering sixty-six genera, and 368 species of Confervæ. The diagnosis of the class is as follows:—Plants with a filamentous, membranous, gelatinous or pulverulent thallus growing in fresh or salt water, or on moist substances, of green or more rarely (often temporarily) red colour, reproduced by zoospores discharged from the ordinary cells of the thallus, or from spores formed in these cells after impregnation; by combination of the contents of two cells, either by conjugation or by the transference of spermatozoids into the parent cell of the spore—the spores passing through a stage of rest before germination. The motion of the zoospores was then more particularly adverted to, and an interesting description by Agardh of the germination of a Conferva, as seen by him, quoted. Mr. Slade then entered on a detailed account of the various points of structure, indicated by the general description of these plants previously given, and concluded with some remarks on the allied forms of gory dew (*Palmella cruenta*) and red snow.

The paper was illustrated by numerous diagrams, and after a discussion which turned principally on the question whether the same germ could become one of the algæ, a lichen or a fungus, according as it might fall upon water, air, or decaying organic matter, as held by some naturalists,—the class adjourned for the summer recess.

The Bradford Microscopical Society.

The monthy meeting of this Society was held April 4th, at the Infirmary, R. H. Meade, Esq., F.R.C.S., President, in the chair.

At this meeting, which was numerously attended by members and friends, Mr. F. M. Rimmington, Honorary Secretary, read a paper, "On the History and Principles of Construction of the Binocular Microscope," tracing the progressive improvements of the different binocular arrangements, from the first announcement of Professor Riddell's to the last beautiful achievements of Wenham. The paper excited considerable interest, and, at the conclusion, an animated discussion on the subject took place. The author of the paper afterwards tested the powers of the new arrangements, by exhibiting to the members a variety of objects.

May 9th.—At this meeting the Secretary read a paper, "On Adulteration of Food."

June 6th.—This meeting was numerously attended, and an interesting paper was read by G. Graham, Esq., M.R.C.S., "On the Parasites of Man;" after which he exhibited some interesting specimens of many of the parasites.

West Kent Microscopical Society.

Since our last notice several meetings have been held, and some interesting papers read. The Society has lately received a great accession by the amalgamation with it of the Greenwich Natural History Club, and will, therefore, in future, be known as The West Kent Natural History and Microscopical Society.

This Society gave its first *soirée* on Wednesday evening, the 5th June, at Blackheath, which proved most successful in every respect. Upwards of forty microscopes were supplied by the members and their friends. Among the many objects of natural history we can only notice a few of the more prominent. A number of very beautiful hot-house plants, lent by the President, John Penn, Esq., attracted universal attention, as did the very superb collection of ferns and sea-weeds, both exotic and English, belonging to J. Jardine, Esq. The beautiful collection of insects, lent by N. B. Engleheart, Esq., and the fossils and other geological specimens by Flaxman Spanell, Esq., were very much admired, and many other rare and beautiful objects too numerous to mention.

Mr. Ladd also exhibited, during the evening, the "spectrum analysis." Refreshments were provided for the visitors, who numbered about 300.

ORIGINAL COMMUNICATIONS.

On Navicula rhomboides.

By W. Hendry, Esq., M.R.C.S., Hull.

Few diatoms are more generally distributed amongst microscopists than *Navicula rhomboides,* for, being found in abundance in a fossil condition, and holding a place high in the rank of numerical striation, it has evidently been eagerly sought after, and as readily supplied, as though its resolution bore the strongest existing evidences of the power and quality of lenses. However, there exists no difficulty in showing that *N. rhomboides* is the most variable in its dimensions, irregular in its form, indistinct in development, and possesses a striation more extended in its range than any other known and measured diatom, thus totally unfitting it to take rank, under any circumstances, as a test-object. As to its figure, it is as oftentimes arched or lanceolate as it is angular in its outline, and in either case presents the same characteristic median lines and nodules, with transverse distribution of striæ.

Median line straight, with dark ground and double-light, coloured inner bands, forming an X-like junction at the central nodule when approaching focus, the angles of which being thus continuous with the bands, the latter terminate distinct and within the apices of the diatom in light-coloured small, conical nodules, having their bases central, a third luminous, middle band likewise in some instances appearing.

If we attempt comparison with other diatoms, it would tend but to confusion, as with *N. gracilis, N. rhombica, N. cuspidata,* &c. I hold some London slides of *N. rhomboides* synonymised American test, *N. gracilis,* so that it is somewhat difficult at times to give a correct interpretation to language.

Facts are stubborn things, and as our subject will not bear too much of the speculative or conjectural, I herewith subjoin a series of measures of these diatoms, as they are presented to observation upon several slides in my own possession, furnished through the kindness of Mr. Harrison, of Hull, and others; the first three slides representing the produce of Connecticut in America, and the fourth, that of Lancashire, in England.

I have on this occasion also, as heretofore, selected a comparative coarse striation in contrast to the high numbers so usually assigned to this diatom on past authority, only wondering myself that when such great painstaking could have been endured in searching, marking, measuring, and recording fine delineations and high numerical quantities, that the coarse, or lower measures, and bold developments should appear never to have entered the field of the microscope or to have attracted the attention of reputed acute observers, even although the great mass of *rhomboides* partake of this latter description, or are of low numerical value contrasted with the assumed standard of 85 in ·001.

N. rhomboides, Slide I.—Connecticut (America).

Diatom. No.	Striæ.	In parts of an inch. Length.	Width.
1	41 in ·001	1/227	1/1214
4	34 ,,	243	1416
6	48 ,,	261	1308
8	48 ,,	243	1416

N. rhomboides, Slide II.—Connecticut (America).

Diatom. No.	Striæ.	In parts of an inch. Length.	Width.
1	47 in ·001	1/399	1/2094
2		600	2791
3	40 ,,	479	2094
4	34 ,,	246	1212
7	34 ,,	246	1212
8	40 ,,	279	1523
9	30 ,,	380	1861
10	40 ,,	266	1396
11	34 ,,	578	2094
12	34 ,,	266	1396
13	37 ,,	239	1396
14	37 ,,	239	1396
15	34 ,,	305	1523
16	34 ,,	558	2094
17	40 ,,	250	1288

N. rhomboides, Slide III.—Connecticut (America).

Diatom. No.	Striæ.	In parts of an inch. Length.	Width.
1	50 in ·001	1/558	1/2393
2	43 „	239	1396
3	40 „	250	1288
4	40 „	245	1396
5	40 „	279	1523
6	47 „	223	1288
8	33 „	453	2094

N. rhomboides, Slide IV.—Lancashire (England).

Diatom. No.	Striæ.	In parts of an inch. Length.	Width.
2	46 in ·001	1/500	1/2063
3	46 „	500	2063
6	43 „	359	1500
7	43 „	359	1500
8	46 „	375	1650
9	50 „	550	2063

There are individuals who object to the appellation of striæ to coarse exhibitions wherein a finer striation is usually ascribed, and who maintain also that upon such coarsely marked diatoms two sets of striation must necessarily exist, could they only be seen, *id est*, the coarse as already assented to when present, and the finer yet in obscurity; but although I must oftentimes ere this have seen the finest visible as well as the coarse, I have hitherto no evidence to induce the supposition of a twofold striation of the kind upon the same frustule.

Amidst the ordinary objects of our observation in nature she is, undoubtedly, at times, exceedingly capricious, hence; why should we hesitate to accord to her a broad latitude in the development of more minute forms, so far surpassing the greater in beauty of design and exquisite delicacy in workmanship as in the diatoms under consideration?

In the accompanying tabulated measurements it will be observed that no numerical striation bears any definite relation to the magnitude of the shell; that upon Slide II, Diatom 11 and 16, the smallest registered exhibits only 34 striæ in ·100, while the largest registered thereupon exhibits 34 striæ in ·100 also.

Upon Slide III the same remark holds good, for No. 6 diatom, being the greatest in size, measuring $\frac{1}{223}$rd of an inch in length, and bearing 47 striæ in ·001; upon the same slide, No. 1 diatom, being the smallest, and the length of which is only $\frac{1}{558}$th of an inch, exhibits only 50 striæ in ·001.

The two preceding specified slides are undoubted American, and if we refer to No. 4 slide, a truly English specimen, all ambiguity upon this matter is set at rest by the gatherings or deposits so widely apart yielding to the same conclusion; for while the smallest frustules thereupon, being Nos. 2, 3, and 9, yield respectively lengths of $\frac{1}{500}$th, $\frac{1}{500}$th, and $\frac{1}{550}$th of an inch, their striæ are, 46, 46, and 50 in ·001, whereas the largest diatoms, being Nos. 6 and 7, and of lengths $\frac{1}{359}$th and $\frac{1}{359}$th, exhibit striæ of only 43 in ·001; and not having witnessed the more subtile markings upon the smaller species, whether English or American, it may be chiefly upon the larger developments of either that a finer striation may be carefully sought for.

In seeking for striæ in this class of objects it is absolutely essential that the slide should be well filled, in order to obtain every advantage of position, &c., the diatoms thoroughly cleaned, uniformly distributed, and mounted free of all vapour and moisture. I owe much in these respects to the examples furnished me, from time to time, through the kind generosity of Geo. Norman, Esq., of Hull, whose general attention and mastery over these details is without a parallel.

And now, having turned our attention to several diatoms, as *Amphipleura pellucida, Navicula rhomboides,* and others thus placed at the extremity of our ordinary list of test-objects because of their supposed numerical value and uniform character of striation, and believing it to be impossible to evade or to gainsay the conclusions at which I have arrived, the question yet remains,—Whence shall we in future derive our standard test-objects?

Shall we cling to diatoms still, if, peradventure, we may find a species in form, development, and striation, more constant; or hence, quitting nature's treasury, shall we fall back upon the resources of human skill?

An Abstract of Dr. Beale's Lectures *on the* Structure *and* Growth *of the* Tissues *of the* Human Body. Delivered at the Royal College of Physicians, April—May, 1861.

Lectures III, IV, and V.

In his second lecture Dr. Beale endeavoured to show that mildew, and all such simple living structures, were composed of matter in two states, *germinal matter* and *formed material.* He tried to prove that the *formed material,* of which the external envelope was composed, was once in the state of germinal matter, and that the inanimate matter, which formed the pabulum or nutrient substance, passed through the outer covering of formed material into the germinal matter, in the particles of which it became living. Here all those wonderful powers, which the germinal matter itself possessed, are communicated to the inanimate particles. Facts were brought forward to show that the germinal matter was composed of spherical particles, and these of smaller and still smaller spherules. These spherical particles always move in a direction from centre to circumference. The formed material differs as much from the germinal matter in its structure as in its properties. The germinal matter alone grows and is active, and can alone animate inanimate matter. The properties of the formed material depend upon the powers of the germinal matter from which it was produced. These powers were derived from the germinal matter, which gave it origin, and so on from the beginning. The germinal matter possesses the power of infinite growth, by which was meant that this material will continue to increase as long as it is placed under favorable conditions and supplied with the proper pabulum or nutrient substances. The germinal matter is coloured by alkaline colouring matters, especially by carmine, while the formed material remains perfectly colourless, although it is much nearer to the coloured solution than the germinal matter. We are not able to form any opinion as to the size of the smallest particle capable of independent existence and endless increase, but there can be no doubt that the smallest living particles we can yet discern have been growing for some time before they were large enough to be seen through our most perfect microscopes. We have now to consider how far these conclusions are applicable to the tissues of the higher animals.

Every tissue composed of elementary parts.—However large and complex the organism may be, it is very easily separated into certain parts and organs which are set apart for the performance of distinct offices. The body of a vertebrate animal contains, as we all know, bones, muscles, fat, the liver, kidneys, the brain, and nerves, &c.

Each of these may be resolved into elementary organs. An entire bone may be regarded as consisting of an assemblage of certain small portions, each of which contains every structure essential to the constitution of bone, and necessary for its growth. A lung, or a kidney, or the liver, may, in the same manner, be shown to consist of elementary lungs, kidneys, or livers, although these cannot always be perfectly isolated.

In different animals, the size of these elementary organs differs, but not the same extent as their number. An organ of a large animal, like the whale, differs from the corresponding organ of a small one like the mouse, enormously as to the number of elementary organs of which it is made up, but in a much less degree as to the size of each of these.

Each elementary part is composed of several structures having very different properties. An elementary lung is composed of a delicate, transparent membrane, with elastic tissue, vessels, a prolongation of the bronchial tube. These structures are themselves compound. Connected with the smallest arteries we find nerve-fibres, elastic tissue, muscular tissue, and epithelium. The nerve-fibres, muscular fibre, and epithelium, are composed of elementary parts, and each elementary part consists of matter of two states—*germinal matter*, active and growing, capable of multiplying itself; *formed material*, passive and incapable of multiplying itself, which was once in the state of germinal matter. An elementary part (cell) of the liver in the same way is composed of the germinal matter within and the formed material externally—the outer part of the formed material is gradually altered, and at last converted into bile and a substance easily converted into sugar.

An elementary part of bone consists of a mass of germinal matter, external to which is formed material, which gradually becomes impregnated with calcareous salts from without inwards, channels (canaliculi) being left, along which fluids pass to and from the germinal matter, which gradually becomes inclosed in a space (lacuna).

An elementary part is seldom more than the 1-1000th of an inch in diameter, and it may be less than the 1-20,000th of an inch. In the adult organism it is often difficult to recognise the elementary parts in all cases, in consequence of changes having occurred in the course of their growth, but in the early life of every creature they are distinct enough in every tissue. In the higher animals these elementary parts are arranged in certain collections which possess very different endowments.

In some of the simplest living beings the entire organism may be regarded as consisting of one elementary part.

Every elementary part comes from a pre-existing elementary part; but it does not follow that its endowments are to be the same as those of the elementary part from which it sprung.

We must not look upon the elementary parts of a tissue as bodies which, having assumed a definite form and reached a certain size, remain perfectly stationary, but as structures which are continually undergoing change—not a single particle of which they are composed is still. It is true the movements occur so slowly in some as to be imperceptible, except after long intervals of time, while we can scarcely conceive the rapidity with which change takes place in others. But movements must occur in all, and they take place in the same direction. The elementary parts, which we examine in our microscopes, were undergoing change just before they were removed from the living structure. We have stopped the changes at a certain point, and, as the ages of the elementary parts differ materially, by carefully comparing the appearances in several, we may obtain, after numerous observations, data which enable us to form something like a connected history of the life of one of them.

The cell-wall not a constant or essential structure.—These elementary parts are usually termed *cells*, and the cell is defined as an organ, consisting of a *wall* permeable to fluids, with certain contents within, and usually, but not constantly, a nucleus. In the process of secretion it is believed that certain materials pass through this wall into the interior of the cell by endosmose, and then become altered by powers existing in the cell or resident in the nucleus, and, having undergone conversion into new substances, pass through the wall of the cell by exosmose, and constitute the special secretion. In tissues it is believed that the cell exerts a peculiar action on the matter which surrounds it, by reason of which this manifests certain peculiar and characteristic properties.

It is the exception rather than the rule to find that the contents of a cell are in a fluid state, and when this is so, numerous living particles are generally suspended in it. In the liver-cell the contents are certainly tolerably firm. In the kidney-cell they present the same characters. Their consistency generally is such that it is impossible to conceive the flowing in and out which is imagined. Again, if endosmose continued for a time, and then the contents remained stationary, and afterwards exosmose occurred, we ought to be able to see the alteration in the size of the cells taking place within a very short period of time; but no such change has been observed. It is difficult to conceive endosmose and exosmose occurring at the same moment at all parts of the surface of the cell-wall, for the physical conditions which would lead to the one are absolutely incompatible with the other. Cyclosis in plants has been accounted for by endosmose; but it would be impossible to cause any particles to pass round and round a closed vesicle in a constant direction by currents flowing in towards the interior from every part of the surface. There are other difficulties in the generally accepted theory which would be tedious to follow out, and as the cell-membrane is not a constant structure, it is unnecessary to show that the changes occurring in the formation of secretions could not be explained by endosmose and exosmose through such a structure, supposing it to exist.

According to the generally received theory, the cell-wall is considered a most important structure; but it does not exist constantly. There is a very large class of the lower animals from whose bodies protrusions may be formed in different parts, and these protrusions may meet here and there. Where they touch, they coalesce. Clearly, then, there can be no investing membrane here; neither is a living structure of this kind confined to the lower animals. It exists in man himself. Dr. Beale has seen such protrusions from mucous particles both from the nose and also from the bronchial tubes, under a power of 1700 diameters. A portion of the mass slowly extends itself outwards; perhaps three or four such outgrowths may be seen in different parts of the mass. If detached, they assume a spherical form; but if two come into contact they coalesce. These movements only lasted for a minute, or less, after the mucus was transferred to the glass slide. Protrusions may be often observed to occur from the white blood-corpuscles, and in rare cases the red blood-corpuscles adhere so intimately to each other that it is difficult not to believe that the outer part of their walls consists of a soft, viscid matter, which runs together when several come into contact.*

It is clear, therefore, that the cell-wall is not a constant structure, and that living organisms and elementary parts of

* A case is mentioned, and a drawing given, at page 264 of the 'Microscope in its Application to Clinical Medicine.' (2nd ed.)

living organisms may exist without it. Again, in the younger, so-called cells, of the cuticle, contents and a cell-wall are figured and described by authors generally; but in the old cells the contents become altered and incorporated with the wall in a manner which has not been explained. The liver-cell is usually appealed to as an excellent example of a cell; yet who has proved the existence of a membrane? Seven years ago, long before the lecturer had attempted to form any general views of structure, he tried to prove the existence of this cell-wall, but utterly failed, and was obliged to mention this in his work on the liver.*

The appearance of elementary parts (cells) from the liver of the mouse was then described. Many were seen to contain two of the so-called nuclei, and some contain three or four. Nuclei are observed of all sizes, and the amount of formed material is very different in the different masses. In some elementary parts the outline is sharp and well defined; in others, it is rough and angular; and in some, the outer part seems to be undergoing disintegration. No cell-wall is to be demonstrated around these masses. The outermost part of the formed material gradually becomes disintegrated and resolved into soluble substances. The largest of the so-called nuclei are, in fact, becoming elementary parts; and what would be called their nucleoli would then become nuclei. Some of the masses are very irregular in shape, angular, and often much elongated, as if they consisted of soft material which had been moulded in a tube.

In the next specimen elementary parts from the liver of an old man, aged 74, were seen. The liver appeared healthy. The elementary parts are, for the most part, small; and there is not that very distinct line of demarcation between the germinal matter and the formed material which was seen in the last specimen, and which is in part due to the method of preparation. Oil-globules and particles of colouring matter have been precipitated amongst the formed material.

In a specimen containing elementary parts from a cirrhose liver the quantity of formed material was much greater than in the last specimen; depending probably on the difficulty to the free escape of the bile caused by the wasted, contracted state of the tubes of the network at the outer part of the lobule.

But, it will be stated, there can be no doubt as to the cellular nature of the red blood-corpuscle. This is admitted by all

* 'On the Anatomy of the Liver of Man and Vertebrate Animals,' 1856.

to consist of a membrane with certain fluid coloured contents. A nucleus is to be demonstrated in some, although not in the adult human blood-corpuscle. The opinion generally received is certainly that the human red blood-corpuscle is a cell with red contents, the nucleus of which has disappeared, or else it is the free nucleus of a cell,—and here the question is dismissed.

But the blood-corpuscle may also be regarded as a corpuscle consisting of matter of different density in different parts, being firm externally, but gradually becoming softer, so as to approach to the consistence of fluid towards the centre. Dr. Dalton, of New York, has expressed this opinion of the structure of the blood-corpuscle in his published lectures, and some few other observers entertain similar views.

Dr. Beale had never succeeded in seeing the cell-wall said to exist, neither had he been able to confirm the oft-repeated assertions with regard to the passage of liquid into the interior of the corpuscle by endosmose, its bursting, and the escape of its contents through the ruptured cell-wall. When placed in some liquids, many of the corpuscles swell up and disappear, but the ruptured cell-walls could not be discerned. The red blood-corpuscles from the same animal differ in character in a much greater degree than observers generally seemed disposed to admit. Some are darker and harder than others. Some are so transparent as to be invisible without the greatest care, and corpuscles may be found which are not more than the fifth or sixth of the size of an ordinary blood-corpuscle. The lecturer had failed in his attempts to colour the red blood-corpuscles drawn from capillaries or from a vein, with carmine, but he had succeeded in colouring many in clots taken from the vessels after death; and, in some instances, certain of the corpuscles within the capillaries of a stained tissue have been coloured. These corpuscles were very much smaller than the white corpuscles, which are always very readily coloured, and did not exhibit the well-known granular appearance characteristic of the latter. It was, therefore, inferred that they were young, red blood-corpuscles.

The majority of the red blood-corpuscles of the human subject are certainly not to be coloured by carmine, the same process being employed as that by which the white corpuscles are always so readily coloured. The granular or nucleated corpuscles of the embryo are readily coloured. The nuclei of the corpuscles of the frog become coloured, but the external portion which is coloured naturally is not tinged by carmine. In winter the capillaries of the frog contain numerous oval corpuscles, surrounded by a very thin layer of the external coloured portion, so that they are not more than half the dimensions of the corpuscles when the animal is active. Dr. Beale concludes that the nucleus of the frog's corpuscle consists of *germinal matter,* and the coloured portion of *formed material;* and that when the animal is active, this formed material is gradually being dissolved away at the surface, while the new-formed material is produced from within; the oldest part of the formed material being at the surface of the corpuscle, the youngest in contact with the germinal matter from which it was formed.

Of the red corpuscles of mammalian animals, some are destroyed by certain chemical reagents which have scarcely any action on others; and they are not all altered in the same degree or with the same rapidity by the action of water, weak alcohol, syrup, and various fluids, which probably only produce a physical change. Neither do all the particles in a drop of blood undergo the same changes immediately after it has been drawn from the living body.

The red corpuscles of man are formed from the germinal matter of the white corpuscles. A particle set free in the current of the blood would appropriate the nutrient material and would grow. During this period it would be coloured by carmine. Gradually, however, the formed material increases, and the germinal matter in the centre dies. The corpuscle now undergoes another series of changes. It begins to be dissolved away at the surface, and at last is, without doubt, entirely converted into substances which are dissolved by the serum, and its place is taken by a new corpuscle.

But the fact which seems to Dr. Beale to prove most conclusively the nature of the mammalian red blood-corpuscle is this:—Guinea-pig's blood, as is well known, crystallizes very readily in tetrahedral crystals, and, if the process be carefully watched in a drop of blood which has been treated with a very little water, and covered with thin glass, and sometimes even without the addition of water, certain corpuscles will be seen to become angular, and four or eight prominent angles will be observed, while others will exhibit the stellate appearance familiar to every one. In this remarkable case, then, *the entire blood-corpuscle may be seen to crystallize.*

The author has seen one corpuscle gradually become one tetrahedron. Now, how can there be a membrane here? The whole process seems inconsistent with the existence of such a structure. The crystals coalesce and larger crystals are formed; but no membranes can be seen. Two crystals may come into close contact and gradually become incorporated, which could not take place if they were invested with a membrane. It is true, that some of the blood-corpuscles are incorporated in the crystalline mass, and may be seen for some time amongst the red crystalline matter, but these are entire corpuscles—probably young ones—not merely cell-walls. These facts permit us to take a very simple view of the development, nature, and offices of the red blood-corpuscle.

Appearance of a cell-wall produced artificially.—In the kidney, and indeed in many other structures, there is the same difficulty in satisfying oneself as to the existence of a cell-wall. The well-defined outline exhibited when elementary parts are placed in water, which is received by many as evidence of the presence of a cell-wall, can be exactly imitated artificially. The urea having been separated, filter off a little of the remaining constituents of urine with the extractive matters, and when this solution is moderately concentrated, add nitric acid, so as to be quite sure that no living structures can exist, evaporate the mixture to the consistence of syrup, and you will very frequently find a number of bodies which might be readily mistaken for cells. It would be very instructive to make a series of such artificial products in different ways, for many forms closely resembling the so-called animal cells would be found. Such facts as these, and the changes which he has observed to take place in particles precipitated from fluids, have caused Mr. Rainey to come to the conclusion, Dr. Beale thinks prematurely, that the growth of bone, and even of some of the soft tissues, may be explained on physical and chemical grounds alone.*

These observations of Mr. Rainey's are most interesting and most important; but in all the tissues which the author had examined he has had no difficulty in demonstrating the existence of living matter, and without this living matter the tissue never could be formed. Indeed, he would assert, without fear, that in every living tissue there is germinal matter and formed material. The germinal matter may die, when the formed material has reached a certain thickness; but this formed material was, in all cases, once in the state of germinal matter, and *could never have been produced except as the result of changes taking place in living particles.*

Although in many structures it is difficult to prove the existence of a cell-wall, in others there can be no question as to its presence. In the mildew it is distinct enough; but it

* 'On the Mode of Formation of Shells of Animals, of Bone, and of several other Structures, by a Process of Molecular Coalescence, demonstrable in certain artificially formed Products,' by George Rainey, M.R.C.S. 1858.

was observed that in the rapidly growing parts of the plant the layer was exceedingly thin—so thin that its existence could hardly be demonstrated; while in other specimens the thickness of the formed material was very great indeed. In the first instance the germinal matter was rapidly extending itself. In the last, in consequence, probably, of the existence of conditions adverse to the free growth of the plant, the germinal matter had slowly undergone conversion into formed material—a certain amount of nutrient matter was absorbed, so that the whole mass had increased in size—but had the conditions been favorable, many times the quantity of formed material would have been produced in the same period of time; but this would have extended over a very much larger surface, and, of course, a greater proportion of germinal matter would at the same time have been formed.

Theories generally held.—Cell theory; Wolff's theory, as modified by Professor Huxley; Virchow's view; Dr. Bennett's view.—Dr. Beale had endeavoured to show that in some instances a cell-wall exists, and that in many there is no cell-wall at all, while in others it is impossible to distinguish between the cell-wall and the so-called cell-contents. The idea of Schleiden, accepted by Schwann, that the nucleus was precipitated from a fluid like a crystal, and the cell-wall afterwards deposited around it, has been often contradicted by actual observation, and it is difficult to see what object could be fulfilled by such a process.

A modification of Wolff's view has lately been strongly advocated by Professor Huxley, and has been made by him to harmonise with the notions entertained with regard to the nature of the intercellular substance. It is supposed that originally a clear, homogeneous plasma is produced, in which spaces (vacuoles) are formed, and these contain, in the interior, the endoplast, consisting, in fact, of the primordial utricle of the vegetable cell, the cell-contents, and the nucleus.

The walls of these spaces are composed of the original plasma altered, which is termed the *periplast*, or periplastic substance. The greatest importance is attached to the periplast. It is supposed to possess the active power of growing in and forming partitions, when division of the endoplasts occur, and of becoming differentiated into very important structures. The intercellular (periplastic) substance is considered thoughout Germany as a most important structure, and it is generally believed that its peculiarities are not dependent upon the cells it contains, but are due to powers residing in it. Mr. Huxley's views may be gathered from the following extract:—"The endoplast grows and divides; but, except in a few more or less doubtful cases, it would seem to undergo no other morphological change. It frequently disappears altogether; but, as a rule, it undergoes neither chemical nor morphological metamorphosis. So far from being the centre of activity of the vital actions, it would appear much rather to be the less important histological element.

"The periplast, on the other hand, under the names of cell-wall, contents, and intercellular substance, is the subject of all the most important metamorphic processes, whether morphological or chemical, in the animal and in the plant. By its differentiation, every variety of tissue is produced; and this differentiation is the result, not of any metabolic action of the endoplast, which has frequently disappeared before the metamorphosis begins, but of intimate molecular changes in its substance which take place under the guidance of the 'vis essentialis,' or, to use a strictly positive phrase, occur in a definite order, we know not why."

Virchow, on the other hand, attaches the greatest importance to cells, which always come from cells, but believes, nevertheless, that "It is not the constituents which we have hitherto considered (membrane and nucleus), but the contents (or else the masses of matter deposited without the cell, *intercellular*), which give rise to the functional (physiological) differences of tissues." The cell is "a simple, homogeneous, and very monotonous structure, recurring with extraordinary constancy in living organisms." It is the other contents, not the nucleus or membrane, which occasion the physiological action of parts. Virchow considers that the nucleus is concerned in maintaining and multiplying living parts, and that while fulfilling its functions it remains itself unchanged.

Dr. Hughes Bennett, of Edinburgh, holds, on the contrary, that cells can grow from a clear exudation; and he considers that granules first make their appearance, and that a cell-wall is afterwards formed around these.

It is very difficult to express briefly the differences and resemblances between all these conflicting views; and it would be quite out of place, in a course like the present, to show in detail the several points in which the author agreed with or differed from, those who had written before him.

The author's conclusions did not permit him to agree with any of these theories. He had already alluded to the difficulty of demonstrating the existence of a cell-wall, and had shown that this is not a constant structure. So far from regarding the intercellular substance as the seat of essential changes, he would endeavour to show that it is the least active part of the tissues, and that it does not possess formative power at all. Neither did he think that cells effected any alteration in the substance external to them. Living structures were, he believed, quite incapable of exerting any important action on matter at a distance from them. He could not think that the cell (elementary part) could be formed from a fluid exudation, but believed, with Virchow, that in all cases cellular elements must have existed wherever cells were found. He believed that every organic compound in the body was once living, or had been derived from a living structure. Albumen in the blood, as such, was not living, but it had been formed by living matter, and might again become living if appropriated by a living structure.

Appearances actually observed.—Some of the appearances connected with the structure of elementary parts which might be readily demonstrated were then enumerated. It was remarked that any theory proposed should be equally applicable to all these different cases; and if it would not account for the phenomena, it should, at least, not be incompatible with any one.

1. The presence of a distinct membrane (cell-wall), permeable to fluids, forming an investment to each elementary part, and containing within clear, transparent or granular matter, at rest or in motion.

2. The absence of any such membrane over every part of the surface, so that protrusions occurring from different parts extend to a considerable distance, and where they come into contact coalescence takes place, and then the most varied forms are produced.

3. A very thick external investment, perfectly homogeneous, granular, or in distinct layers, varying in thickness and density, or resembling each other in these particulars.

4. The formation of insoluble substances, as well as the presence of matter in solution amongst the living matter within the external membrane.

5. The presence of a large or small quantity of a peculiar material, homogeneous, granular, deposited in laminæ, or fibrous (intercellular substance), between the so-called cells or nuclei.

6. The absence of such a structure in another part of the same tissue.

7. Elementary parts with nuclei and nucleoli, or destitute of both.

8. The formation of fibres projecting from the envelope of the elementary part.

9. The formation of fibres clearly prolonged from the substance of the elementary part, and composed of the same structure.

10. Elementary parts may begin their existence as minute masses of granular (germinal) matter. At a later period a membrane may be demonstrable. Afterwards the membrane may become very thick indeed, so that a small cavity alone remains in its centre.

The length of this already long list might be increased, but it was sufficient to prove that the doctrines at present taught would not explain all the phenomena which were observed; indeed, some of the facts mentioned were altogether incompatible with the favorite theories now entertained.

Changes in an elementary part.—An elementary part may commence its existence as a very minute granule, too small to be seen even with the highest powers. It grows, and then exhibits an outer portion of different character to the material within. Changes may then occur in the inner material. Small bodies may appear, from which new growth may proceed at a subsequent period, and within these smaller particles may be evident. These clearly arise one within the other. The central mass may divide, and the resulting portions may divide and subdivide, until an immense number of masses are produced. These may be quite separate from each other, or they may be included within the original capsule. In other cases there is no capsule, and the division and subdivision take place in a transparent, and more or less viscid substance, which lies between each resulting mass. In all cases the whole mass, and each component particle, consists of *germinal matter* and *formed material.* The latter forming a hard or soft external envelope, varying in structure, or a fluid or viscid substance external to the *germinal* matter, and sometimes also deposited amongst it.

The power of growth of the germinal matter of man and the higher animals, like that of the lower, is, there is reason to believe, quite unlimited. Although this cannot be proved absolutely, facts will be advanced which justify this statement. The conditions necessary for the growth of the germinal matter of the tissues of the higher animals are, however, so complicated that the vitality of the germinal matter is much more easily destroyed, and it is therefore more difficult to study the changes produced in the elementary parts by alteration of the circumstances under which they grow; still, by a minute examination of the morbid changes occurring in tissues in disease, or induced artificially, most important general conclusions have been arrived at, and there is the greatest encouragement to continue the same course of investigation.

Changes occurring as elementary parts grow.—If we examine the elementary parts near the vascular surface of the skin, or a mucous membrane, we shall have no difficulty in convincing ourselves of the following facts :

1. That they are much smaller than those near the surface.

2. That, although very small, the proportion of the *germinal matter* to the *formed material* is very much greater than in the older elementary parts.

3. That the formed material gradually increases as the elementary part grows towards maturity, the germinal matter absolutely increasing; but in proportion to the formed material it is relatively diminished.

After the elementary part has reached maturity, and has advanced some distance from the vascular surface, where it commenced its existence, the outer part of the formed material perhaps shrinks and becomes harder and drier, while the germinal matter gradually undergoes conversion into new formed material, until the proportion becomes very small, and the remainder, now at a long distance from the vascular surface, and separated from any nutrient matter by a hard, dry mass of formed material, as, for instance, in the cuticle, dies.

Specimen No. 17 showed a portion of the epithelial covering of a papilla from the tongue of a girl aged ten years. This is to illustrate the growth of the epithelium. The deepest layer consists of masses of *germinal matter* separated from each other by a very thin layer of *formed material,* which is not coloured by the carmine. These are for the most part spherical or oval, some are undergoing division into two. The formed material of the deepest series is seen to be continuous with the formed material of the dermic structure. At the outer part elementary parts are seen which occupy as much space as six or eight of the youngest ones. Each contains a dark-red mass of germinal matter, larger than that of the youngest particles, but bearing a proportion to the entire elementary part considerably less than that belonging to the youngest particles. It is, therefore, clear that in the growth of these elementary parts the germinal matter and the formed material have both increased. The whole of the nutrient matter absorbed has passed through the stage of germinal matter, and become formed material which has gradually accumulated. The oldest elementary parts are removed from the specimen, but the proportion of germinal matter gradually diminishes, and in the hardened scales which are about to be cast off not a trace can be shown to exist by soaking in carmine.

The rapidity of division of the germinal matter near the nutrient surface, and the formation of new elementary parts, is especially influenced by the amount of nutrient matter present.

The next preparation shown was a thin section of the tongue of a fœtus at the seventh month. The arrangement of the muscular fibres is well seen, and the papillæ are already developed as little, simple elevations from the general surface. All the tissues consist principally of germinal matter, and in every part of the specimen the number of these masses coloured by carmine is remarkable. The interval between the mucous membrane and the point of insertion of the muscular fibres corresponds to the corium and submucous tissue of the adult tongue. It is occupied entirely by oval nuclei, many of which are observed to be in lines, and these can be shown to be connected with the capillary vessels and nerves. No fibrous appearance whatever exists, and the quantity of formed material existing in connection with the germinal matter is very small.

This specimen of the tongue of a fœtus at the seventh month was contrasted with No. 19, which was a corresponding section from the tongue of a child ten years of age. Both were under the same magnifying power. In the first, eight papillæ, with the submucous tissue, could be seen in the field at once, as well as many bundles of muscular fibres. In the other specimen, three papillæ only, and a layer of submucous tissue and corium five or six times thicker than that in the fœtal tongue were to be seen. The field was only large enough to take in just the pointed insertions of the muscular fibres, although the epithelium had been entirely removed, which greatly diminished the thickness of the specimen. The masses of germinal matter were numerous in the simple papillæ, of which the three large ones in the field were composed; but in the base of the large papillæ, and throughout the corium, a number of transparent spaces or areolæ were observed, which were bounded by lines of small, oval particles of germinal matter, the so-called nuclei of the areolar tissue. The space which looked so transparent was occupied by a tissue which possessed a fibrous appearance, which was firm and unyielding, and which yielded gelatine by boiling. The whole of this tissue was generally called connective or areolar tissue, or "bindegewebe," and those nuclei which were seen bounding the transparent spaces have been christened areolar or connective-tissue-corpuscles. They are supposed to take part in the nutrition of this structure, which does not exist in the embryo, but which increases with age, and undergoes condensation as life advances. In the sixth lecture the connective tissue question will be discussed at some length. Dr. Beale then directed attention to the fact that many of these corpuscles were connected with arteries, veins, capillaries, and nerves; and he stated that there is reason for believing that some of the more spherical particles, coloured red by the carmine, are lymph-corpuscles in the lymphatic vessels, and white blood-corpuscles in the capillaries. The linear arrangement of the nuclei in the papillæ, external to the capillary vessels, and immediately beneath the epithelium, should be noticed. These are undoubtedly connected with nerve-fibres, and from their position it follows that if the capillaries were congested, these corpuscles would be subjected to slight pressure. In the areolar tissue there are also a number of masses of germinal matter, which ultimately become fat-cells.

The changes which occur in elementary parts, when the conditions under which growth takes place in a normal state were modified, were then referred to.

Modification of elementary parts produced by altered conditions.—Preparation No. 20 showed the elementary parts situated in the middle of the cuticle of the arm, about twelve hours after the application of a blister, at the time when the superficial layers were being separated from the deeper ones, and fluid was accumulating in the interval betwen them. In the part of the preparation now shown several elementary parts were seen invested with a moderately thick layer of formed material, but to the left of the field were some having but a very thin layer indeed. Several spherical masses of germinal matter were observed in close contact with the inner surface of the softened external substance, and these were evidently in a state of active growth. They seemed to be growing through the formed material. They were multiplying in number. If set free, and nutrient material continued to be abundant, they would soon increase in size, and multiply very fast. The layer of formed material, investing each, would be exceedingly thin. The masses first resulting from the growth of the germinal matter set free from the epithelial particles would be invested with a layer of formed material, and would resemble a young cell of cuticle; but as they multiplied faster and faster, there would not be time for the formation of the layer of *formed* material, and at last corpuscles resembling pus would result.

This last stage is seen in another preparation, which was obtained from the same blister twenty-four hours after it had risen.

These specimens are most important, as they show the manner in which the formed material is produced, and how, under certain altered conditions, the germinal matter may increase quickly, and a vast number of separate masses may be rapidly produced. The preparations just described also prove that the thickness of the layer of formed material (cell-wall) is determined by the rapidity of increase of the germinal matter, which, in great measure, depends upon the proportion of nutrient matter present.

Formation of pus.—If the germinal matter of a structure grows unusually quickly, particles resembling the pus-corpuscle, which contains very little formed material, are produced. Conditions favorable to the rapid increase of germinal matter are adverse to the formation of formed material. The formation of pus from epithelial cells has been demonstrated by Virchow; but he does not seem to have observed the alteration in the proportion of the germinal matter (nucleus and cell-contents) to the formed material (cell-wall) alluded to. He attaches by far the greatest importance to the formation of pus in the areolar-tissue-corpuscles; and considers that from these bodies various morbid processes, which may affect other tissues, start.

The first stage in the process seems to be the more rapid multiplication of the elementary parts and the formation of a diminished quantity of formed material, the *tendency* being towards the production of similar elementary parts. The formation of these is, however, prevented by the abundance of nutrient material, and the rapid increase of the germinal matter. In certain fibrous textures, in which growth occurs more rapidly than in the normal state, only soft, spongy fibres may be formed; and if the process were to continue, the fibrous material would be less and less, until the rapidly growing spherical masses of germinal matter were produced. There can be no doubt that germinal matter may even grow and multiply, so to say, at the expense of its own formed material.

Pus is not a special formation always produced from the same substance, or in a particular kind of cell, but it may result from the germinal matter of any tissue, and its characters are modified according to the circumstances which have already been alluded to.

The living germinal matter of an elementary part may be set free by the destruction of the formed material, as in a scratch, perforation by the sting of an insect, or other mechanical injury, or by softening of the formed material, caused by an alteration occurring in the composition of the fluid which bathes it, or induced artificially by various chemical compounds. When germinal matter comes into contact with nutrient material under favorable circumstances, its power of infinite multiplication becomes apparent. Inanimate matter near it is absorbed by the several particles, and their active powers are communicated to it. If the nutrient matter be very abundant, the particles will consist almost entirely of germinal matter; but if not very abundant, time will be allowed for the formation of a certain amount of formed material. The germinal matter of any tissue in the body is capable of growing in this way. Every particle of germinal matter possesses the power of infinite growth. Whether a texture with a smaller quantity of formed material than in the normal tissue, and hence a soft, spongy tissue, or a substance composed almost entirely of small, spherical masses of germinal matter (pus-corpuscles) is to be produced, will depend mainly upon the quantity and character of the nutrient matter. If we look at suppuration in this light, the cause of the different characters of pus becomes evident. The germinal matter of any tissue in the body may grow infinitely. In the normal state it multiplies under certain restrictions, and as it grows, the formation of formed material gradually proceeds, and the germinal matter becomes separated further and further from the nutrient fluid. The formed material is prevented from undergoing any but slow change, and the removal of the small quantity of products resulting from this change is sufficiently provided for. But if the germinal matter be set free, active changes immediately commence, the inanimate nutrient matter around is soon taken up and becomes living, and the process will continue as long as the above conditions last. And if this were not the case, what would happen? Why, clearly, the fluids set free, prevented from undergoing the incessant change which is provided for in the normal state, would rapidly putrefy, and the products resulting from the putrefactive changes would soon cause the death of the tissues immediately surrounding. The process would go on, and a considerable quantity of tissue would be destroyed, and the death of the whole organism would result. In gangrene the germinal matter is killed; in suppuration it grows freely, and if this process did not occur, there are cases in which the death of the tissues must result.

At the high temperature of the higher vertebrate animals, moist organic matter, in which the fluid is not perpetually changing, rapidly putrefies; but in the lower, cold-blooded animals the putrefactive change occurs very much more slowly, and hence there is not the same necessity for the rapid conversion of the dead tissue into living germinal matter. In them the process which we know as suppuration does not take place, the changes, although they are the same in their essential nature, do not go to the same extent. Dr. Beale alluded to specimens of the growing elementary parts of the cuticle of the frog, after injury, which correspond exactly with those from the human skin.

The pus-corpuscle, as would be supposed from the above remarks, is well coloured by carmine.

The specimen of pus was to be compared, with a preparation showing the elementary parts of a rapidly growing fungus, which reached the size of a small pear in a single night. There was no absolute membrane of formed material surrounding each mass of germinal matter. The rapid increase of such a structure is marvellous, but it cannot live long, because there is no provision for the equable distribution of nutriment to all parts, or for removing the substances resulting from the death of the particles of germinal matter. The consequence is, that the entire structure, having reached a certain size, very soon dies.

The free growth of the germinal matter in such cases is very interesting, and the readiness with which we can, by the action of colouring matters, distinguish the germinal matter from the formed material, will, I think, enable us to regard various morbid changes which appear now very complicated from a much simpler point of view.

From the examination of the above specimens, it appears that the germinal matter of elementary parts, growing under certain conditions different to those existing generally, will, if pabulum be abundant, multiply very freely. A number of masses result, each of which is capable of producing new ones by division, but only a very thin layer of formed material investing each will be produced, or it may not be possible to demonstrate an investing membrane at all. On the other hand, masses of germinal matter, which, in the normal state, multiply very rapidly, and are therefore not surrounded by formed material, may produce it, if placed under circumstances not favorable to their free increase. The white blood-corpuscle, in a state of rest, and freely supplied with nutrient matter, may even form weak fibres. In coagula of fibrin, white corpuscles, from the surfaces of which fibres of considerable length projected, have been demonstrated, and it seems probable that the relation of this fibrous material to the germinal matter is the same as in other structures. Dr. Beale has seen white blood-corpuscles entangled in the coagulated, transparent matter of the casts of the uriniferous tube, undergoing multiplication, and in the same case, between the capillary loops and the membranous capsule of the Malpighian body, some long, soft fibres, with a body in the centre exactly resembling a white blood-corpuscle, were observed. White blood-corpuscles had accumulated considerably in the capillaries in every part of the kidney in this case.

So that germinal matter may multiply very fast, and produce less formed material than in the normal state, or germinal matter, which in the normal condition produces very little formed material, may be placed under circumstances which favour the accumulation of a considerable quantity of formed material around it. It is, therefore, very essential to study the conditions which effect these very striking modifications in the germinal matter of different structures.

Alteration in the relative proportions of germinal matter and formed material in elementary parts as they increase in age.—Preparations showing the relation existing between the germinal matter and formed material of the tendon of a kitten, and in the true skin from a fœtus, at the seventh month, were then passed round.

The first is a structure in which the changes are exceedingly slow; the second is one in which we know changes are occurring constantly, and with comparative rapidity throughout life. It will probably be admitted that the germinal matter, in the one preparation, corresponds to that in the other—fibrous tissue being the result of the growth of the germinal matter of the tendon—nerves, capillaries, fibrous, elastic, and adipose tissues being formed from the particles of the germinal matter in the last specimen. The relation of the germinal matter to the formed material, in quick and slow-growing tissues, is well seen in the fœtus from the sixth to the ninth month.

On examining the bulbs of two or three hairs from the foot of a kitten, it was observed that the bulb was much wider than the shaft of the hair. The elementry parts, in this region, are composed almost entirely of germinal matter. Higher up, the formed material increases, and each elementary part undergoes condensation. Much of the water of the elementary parts is absorbed, and the whole, consequently, contracts and becomes firmer. The manner in which the formed material is produced is seen very beautifully by examining the elementary parts at different heights in a specimen of hair prepared with carmine. According to the language generally employed, the nucleus gradually diminishes while the cell increases in extent, as we ascend from the deep part of the bulb upwards towards the shaft, until, when we arrive at the dry part of the hair, the cells (cortex) are destitute of nuclei. The change is explained very simply by the author's view, and follows of necessity, because the supply of nutrient material to the elementary parts gradually diminishes from below upwards.

The structure of morbid growths.—A thin section from a tumour which grew very rapidly was the next specimen. It appeared at the lower angle of the scapula of a boy, aged twelve years, and when first noticed was about the size of a bantam's egg. In six months it measured twenty-seven inches in circumference. It was firm and hard, and was intimately adherent to the scapula. The case occurred in the practice of Dr. Elin, of Hertford. The friends would not consent to have the mass removed, and it continued to grow for about twelve months after its first appearance, when hæmorrhage occurred from some large veins on the surface of the tumour, and the boy died of exhaustion. The mass was of the same character throughout. Dr. Elin says:—"It surrounded the scapula, which was partly absorbed. The bone was very brittle, breaking like a piece of glass. I have no doubt that the tumour originally spread from the periosteum of the margin of the scapula." An aunt or cousin of the boy seems to have died of a similar tumour several years ago. The relation of the germinal matter to the formed material is well seen in this specimen, and the free, but irregular, mode of growth of the elementary parts is also well shown.

In a section of a tumour, about the size of a walnut, connected with the parotid gland, the remains of some of the gland-follicles were seen, and as the elementary parts in them were dead and undergoing disintegration, they were not coloured by the carmine. On the other hand, the actively growing tissue contained a large amount of germinal matter, every separate mass of which was darkly coloured. The growing tissue insinuates itself in every direction, and where the parts of the growth first formed are becoming old and are losing their vital activity, offsets from the more recently developed parts may be seen invading them.

In these morbid growths we have no difficulty in demonstrating the existence of germinal matter and formed material, and even cursory observation of the tissue affords abundant evidence of its wonderful power of rapid growth. Although it would not be possible to distinguish a single elementary part of one of these growths from an elementary part removed from certain healthy tissues, the striking irregularity of the structure, the absence of that orderly arrangement exhibited by all healthy textures, and the great extent of tissue exhibiting precisely the same characters, afford conclusive evidence as to the nature of the structures under consideration.

If the elementary parts of a tissue multiply to an unusual extent, and thus overstep the limits assigned to them in the normal state, a growth is produced which may only differ from the healthy tissue with respect to its bulk, with reference to the position which it may occupy or to which it may spread, and in the relation it bears to other textures. Adipose tissue, fibrous tissue, cartilaginous and bony tissues, often form tumours of considerable size in direct continuity with the normal structure. It would seem that just at the point where these outgrowths originate, the restrictions under which growth occurs normally are to some extent removed, and here we see the power of unlimited growth, which is a property of the germinal matter of all tissues, manifesting itself.

In the normal state there is reason to believe that, of the nutrient material distributed to the tissues, a certain proportion is absorbed by the germinal matter, and at length undergoes conversion into tissue, while any excess is probably taken up by lymph-corpuscles, and, perhaps, by the white blood-corpuscles, which increase in number, and is at length restored to the blood. It is probable that, in many of the textures in the interior of the body, a balance of nutrition is thus maintained in the healthy state. If, however, the active powers of the germinal matter of the tissue be impaired, in consequence of some inherent deficiency, or through the influence of a pabulum not fitted for its nutrition, or by some change in the formed material which separates the germinal matter from the nutrient fluid, the tissue must suffer; and, as new material is not added to it as fast as the old is removed, it must waste. In this case a large proportion of the nutrient matter will be taken up by lymph-corpuscles, which will rapidly increase in number, and the pabulum, which ought to have been made into tissue, will be again restored to the blood.

It seems not unreasonable to assume that a result, corresponding to that which is effected in the skin by the removal of the superficial layers of the cuticle and hair, and by the escape of the secretion of the sebaceous and sudoriparous glands—in mucous membranes, by the falling off of the superficial layers of epithelium, and in glandular organs by the conversion of formed material into the secretion—is brought about in tissues distant from such surfaces as the muscles, nerves, and some other textures, by the little masses of active germinal matter known as the lymph and white blood-corpuscles, and thus the débris is again restored to the blood, to be resolved into matters which may serve as pabulum, and compounds which must be eliminated.

An abnormal or morbid growth may originate in any tissue in the body. If it commences in a tissue of simple formation, it will retain, to a great extent, the character of this structure, but if it arise in one of the higher tissues it will soon become so modified that it would not be possible to determine its origin from its microscopical characters.

The character of a morbid growth will, therefore, in great measure, depend upon the tissue in which it originated. Not unfrequently it would be quite impossible to distinguish a section of a morbid growth from one of the healthy tissue in which it commenced. In other cases an important modification in the elementary parts will have taken place. The muscular fibre-cells around the pylorus, and in other parts of the intestinal canal, sometimes increase enormously in number, leading to the formation of a firm, unyielding tissue, which is almost as firm as fibro-cartilage (sometimes described as scirrhus of the pylorus). As the contractile element increases it loses its contractile power, and the whole mass appears to be composed of a form of fibrous tissue, in which the separate fibres are very distinct, and arranged parallel to each other in concentric layers.

A specimen of the uterus of the mouse, in which the contractile elementary parts of organic muscle are seen, at the margin of the bundles, to shade into those of fibrous tissue, was shown. Up to a certain period the germinal matter of these might have produced organic muscle, but the contractile tissue not being produced, a lower form of tissue is, as it were, formed in its stead. Since such a transition may be demonstrated in the healthy state, we shall not be surprised at finding what amounts to a very exaggerated change in disease. The elementary parts have multiplied enormously, but they have developed, not their characteristic contractile tissue, but a lower and simpler form of *formed material*, not possessing the peculiar endowments of the normal structure.

If the restrictions under which a soft, healthy tissue grows be removed, a soft and often very rapidly growing structure results.

Those structures which in the healthy organism grow fastest, and pass most rapidly through the various stages of their existence, as would be supposed, give rise to the formation of the most terrible and uncontrollable of morbid growths. An irregular growth of a part of the secreting structure with the vessels, for instance, of the liver, kidney, mamma, sweat-glands, &c., may lead to the formation of a very soft, spongy, and highly vascular growth, which will attain a very large size, and appropriate the nutrient material which properly belongs to other textures. After a time, perhaps, it reaches the surface of the body, and fatal hæmorrhage may take place from its superficial vessels. In many such morbid growths we can distinguish the elementary parts which have descended from those taking part in secretion, although they have become much modified, from the elementary parts which are connected with the vessels prolonged into the structure. The former constitute the "cells," or "cellular elements" of the morbid growth, and the latter, with the vessels themselves, form the "matrix" or walls of the areolæ or spaces in which the cells lie.

When we consider what a very slight derangement of the elementary parts at an early period of development would infallibly lead to the suppression or exaggeration of normal structures, which are their direct lineal descendants, is it not wonderful that morbid growths (irregular growth of one or more tissues) or monstrosities (exaggeration or suppression of series of elementary parts from which numerous different tissues, entire organs, or limbs, are produced) are not of yet more frequent occurrence than they are?

Many healthy structures may be removed from the part of the body where they have been developed to a distant part, and will nevertheless grow there. Skin, hair, teeth, and other tissues, have been successfully transplanted, but perhaps the most interesting, and not the least useful, instance of this kind which could be adduced is the transplantation of growing bone. M. Ollier has removed a portion of the periosteum from a bone, and planted it in a distant part of the body—under the skin, for instance—and bony tissue has been produced. The periosteum contains bone-germs, which only require nutrient material to undergo development into ordinary bone. The practical surgeon will, of course, soon apply so important a discovery to the treatment of certain cases. Some textures retain their vitality after they have been separated from the parts where they grew for a much longer period of time, and have a much greater power of resisting destructive agencies, than others.

In some of the lower animals, so active is the tendency to growth, and so strong the power of resisting what would seem to be adverse conditions, that mechanical separation into numerous parts serves but to increase the rapidity of the production of separate, independent organisms.

When we consider how very greatly the normal tissues of the higher animals vary in structure, properties, and power, we shall not feel surprised at the great differences observed in the morbid growths which originate in them. Some of these grow very slowly, others very rapidly—some form circumscribed and comparatively isolated masses, while others burrow in every direction, invading every tissue in their immediate neighbourhood, and growing at its expense. A part of a morbid growth may be cut off from nutrient material by the growth of the rest, and may die. Into this dying or dead portion part of the living mass may grow, and, as it were, live upon the very tissue which once formed a living part of the whole, and of which, in fact, the last is a direct extension.

The larger the growth becomes the greater seems to be its powers of resistance, and the more readily do the normal structures yield to its advance. The least particle of it will spread rapidly, its increase appearing to be limited only by the supply of nutrient material. The faster it grows the more irresistible the power of growth seems to become, and, especially in cases where the growth is composed of a number of loosely connected portions, even a very small piece detached and carried to a distant part will readily grow. In not a few cases a very minute portion of the germinal matter of one of these structures may be carried away to a distant part of the body, and so powerful is its tendency to animate any form of nutrient matter in the organism, so unrestricted the conditions under which it grows, and so increased is its power of resisting the action of conditions which would doubtless have destroyed the germinal matter from which it originally sprung, that it will grow wherever it may chance to become stationary. An elementary part, or even a little of the germinal matter, may be detached from the original mass, and removed to distant parts by the movement of organs one on the other, or it may be carried a long way from the point where it originated by the lympathic vessels, and, there can be little doubt, by the blood-vessels also.

These morbid structures may ultimately be found growing in connexion with healthy tissues with which they have no characters in common. A bone-germ, detached from a soft, rapidly growing, spongy, bony tumour, may take root even in the pulmonary tissue, and thus several hard, solid, separate masses of bony structure, which may attain considerable size, may grow in different parts of the lung.

In all these cases the vessels grow with the other elements of the tissue, and thus the conditions for unlimited increase without order, in an irregular manner, and without advantage to the organism, are present, and may persist. These results appear to depend more upon the circumstance that the restrictions under which the growth of the tissue occurs normally are removed, than upon any special peculiarities of the morbid growth itself. The conditions favorable to the development of such structures are not the result of accident, but depend upon changes which have occurred at an earlier period of time, and these may, in the same manner, be referred back. The hereditary nature of many of these growths, and the symmetrical character of certain morbid processes, receive something like an explanation from the view above given.

Dr. Beale had endeavoured to indicate very briefly some of the circumstances which probably determine the different characters of various morbid growths, including those tumours which have received the very inappropriate term of *benignant,* and the numerous intervening forms which pass by almost insensible gradations into those of a *malignant* character.

On vegetable tissues and starch.—A few specimens of vegetable tissues were then examined in order to ascertain if their structure and growth could be explained by the same general doctrine which will account for the appearances observed in the tissues of the higher animals, both in a state of health as well as in disease.

The characters of mildew, one of the simplest structures in the vegetable kingdom, have been described, and a preparation of another fungus has been alluded to. In these, as in the animal tissues, the *germinal matter* was coloured red with carmine, and the formed material remained perfectly colourless. It is, however, desirable to examine the tissues of one of the higher plants.

A portion of the young leaf of the common mignonnette, showing the germinal matter coloured red with carmine, and a piece of the epidermis from the same plant, showing numerous stomata, and in the youngest elementary parts masses of germinal matter, stained with the carmine, were then passed round.

A small piece of the rootlet of the mignonnette was also exhibited. The elementary parts in this specimen were very beautifully coloured. A section of a common potato, near the point at which a bud was being developed, was submitted to examination. In many of the elementary parts, the primordial utricle, and the nucleus (germinal matter), are well coloured, and in many cases the central part of the germinal matter is occupied by numerous small starch-grains. The matter deposited amongst the particles, or in the central part of the germinal matter, Dr. Beale proposed to call *secondary deposits*. The germinal matter will always be found between these and the so-called cell-wall. It is possible that these substances are precipitated in consequence of certain changes having occurred in the formed material in the interior, of a different nature to those which led to the formation of the envelope or cell-wall on the external part of the mass. In many cases the secondary deposits accumulate as long as any germinal matter remains in a living state.

We may, then, conclude that the elementary parts of all tissues, vegetable as well as animal, are composed of matter in two states, *germinal matter* and *formed material*, and that all growth takes place through the intervention of the germinal matter alone, which possesses the power of growing infinitely.

It appears that in certain cases, both in animals and in vegetables, the formed material, or insoluble substances resulting from certain changes effected in it, may be deposited upon the external surface of the germinal matter, or it may accumulate amongst the particles of the germinal matter itself. The deposit in the latter case would take place, first of all, in the fluid which intervenes between the spherical particles of germinal matter, and this process, having once commenced, might proceed until a very considerable accumulation had taken place.

In many structures the substance which is precipitated amongst the living particles in an insoluble form is prevented from escaping through the outer layer of formed material or membranous capsule (cell-wall) within which the germinal matter (primordial utricle) and the substances which have been termed secondary deposits (a part of the so-called cell-contents) are found. The escape of these substances, which are precipitated in an insoluble form, can never take place without the destruction of the whole mass, or the formation of an opening. If the products so formed were fluid they would coalesce, and at length a mass of considerable size might be produced, and the actively growing, or germinal, matter would form a layer between the insoluble substance and the inner surface of the wall of the capsule, the position which the primordial utricle occupies in the vegetable cell, and the germinal matter (here called the nucleus), in the fat-vesicle. When these changes commence in the fat-cells, a little oil-globule is sometimes seen in the centre of a mass of germinal matter, and this might be mistaken for a nucleolus, but it is not coloured by carmine; and by carefully examining several masses in different stages of growth, its true nature can be made out. In other cases the fatty matter is deposited on one side of the germinal matter, which gradually becomes pushed to the opposite part. In both cases the relation of the germinal matter to the investing membrane and the secondary deposits is precisely the same.

Sometimes particles in all parts of the germinal matter rapidly grow, pass through their stages of existence, and become resolved into a substance allied to that which is ordinarily applied to the thickening of the outer membrane. In this case the germinal matter will be found partly just within the membrane, and partly amongst the insoluble particles in the interior. In the large, starch-holding cells of the potato the living germinal matter is seen to be in contact with the inner surface of the capsule, while the starch-granules accumulate, for the most part, in the centre.

There is no difficulty in finding starch-granules in every stage of formation; and careful examination will lead the observer to the opinion that the starchy material is deposited in successive layers, so that the inmost are the first, and the outermost the last layers which have been formed, and the deposition has taken place more rapidly at one part than at another, as shown by the different thickness of the layers at different parts of their circumference.

The following very interesting point will also be observed by careful examination of sections of potato:—Insoluble matter has been deposited in successive layers on the inner surface of some of the large capsules, producing a laminated appearance exactly resembling that of a starch-granule, but spread out, as it were, over an extended surface. It is also important to observe that, at short intervals, there are openings in these transparent lamellæ through which nutrient material passed into the interior of the capsule. These are more correctly described as spaces, or channels, which probably are closed on their outer surface by the thin membrane of the original cell-wall. Here the deposition of insoluble matter has never taken place, and through the spaces, currents of fluid pass to the interior, and continue as long as any living matter exists within in an active state. The mode of deposition of this insoluble matter can be very satisfactorily watched in these capsules.* In many other

* These insoluble lamellæ are not starch, although they refract and polarize like this substance. The peculiar cells contain very little starch, and there

vegetable starch-holding cells the lamellæ and pores above described may be seen.

According to this view, the starch-granule is formed on the same principle as a calculus, and the *deposition* of the starchy matter from solution is purely physical, but its *formation* depends upon the peculiar properties of the particles of germinal matter, which select and combine substances in a special manner while passing through the various stages of their existence. At last their active powers cease, and their constituents become resolved into starch amongst other substances.*

Starchy matter in animal tissues.—One of the most interesting points which has been demonstrated during the last few years, in connection with the chemical changes occurring in animals, is the discovery that matters nearly allied to starch and cellulose were formed in them as well as in plants. C. Schmidt, in the year 1845, proved the existence of a substance of the cellulose series in certain Ascidians; and Virchow, about the year 1854, made the very important discovery of an amyloid substance in the human subject. This was found in the form of roundish bodies in the deep layers of the membrane lining the cerebral ventricles, and that which lines the canal of the spinal cord. Since this time amyloid matter has been demonstrated in many other situations. In the liver it is found in considerable quantity, and, as Dr. Pavy has shown, is a substance which is so easily and rapidly converted into sugar after death, that Bernard was led to conclude that sugar was actually formed in the liver in considerable quantity in health. In certain cases of disease a substance containing amyloid matter accumulates to an enormous extent in the lobules of the liver, especially in their central part, giving rise to the amyloid or waxy degeneration (scrofulous liver, albuminous liver, spekkrankheit). This amyloid substance is one of several compounds into which the formed material of the liver elementary part is resolved. In health it is carried away in a soluble form, and probably is soon converted into other compounds, which are at last resolved into carbonic acid. In diabetes it is converted into sugar, and in certain scrofulous cases it

can be no doubt that the changes which usually lead to the formation of starch have in these instances been modified, so as to cause the altered matter to be deposited in a different position.

* The opinions generally held on the formation of the starch-granule are different to the conclusions in the text; *vide* a paper by Mr. Busk, in vol i, New Series of the 'Trans. of the Microscopical Society,' 1853, p. 58; and Professor Allman, "On the Probable Structure of the Starch-Granule," 'Quarterly Journal of Microscopical Science,' vol. ii, p. 163.

accumulates in the liver, and in other tissues of the body, in an insoluble form. It is probable, however, that this amyloid material is not alone produced in the liver, for in disease it is found in connexion with almost all the tissues, especially in the coats of the arteries.

Busk and Donders stated that the so-called amyloid bodies in the brain, and other parts of the nervous system, were actually composed of starch. Mr. Busk described their concentric laminæ, and stated that they behaved towards polarized light and iodine just as starch does. Of late, however, doubt has been thrown upon many of these statements by the detection of starch almost everywhere, and it has been hinted, or actually asserted, that in many cases in which starch had been detected it had an extraneous origin. Unquestionably there are cases in which this mistake has been made. Several have come under my own observation; but I feel sure that Busk and Donders were quite alive to the possibility of such an origin of the starch, and Virchow has especially cautioned observers against mistaking starch and cellulose accidentally present for the substances actually formed in the living animal tissue.

It seems a pity that anyone should record negative results in an examination like the present, especially as, where is well known, there is some difficulty in obtaining a uniform action from the test, unless he has devoted considerable time to all the little niceties which experience proves to be necessary in employing chemical tests in minute investigations.

Within the last few days Dr. Beale had received a specimen of a cancerous liver, which weighed upwards of thirteen pounds, containing numerous bodies exactly resembling starch-granules. These bodies exhibited the concentric layers, and were coloured dark blue by iodine and sulphuric acid. The evidence here against the *accidental presence* of starch is most positive.—1. From the testimony of Dr. Webb, of Wicksworth, by whom the specimen was sent for examination. 2. From the fact that these bodies were found in sections cut from the very centre of the mass. 3. That the starch bodies may be seen in the specimens actually imbedded in the tissue, and they may be removed with fragments of the tissue of the liver adherent to them.

The specimens have been preserved; and it is believed they will keep for years.

Under certain circumstances, then, it appears that the formed material produced by the germinal matter of certain elementary parts, both in vegetables and animals, may become resolved into starchy and other substances. The starchy matter may be deposited around granules, layer after layer, until a mass of considerable size is produced; or a material allied to starch, and formed from the same germinal matter as this substance, may be deposited upon the inner surface of the investing membrane (cell-wall) of an elementary part in thin laminæ.

There is every reason to believe that in this case of cancer of the liver the cell-containing network of the lobules had been encroached upon by the cancerous growth, growing principally in the interlobular fissures. The excreting channels which carry off the bile would soon become occluded, and the distribution of blood to the substance of the lobule much diminished. Nevertheless, some of the masses of germinal matter of the original elementary parts still retained their vitality, as was proved by their being coloured by the carmine; and a certain amount of formed material under these disadvantageous circumstances was produced. We may assume that this, being placed under very adverse conditions, did not undergo precisely the same changes which occur in the normal state; and, amongst other substances resulting from the changes induced, was this starchy matter, which was prevented from escaping, and was slowly deposited in the insoluble form, the amyloid masses gradually increasing in size by deposition on their exterior.

On the Generative System *of* Helix aspersa *and* hortensis. By Henry Lawson, M.D.

(Read before the Natural History Society of Dublin, December, 1860.)

The following observations upon the reproductive system of *Helix aspersa*, our commonest Irish snail, are given as the result of a series of dissections and microscopic examinations, made during the past summer. The object of the paper is twofold—first, to supply a deficiency in our text-books on zoology and comparative physiology, by publishing the descriptive anatomy of the species of *Helix* most widely distributed in Ireland, and of thus affording to the student of natural history an opportunity of verifying by dissection the descriptions given—a circumstance too much neglected by writers upon the subject, who prefer the less difficult task of quoting, wholesale, the investigations of Cuvier, which were made upon that species (*Helix pomatia*) most abundant in his own neighbourhood. Secondly, to put forward my own opinion concerning the relations of function of the parts which compose this system.

The generative organs of this animal are hermaphrodite in their nature, and excessively complicated in their arrangement. They occupy a larger volume of the body comparatively with the other systems than at first one would be inclined to suppose, extending from one extremity to the other, and seeming more or less closely related to every organ in the economy of the creature. They present an external aperture adjacent to the right upper tentacle, and terminate at the ovary, in the final spire of the shell. For convenience, they may be divided into four groups:

1. Female.
2. Male.
3. Androgynous.
4. Appendicular.

Of these, the female organs form by far the largest portion, and extend over the greatest surface. They consist of an ovary, oviduct, albumen-gland and uterus. The ovary is a small, rather compact, fan-shaped gland, spread over the last lobe of the liver, and, with it, included in the terminal volution of the shell; its broad or basal extremity is most external, the narrow portion being directed inwards, to terminate in the commencement of the oviduct. When separated from its attachments, it measures at its widest part about three eighths of an inch; whilst from within outwards, it is about a quarter of an inch. It is composed of numerous branching cæca, or lobules, of a light-yellowish colour, bound together by folds of a delicate areolar or fibrous membrane. A portion placed under the microscope presents the appearance of a follicle, secreting from its inner wall numerous oval or spherical, nucleated cells, and having occasionally within it, and rather near its mouth, a few isolated zoosperms —no trace whatever of a second sac invaginated by the former can be observed. The ducts of the various lobules unite towards the apex of the organ, and form a common channel—the oviduct. This vessel bends its course in a spiral direction from the ovary to the albumen-gland. It is simple at both extremities, but very much convoluted in the interval. It is about seven eighths of an inch in length; and before it terminates in the sinus of the albumen-gland it makes a slight spur-like turn backwards. (I have not seen any of those decided projections on its convoluted portion which Professor Goodsir has described as existing in *Lymneus* *involutus.*) Examined microscopically, nothing resembling a second tube included within the duct is to be seen. The albumen-gland is a large, homogeneous-looking structure, in shape like a boat, situated in the first spire of the shell, of which it occupies one half. It lies beneath the lung, rectum, heart, and urine-gland. Its concave surface embraces the second spire, whilst its keel is bounded externally by the liver, into which its apex or prow also projects, its base or stern being attached to the upper extremity of the uterus. It measures about an inch in length, and is composed apparently of two distinct portions, an opaque and a translucent. It is very difficult, if not impossible, to ascertain its minute structure. A central duct traverses its substance, which would seem to collect from others more minute the peculiar gelatinous secretion. Viewed under the microscope, a confused chaos of spherical albumen-globules and minute fibres is observed. I have not found any zoosperms in this organ. The sinus is a membranous expansion, formed at the point of junction of this gland with the uterus; into it the oviduct passes, after having been lodged for some short distance in the substance of the albumen-gland. The uterus is a sacculated duct, measuring usually an inch and a half in length, and being fully one eighth of an inch in calibre. Starting from the last-named gland, it makes two or three zigzag turns, and ends as a cylindrical vessel in the vagina. It is closely adherent along its whole length to the testis, which lies on its left border, and which, being shorter than the uterus itself would be if isolated, has the effect of producing the various sacculi above described; so that the two together have not been inaptly compared to the intestine supported by its mesentery. It is situated upon the powerful muscles of the foot, and has the gullet and salivary glands on its left. At the period of depositing the eggs this vessel becomes enormously distended, the sacs appearing much more distinct than usual, each containing its large ovum, and separated from its neighbour by a well-marked constriction. I am inclined to agree with Turpin, in believing that the uterus secretes those beautiful rhombic crystals of carbonate of lime seen on the egg of this animal, inasmuch as I have not found them upon those ova which had just entered the upper sacculi, whilst those situate in the lower ones were invariably studded with them.

The male organs lie to the left of the female, and include the testis, vas deferens, and penis, with its flagellum. The first, as before mentioned, is closely united to the uterus, commencing and terminating with it; nevertheless, it is a very distinct and extensive structure, and deserves far more attention than has been heretofore bestowed upon it. It consists of a central duct, closed at its posterior extremity (as shown by the obstruction to liquids introduced as injections), which is beset on its sides by two rows of long, white, granular-looking follicles. These are observed, under the microscope, to open into the central channel, and to contain those oval and elliptical, epithelial-like cells, usually described as the parents of zoosperms. The central vessel now leaves the testis at the point of the union of the uterus and vagina, and is continued as a simple duct for a distance of an inch and a half, or thereabouts, when it terminates by a rounded aperture in the penis. It is this portion to which the term vas deferens has been applied. The penis is represented by a long, attenuated tube, wide, and of rather thickish consistence at its base, which is perforated and communicates with the generative outlet, cæcal at its apex, which is extremely delicate, and situate deeply in the mass of viscera. It communicates with the vas deferens by a small aperture, distant from the basal opening about an inch and three eighths, and measures, from end to end, when extended, about three inches and a quarter. The blind extremity, from its fancied resemblance to a whip-lash, has been termed the flagelliform portion. About the junction with the vas deferens there exists, attached to the penis, a strong muscular fasciculus, which probably performs the function of drawing back this organ after it has been averted in copulation.

The androgynous group includes the vagina, vas differens, and sperm-sac, with its duct and cæcum.

The vagina is usually described as the termination of the uterine portion; but from the direct continuation which it forms with the copulative vessels, and its almost rectangular connexion with the uterus, it seems more correct to look upon it as the dilated extremity of the former. Viewing it thus, both may be said to constitute a tube, leading from the dart-sac, on the one hand, to the sperm-sac, on the other, wider at its proximal than at its distal end, about one inch and three eighths in length, and one sixteenth of an inch in diameter, following a backward course, beneath the superficial viscera, toward the anterior margin of the liver, where it expands abruptly into a spherical or pyriform bag—the spermatheca, or sperm-sac. This vesicle, whose office appears to be the storing up of the semen received during coition, varies in its dimensions under different conditions. Thus, immediately after union of the sexes, when distended by its seminal contents, I have often found it attain the size of a large swan-drop, being more than a quarter of an inch in diameter; whilst in specimens examined some time after the performance of the sexual function, it has rarely exceeded the bulk of a grain of sparrow-shot. I have had many opportunities of observing the nature of the contained zoosperms, yet I have never succeeded in seeing them isolated; they were invariably in enclosed bundles or spermatophora. The cæcum is an appendage whose function, so far as I am aware, has not yet been investigated. It is a duct, springing from the copulative tube, at about a quarter of an inch from its union with the uterus. It measures three inches in length, is of slightly greater calibre than the tube, and terminates, by a blind extremity, at the point of junction of the uterus and albumen-gland. It is closely attached to the sinus before described, and, to a superficial observer, would seem to convey thus the male element to the female. It seems homologous with the duct connecting the sperm-sac and ovary in *Doris* and *Eolis*, which Messrs. Alder and Handcock have described in their anatomy of the Nudibranchs.

The appendicular group comprises the dart-sac, dart, and multified vesicles. The dart-sac is a pyriform vesicle, bearing in miniature a decided resemblance to the human uterus; it is situated at the anterior extremity of the animal, to the right of the testes and penis, and is quite superficial, being covered only by the outer integument and loose fibrous tissue which involve the other organs. It is about half an inch in length, and in diameter a little above a quarter at its base or fundus, and is provided with very dense and apparently muscular walls, which are pierced on the left, close to the external opening, by the termination of the vagina; it communicates with the generative cloaca by a small, circular outlet, which is guarded by two delicately constructed lips. These may be traced from their point of union on the right side of the orifice, passing round and approximating on the left, where they leave a small portion unprotected. I would be cautious in hazarding an opinion upon their function, but it seems to me not unlikely that they may direct the penis in entering the vagina, and so prevent the possibility of its being lacerated by any existing remnant of the dart; while, on the other hand, by opening in a valve-like manner externally, they thus offer no obstruction to the exsertion of the latter. Springing from the fundus of the sac is observed a fleshy, conical projection, armed at its free end with a calcareous spicule—the dart or stilette. This projection, or papilla, is about one eighth of an inch in length, and is distinctly tubular, being connected at the base with a small follicle, situated between the layers of the dart-sac. The stilette appears to be the secretion of this papilla; it is perfectly transparent, about a quarter of an inch long; tapering from base to apex, it is tetrahedral in form, the sides being trenchant; a transverse section appears like a square, upon each of whose external sides an equilateral triangle had been constructed; it is perforated throughout, and at its papillary extremity is funnel-shaped, the lips also being slightly everted, or trumpet-like. Thus it would seem to have the power of conveying the product of secretion of the follicle (if any) through the dart, and in this way by inoculation of inflicting the "love-inspiring wound." I believe it has been asserted on all hands that the stilette never penetrates beyond the integument of the animal against which it is projected; that such an assertion is correct I must, with all deference, deny, as I have in several instances observed it lying deeply imbedded among the viscera, whilst a second, quite distinct, existed in its normal position within the sac; nay, more, from one specimen, which I examined at the period of depositing the eggs, I succeeded in extracting two almost perfect darts.

The multified vesicles are a number of branching cæca, produced by the dichotomous division and subdivision of two small ducts, whose orifices are situate upon each side of the vagina, adjacent to its union with the dart-sac. In all, there are about forty cæca, and each group extends for about half an inch in the lateral direction. As yet no distinct function has been assigned to them.

The cloaca is the canal which leads from without to the two great orifices of the genital organs within; it is, of all, the most anterior; it is a very flexible vessel, about a quarter of an inch in length, and one eighth in calibre; it terminates externally in a vertical slit, closed during life by a sphincter of elastic membrane. This, which is sometimes termed the generative outlet, lies at the distance of a quarter of an inch from the upper tentacle, on the right side, in a plane posterior, and a little inferior. Near this outlet is the communication with the penis, whilst at the further extreme of the cloaca is observed the orifice of the dart-sac before mentioned.

It will be seen by the foregoing remarks that I have taken a view of the parts composing the generative system different from that heretofore put forward on the matter. The older supposition was that the liver-imbedded gland represented the ovary, whilst the tongue or boat-shaped structure performed the part of testes;* more recently it has been conceived by Henrich Meckel, Siebold, Gegenbaur, and Moquin-Tandon, that the so-called ovary of the older writers is in reality an hermaphrodite gland, each lobule of which has contained within it a second, the external secreting ova, the internal zoospores, the oviduct also having a second vessel invaginated by it. Of these four, however, the two latter, who have been the latest to write upon the subject, deny that any included sac or duct exists. Moquin-Tandon, moreover, follows Van Beneden in his ideas concerning the prostate.

The following are some of the reasons which urged the adoption of the view I have now put forward.

CONCERNING THE OVARY.

(A) Arguing merely from authorities, I feel inclined to agree with Cuvier and his disciples, inasmuch as his opponents, though men of great research and vast fame, are but few in number, and are equally divided in a matter of observation, upon which, in fact, their argument is wholly based.

(B) I have carefully, from time to time, examined single lobules under the microscope with the aid of the compressor, and never have I succeeded in bringing any contained sacculi into view; although, when I placed several lobules in the compressor, I had an appearance produced somewhat resembling invagination, but evidently the result of some lobule becoming superimposed, and then pressed into the substance of another.

(C) There being no invaginated duct leading from the ovary, the zoosperms, if there secreted, would have a greater tendency to pass into the normally widened uterus than into the constricted vas deferens (indeed, the latter passage could not be effected, as there is no communication of the vas deferens with the uterus), and so would pass away externally, and be lost; but such a state of things could not reasonably exist.

(D) From my own observations I may make use of Mr. Handcock's most ingenious argument applied to the Nudibranchs, that, as the zoosperms were found in a condition of imperfect development in the sperm-sac, and fully matured

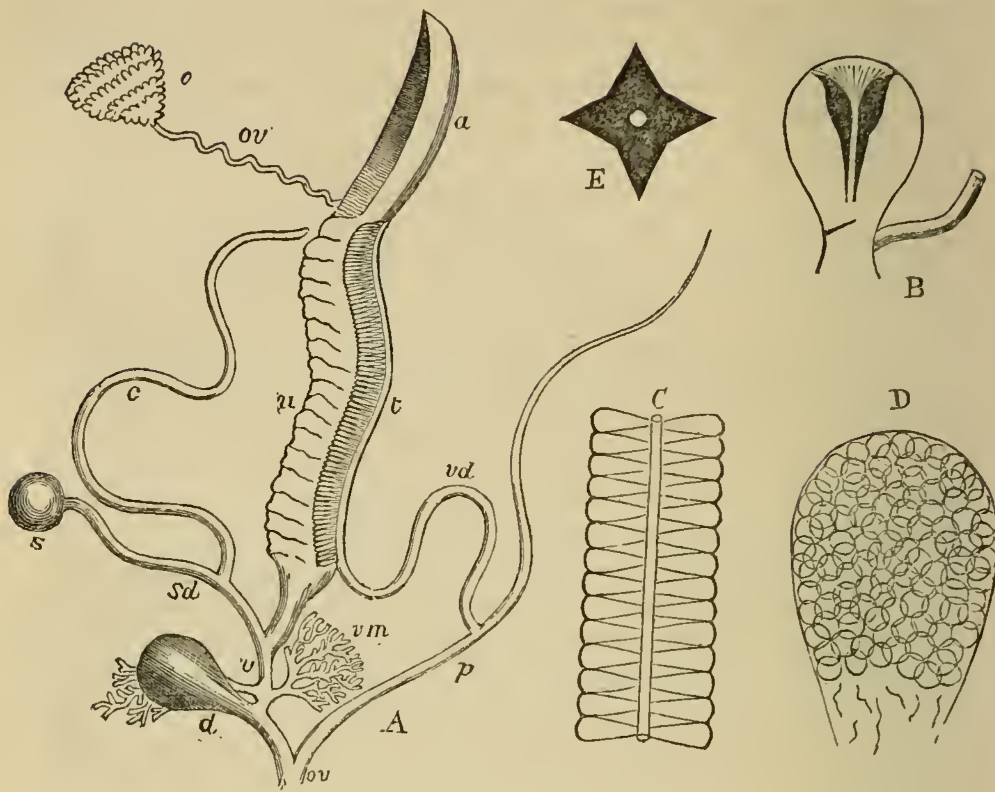
* This was Cuvier's idea, and also that of J. F. Meckel, Carus, Erdl, Sister, Bendach, Pappenheim, Berthelen, Fyfe, and Rymer Jones. Van Beneden also held it; but he considered that gland a prostate, which is here maintained, to be in the sperm-secreting organ.

and isolated in the lobules of the ovary, they could not have proceeded from the latter; for had they been there secreted, they would have been observed in process of development in the ovary, and fully formed and unconnected in the spermatheca.

RESPECTING THE TESTIS.

(A) As there is but one gland in connexion with the vas deferens, and that so extensive as to rival the ovary in size and structure, we may fairly conclude that, if a testis exists at all, it is most probably its representative. It seems to me very unreasonable to term this gland, as Van Beneden has done, a *prostate;* such a mode of applying names to parts is more to be deprecated than the barbarous terminology of human anatomists, who not unfrequently call an interesting and peculiar structure *innominata,* when, to quote the language of a well-known author, "their little puddle of invention has been used dry." I cannot conceive what resemblance it is supposed to bear to an appendage found in another sub-kingdom, and whose function is so much unknown that of two of the most distinguished physiologists of the day one thinks it little more than a mass of muscles,—the other that, most probably, it is the part in the male homologous with, or representing, the uterus of the female.

(B) The generative organs of the Nudibranchiata, which have been so exquisitely delineated by Messrs. Alder and Handcock, bear, on the whole, so great an analogy to those of the Pulmonifera, that it is very likely, as the sperm and germ-producing organs are isolated in the former, so are they in the latter. The vas deferens in Helix, with its continuation, the testis, which is attached to the border of the uterus, holds the place of the greatly elongate corresponding vessel in Eolis, there being, however, less distinction or separation of parts.



EXPLANATION OF THE PLATE.

A. The entire reproductive apparatus, natural size—*a*, albumen-gland; *c*, cæcum; *d*, dart-sac; *o*, ovary; *ov*, oviduct; *p*, penis; *ou*, outlet; *v*, vagina; *vm*, multified vesicles; *s*, sperm-sac; *sd*, spermatheca-duct; *t*, testis; *u*, uterus; *vd*, vas deferens.

B. Vertical section through the dart-sac, enlarged, representing the follicle, papilla, dart, protective valve, and orifice of vagina.

C. Outline view of the testis, greatly magnified.

D. A lobule of the ovary, enormously enlarged, exhibiting the absence of included lobule, and the isolated zoosperms at the aperture.

E. Transverse section through the stilette, exhibiting the trenchant outline and central perforation.

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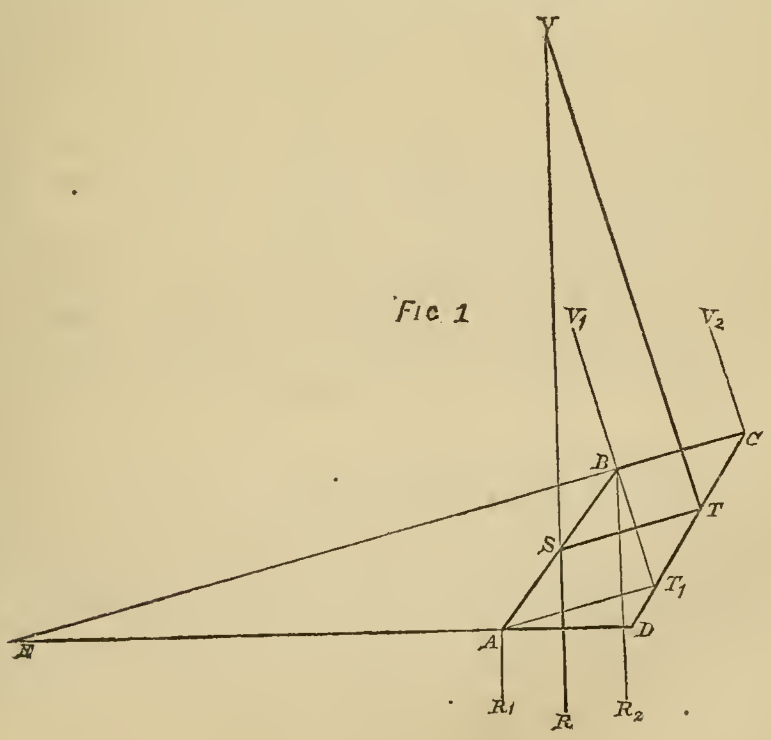
On the Form *of a* Doubly-reflecting Prism, *and its application to the* Microscope. By Peter Gray, F.R.A.S.

Problem.

A parallel pencil of light, of given magnitude, is incident at right angles on one of the sides of a quadrilateral prism of



glass; entering the prism, it meets one of the adjacent sides, at which it is reflected to the opposite side. It here undergoes a second reflexion, and falling at right angles on the side opposite that of incidence, it finally emerges, forming with its original direction a given angle. Determine the form of a prism which shall best fulfil the prescribed conditions.

Let ABCD be a section of the prism, and RSTV the axis of the pencil, entering the prism at the side AD at right angles, and emerging, also at right angles, at the side BC, after two reflexions, at the points S and T. Let the angle TVR, made by the emergent with the incident pencil, which we call the deviation, $= d$.

Produce CB, DA, to meet in E.

ED, EC, being respectively at right angles to RV, TV, the angle contained by the former two lines is equal to that contained by the latter; that is, $\angle CED = \angle TVR = d$.

Denote the angle of incidence at S by i_1, and that at T by i_2; hence, the angles of incidence and reflexion being equal,

$$\angle RST = 2i_1, \text{and } \angle STV = 2i_2.$$

Now, $\angle RST = \angle STV + \angle TVS$;

$$\text{or, } 2i_1 = 2i_2 + d; \text{ whence } i_2 = i_1 - \tfrac{1}{2}d.$$

The angle of incidence at S is complementary to the angle ASR, and so also is the angle SAD. Hence the angle of the prism at $A = i_1$; and, for a like reason, the angle at $C = i_2 = i_1 - \frac{1}{2}d$.

Also the angle at $B = 180° - \angle EBA = 180° - \angle BAD + \angle BEA = 180° - i_1 + d$; and the angle at $D = 180° - \angle DCE - \angle CED = 180° - i_2 - d = 180° - i_1 - \frac{1}{2}d$.

The sum of these four angles is 360°, as it ought to be.

Were the sides AB and DC produced, they would meet at an angle which would obviously be supplementary to the sum of the angles at A and D, and the value of which would therefore be $\frac{1}{2}d$. This property may be enunciated as follows:

The angle contained by the transmitting sides is double of that contained by the reflecting sides.

We have no immediate concern with this property, but possibly it may aid in the practical construction of the prism.

The four angles of the prism are thus determined, in terms of i_1 and d. Of these d is given, and i_1 remains disposable. Inquire, therefore, whether there is reason for preferring for i_1 any particular value, to the exclusion of others. It is desirable that the prism should not be larger than it needs be, since, the loss of light by absorption being proportional to the length of the path traversed by the pencil in the prism, the shorter we can make the path the less will be the loss of light. The sides of the prism ought, therefore, if the arrangement is practicable, to be just sufficient to receive and transmit the given pencil, and no more.

Let R_1A, R_2B be the extreme rays of the pencil, and its diameter $R_1R_2=p$. Now, AB is obviously equal to p sec. i_1, and, the pencil being the same diameter at emergence as at incidence, BC ought to equal p. In order to this, R B ought to be reflected to C; in other words, ST, the axis of the pencil, must be parallel to BC, which it will be if the angle AST be equal to the angle B of the prism.

Now, $\angle AST = \angle ASR + \angle RST = 90° - i_1 + 2i_1 = 90° + i_1$; and the angle $B = 180° - i_1 + d$. Equating these,

$$90° + i_1 = 180 - i_1 + d,$$

we get,

$$i_1 = 45° + \tfrac{1}{2}d.$$

Employing this value of i_1, therefore (which gives 45° for the angle i_2, and also for the angle C), the prism will be the least possible, and the loss of light by absorption will consequently be a minimum.

The angles of the prism will now be—

$$\begin{aligned} A &= 45° + \tfrac{1}{2}d, \\ B &= 135° + \tfrac{1}{2}d, \\ C &= 45°, \\ D &= 135° - d. \\ \hline \text{Sum} \quad . &\quad 360°. \end{aligned}$$

From the values of A and B above, and also from that of i_1, we learn that 90° is the greater limit of d; so that we may, by means of such a prism as is here described, obtain any amount of obliquity or deviation short of 90°. The value obtained for i_2, the less of the two angles of incidence, namely, 45°, is an admissible value, being sufficiently removed from *the critical angle* in a prism of glass (about 41° 28′) to afford total reflexion.

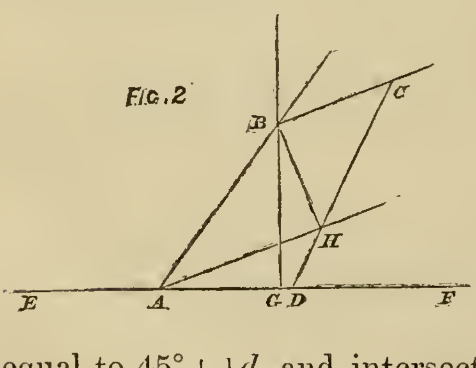
It would, I believe, be practicable to assign the values of AD, DC, the remaining sides of the prism, in terms of p and d; but the angles, and the two adjacent sides, AB, BC, now known, suffice for its geometrical construction; and it will be, perhaps, quite as easy specially to compute the remaining sides, if they should be required, in any particular case to which the formulæ may be applied.

A prism of the form now under consideration was first used in connexion with the microscope by M. Nachet, for the purpose of illuminating the object by oblique light. A figure and description of this prism will be found in Quekett, 3rd edition, pp. 141, 142, and in the 'Mic. Trans.,' 1st series, vol. iii, pp. 74 to 81. The pages last cited contain a mathematical investigation of the form of the prism by Mr. Shadbolt, with whose results, so far as he has given them, mine agree; but it will readily appear that I have made no use of his investigation.

The next application to the microscope of the doubly-reflecting prism is by Mr. Wenham. The purpose of Mr. Wenham's prism is distinct from that of M. Nachet. Being placed behind the object-glass, it receives a portion (say half) of the emergent rays, and deflects them into a supplementary body, attached to the principal body at an angle corresponding to the angle of deviation of the prism. These deflected rays form, in the supplementary body, an image, which, while *symmetrical* with that formed by the remaining rays in the principal body, possesses yet such an *amount* and *kind* of *dissimilarity* as to afford, when the images are viewed simultaneously by the two eyes, the effect of perfect stereoscopic vision. It is the interest excited amongst microscopists by the wonderful and startling effect of this binocular arrangement (numerous inquiries on the subject of the prism having been addressed to me) that has induced me to enter upon the present investigation.

The two prisms are identical in principle, and the preceding investigation and formulæ apply equally to both. Their differences (apart from the lens cemented on the upper surface of Nachet's) are matters of detail, the different purposes to which the prisms are applied requiring different values of p and d.

FIG. 2



Before illustrating the formulæ by their application to Mr. Wenham's prism, I give a geometrical construction.

In the indefinite straight line EF take AG$=p$. From G draw the perpendicular GB, and from A draw AB, making with AG an angle equal to $45° + \frac{1}{2}d$, and intersecting GB in B. Also from A draw AH, making the angle GAH$=d$, and from B draw BC parallel to AH, and equal to AG$=p$. From B let fall BH at right angles to AH. Join CH, and produce it to D. ABCD is the figure required.

Now to apply the formulæ. In Mr. Wenham's prism p will be equal to the semi-diameter of the back lens of the *largest* object-glass with which the prism is to be used. (If made to suit the largest, it will suit the smallest about equally well; but the converse of this does not hold.) The back lens of the 3-in. and 2-in. being about $\frac{1}{2}$ in. in diameter, we may take for p ·25. The value of d depends on the length of the bodies (measured from the point where the axis of the deflected pencil intersects the axis of the principal body) and the distance of the eyes apart. If the length be 10 inches and the distance $2\frac{1}{2}$ inches, then will d equal twice the angle whose tangent is $\cdot 125 = 2\ (7^\circ\ 8') = 14^\circ\ 16'$.

Hence the angles of the prism are—

$$\begin{aligned} A &= 45^\circ + 7^\circ\ 8' = 52^\circ\ 8' \\ B &= 135 + 7^\circ\ 8' = 142^\circ\ 8' \\ C &\qquad\qquad\quad = 45^\circ\ 0' \\ D &= 135 - 14^\circ 16' = 120^\circ 44' \\ \hline &\text{Sum} \ . \ . \quad 360^\circ\ 0'; \end{aligned}$$

And the sides—

$$\begin{aligned} AB &= \cdot 25 \times \sec.\ 52^\circ\ 8 = \cdot 25 \times 1\cdot 6291 = \cdot 4073 \\ BC &\qquad\qquad\qquad\qquad\qquad\quad = \cdot 2500 \end{aligned}$$

If the other sides are wanted, they may be computed as follows:

In the $\triangle$ EBA (fig. 1) the angles are known, and also the side BA.

Hence $$EB = \frac{AB \sin BAE}{\sin BEA} = 1\cdot 3048,$$

and $$EA = \frac{AB \sin EBA}{\sin BEA} = 1\cdot 0145.$$

Again, in the $\triangle$ ECD the angles are known, and the side $EC = EB + BC = 1\cdot 3048 + \cdot 2500 = 1\cdot 5548$.

Hence $$ED = \frac{EC \sin ECD}{\sin EDC} = 1\cdot 2791,$$

and $$CD = \frac{ED \sin CED}{\sin ECD} = \ \cdot 4458.$$

Therefore $AD = ED - EA = 1\cdot 2791 - 1\cdot 0145 = \cdot 2646$.

Or they may be otherwise computed thus:—If A and C (fig. 1) be joined, the quadrilateral ABCD will be divided into two triangles, ABC and ACD. In the former two sides and the included angle are known, whence the angles at A and C, and the remaining side AC, may be determined. In the latter triangle, ACD, there wlll now be known the angles and the side AC; whence the sides AD, DC may be found.

It will be for practice to determine with what amount of rigour the indications of theory will require to be carried out. And it may be worth while to remark, finally, that the pencil, as emergent from the object-glass and incident on the prism, is not strictly parallel; but it would serve no useful purpose to take account of the slight amount of convergency it possesses.

NOTE *on the* OVICELLS *of the* CHEILOSTOMATOUS POLYZOA. By the Rev. THOMAS HINCKS, B.A.

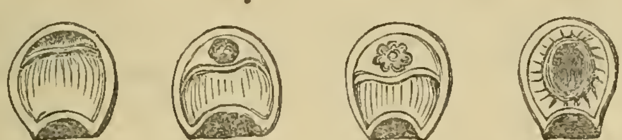
(Read at the British Association, September, 1861.)

MOST of the *Cheilostomatous Polyzoa* (Polyzoa furnished with a moveable lip, which closes the mouth) exhibit at certain seasons external capsules, of various forms, which are situated generally at the upper extremity of the cells, and overarch the orifice. It has long been known that in these ovicells ciliated embryos are matured, which, after making their escape and passing through a free existence of longer or shorter duration, become fixed and are developed into the perfect Polyzoon. A question has been raised, however, as to the birthplace of the *ova* which originate these motile embryos, and Professor Huxley has adopted the theory that they are produced within the cell itself, either in an ovarium attached to the side of the cell-wall (endocyst), or on the cord (funiculus) which in some species connects the body of the polypide with the bottom of the cell. He supposes (or did suppose in 1856, when his note on the subject was communicated to the 'Microscopical Journal,' vol. iv, p. 191), that the ova, after impregnation in the perigastric cavity, pass into the ovicell, and "there, as in a marsupial pouch," undergo their further development. In the same paper Professor Huxley remarks that "the general idea, that the ova are developed within the ovicells," is "wholly an assumption."

This very plausible conjecture has been virtually accepted as the true explanation of the function of the Polyzoan ovicells, and has not been challenged, so far as I am aware, in any published work. My object in this notice is to give a brief account of observations which I have made on the development of the ciliated embryo and its relation to the ovicell, and which are, I believe, conclusive against the marsupial theory.

I may remark, however, in the first place, that the common opinion could not be correctly represented as a mere "assumption," even when Professor Huxley's paper appeared. For as early as 1845 Professor Reid, in a communication to the 'Annals,' vol. xvi, p. 385 ("Anatomical and Physiological Observations on some Zoophytes"), had recorded the results of his examination of the ovicells of *Flustra avicularis* and the contained ova, and had clearly pointed out that the latter, in the first stage of their growth, "adhere to the upper end of the lining membrane of the capsule," and are enclosed in a sac formed by a reflection of this membrane. In his account of the structure of the Polyzoa in the 'British Zoophytes,' Dr. Johnston has referred to Professor Reid's investigations, and adopted his views.

My own observations, repeatedly made on several species, completely agree with Dr. Reid's, and leave no doubt that the ovum, which is ultimately developed into the ciliated



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embryo, is produced within the ovicell, in an ovarian sac, which buds from the endocyst, at the upper extremity of the capsule.

I shall briefly detail the various points which have come under my notice, and trace the growth of the capsular ovum from its first appearance to its final exit.

The species upon which my observations have been made are *Bugula flabellata* (the *Flustra avicularis* of Reid), *B. turbinata*, and *Bicellaria ciliata*. In all these forms the ectocyst is strengthened by the deposition of calcareous matter. The *ovicell* is a stony receptacle, lined by an extension of the endocyst or inner coat, which constitutes the wall of the perigastric cavity and encloses the body of the polypide. This lining membrane, according to Dr. Reid, "stretches across the aperture in the capsule."

The examination of a number of ovicells enables us to determine the following stages in the development of the ovum. It appears at first as a minute mass of granular substance, in contact with the endocyst, at the top of the capsule, and enclosed by a well-marked sac, formed by a reflection of the lining membrane, stretching from side to side (fig. 1). At this stage the ovum has not attained any very definite form. It is simply a mass occupying the space between the endocyst and the wall of the ovarium. The first change which I have noticed seems to consist in a slight concentration of the matter at the centre of the nascent ovum. Gradually it assumes a circular form, and segmentation takes place, the mass being divided into four and afterwards into more numerous granules (figs. 2, 3). I have not detected a germinal vesicle. On the disappearance of the segmentation the ovum exhibits a marginal band of large and somewhat oblong cells, surrounding a central, opaque, granular mass, and changes its circular for a more or less oval figure (fig. 4). As the growth of the ovum proceeds the membranous partition which encloses it is pushed downwards, and the sac at last occupies a considerable portion of the ovicell, suspended, as it were, from the top, and reaching towards the aperture. Its wall is also thickened, and shows very distinctly. Indeed, from its first differentiation it may be detected without difficulty.

Subsequently the ovum increases in size until it nearly fills the cavity of the capsule, and the containing sac would seem to be ruptured and to disappear. Cilia are at last developed on the surface, and the embryo moves restlessly about the interior of the ovicell, and at last makes its escape through the aperture.*

I have never seen spermatozoa within the ovicell, and am unable to throw any light on the way in which impregnation of the capsular ova takes place.

Dr. Reid mentions having witnessed the division of an embryo into two portions, one of which immediately escaped from the capsule, the other remaining in it for the time, but nothing of the kind has occurred to me.

A word now as to the *ova*, which are produced within the *cells*, and which Professor Huxley supposed to make their way into the ovicell, for the purpose of accomplishing the later stages of their development.

They are commonly present in cells bearing capsules from which the embryos are being discharged. Professor Huxley has described them as they appear in *Bugula avicularia*, and has pointed out the respective positions of the ovary and testicle. They present one very distinctive character. They are never ciliated. No observer, I believe, has professed to detect cilia upon them at any stage of their development. Van Beneden

* I do not offer the foregoing as a complete account of the development of the ovum, but only as an enumeration of certain successive stages of it, which have come under my notice.

asserts that on one occasion he saw an ovum escaping through an orifice near the tentacular rim from the cell of *Laguncula*, but he distinctly states that it had no cilia. His observation, however, has not been confirmed. No such orifice as he supposes has, I believe, been detected by any other naturalist. On the contrary, these non-ciliated ova may very commonly be met with in the cells after the disappearance of the polypides, and everything seems to show that they are only liberated when the soft portions of the Polyzoa have quite perished. I have repeatedly found specimens in which the polypides had all disappeared, while in nearly every cell there was one of the red, circular bodies of which I have spoken. In the case of *Flustra foliacea*, Van Beneden remarks that the eggs (round, deeply-coloured bodies, and perfectly motionless) "appear to be hatched in the empty cells," for that he had seen very young individuals in the cells of adults.

It would seem, then, that we have in this class two kinds of reproductive bodies—the ciliated, actively moving embryos, produced in the ovicells, which are liberated in immense numbers, and diffuse the species far and wide; and the non-ciliated ova, produced in the cells, which are only removed from the polyzoarium after the death of the polypides, and may, perhaps, require a longer period for their perfect development.

It would be very interesting to know the complete history of the last-named bodies, and I trust the subject will receive the attention of those who may have the opportunity of continuous observation.

On the Motionless Spores (Stato-spores) *of* Volvox globator. By J. Braxton Hicks, M.D. Lond., F.L.S., &c.

I believe that the condition of the zoospores of Volvox have not been observed beyond the time when, in the autumn, the imperfectly or partially formed daughters in their early segmenting stage, or in their encysted state (testing spores), are set free by solution of the parent envelope. I shall, in the following lines, be able to show that there is yet another stage through which they pass.

These observations were made by keeping a large quantity of Volvox, gathered late in autumn, in water in a glass vessel for upwards of three months, watching very carefully and very frequently; after which time an accident unfortunately prevented my extending them further.

It is well known that towards the end of autumn the zoospores, instead of tending in the usual manner towards the formation of the gemmules after the parent type, become irregularly developed in that direction, and also into a condition which might, perhaps, be called an arrest in development, being in this state set free by the destruction of the old Volvox.

Let us take up our examination at the point where, in the usual order of gemmule growth, the division of the zoospore has continued to the formation of about thirty-six cells within the common cell-wall (Pl. IX, fig. 1). These, in the ordinary way, would pass on to further subdivision, producing almost from this point ciliated cells, which, again redividing, would produce the ultimate zoospores held together by the hollow, spherical membrane, or, in other terms, the ordinary Volvox. Instead, then, of the subdivision forming the ciliated cells, which tend towards the exterior of the mass, motionless spores or gonidia are produced, which do not tend outwardly, but which retain their position, except that they become more separated from each other by the increase of the intervening mucus. Watching these throughout the period above mentioned, I found that the segmentation continued in various modes till the masses became one eighth of an inch in diameter, preserving more or less of a globular form, but indefinite so far as any investing membrane was concerned.

At first the division went upon the binary plan (fig. 2), after which some of them divided into three or four segments, —the division being cruciate—while others extended themselves in a linear series, with their short diameters in a line (fig. 3). These are shown magnified, with nuclei, at fig. 3′. Some of the divisions, instead of subdividing, increased in size, producing a green cell much larger than the rest (fig. 3′). At fig. 4 are two pairs of cells enclosed in a common mucous envelope, much larger than the ordinary size. I have shown at fig. 4—11 different varieties of the segmentation of these motionless gonidia, forming in the last (fig. 11) a mass not dissimilar to that of Tetraspora.

The mucus which formed around these cells was at first more or less definite in boundary, but after segmentation had advanced to some degree its outline was irregular, and at last quite indefinite. The outer edge never possessed more solidity than the mucous envelope of *Cladonia gleocapsa*.

It is worthy of note that this condition I have seen to commence *within* the parent Volvox, before separation.

Some of these forms will be recognised as analogous to those which occur during the growth of Pandorina and in

Stephanosphæra (Cohn), and serve to establish another link between them.

It would be very interesting to extend observations beyond the point I have carried mine, and those interested in these researches would do well to secure as many Volvox as possible this autumn.

Thus, there seem to be two modes by which the life of Volvox (which ceases as such on the approach of winter) can be perpetuated, namely—1, by the encysted cell (*winterspore, hypnospore*), which Cohn conceives to be of the nature of an *oospore* (impregnated *gymnospore*); 2, by the above-described form of motionless segments of the zoospore, which clearly has its homologue in many algæ, and for which, perhaps, a more appropriate name may be found in "*stato-spore,*" not sleeping, but free from motion, because without ciliæ, and thereby distinguished from *zoospore.*

There is also a striking analogy between these and the segmenting gonidia of lichens, especially of Cladonia.

On a new Hydroid Polype *belonging to the Genus* Cordylophora, *Allm.*, discovered by Senator Kirchenpauer, of Ritzebüttel. By George Busk, Esq., F.R.S.

In a letter recently received from Senator Kirchenpauer, to whom we are already under great obligations of the same kind, he encloses specimens and drawings, together with the description, of a Hydroid Polype, "which," he says, "seems to be new. It belongs to Professor Allman's genus *Cordylophora*, and as it differs from *C. lacustris*, Allm., the only species that has been published, I have named it *C. albicola*. I found it three years ago, and since then every summer again, on some of the buoys moored in the mouth of the Elbe. Description and drawings were sent to the Hamburg Naturwissenschaftliche Verein."

Fam. Tubulariadæ. Gen. *Cordylophora*, Allm.

(Polyparium corneum, tubulosum, fibris tubulosis reptantibus affixum, erectum. Polyporum capitula in apice ramulorum, conoidea, tentaculis sparsis nec capitatis munita.)

1. *C. lacustris*, Allm.

C. ramulis brevibus, alternis, lævibus; capitulis conoideis, acuminatis; tentaculis filiformibus; (fluviatilis). Branches short, alternate, smooth; capitula conoid, acuminate; tentacles filiform; (fluviatile).

2. *C. albicola*, n. sp. Pl. IX, figs. 1, 2, 3.

C. ramulis alternis, annulatis; capitulis conoideis, truncatis; tentaculis crassis, granulatis; (submarina). Branches alternate, ringed; capitula conoid, truncate; tentacles thick, granulate; (submarine). Hab. Mouth of the Elbe, on buoys.

TRANSLATIONS.

On the Morphology *of the* Copepoda. By C. Claus.

(From Würzburger, Naturwissenschaftliche Zeitschrift. I, p. 20. 1860.)

I. *A Case of Monstrosity in* Cyclops (Plate X, figs. 1 and 2).

The observation of a minute *Cyclops,* scarcely two thirds of a millimetre in length, and yet furnished with ovisacs containing developed embryos, made me suppose, at first sight, that I had fallen in with a new species of the genus. Closer investigation, however, showed that this sexually developed individual represented a stunted or arrested form of growth, which, from the variety of similar cases among the Entomostraca, is worthy of notice, and the more especially so since the known processes attending the free metamorphoses in *Cyclops* throws some light upon the origin and cause of this malformation.

The essential morphological distinctions of the sexually mature Cyclopida are derived from the definite number and regular articulation of the somites and their appendages. The same value which in the Vertebrata attaches to the number or form of the vertebræ in the characterization of the various regions of the body, also attaches to the number and differences of the segments in the different divisions of the body in the Arthropoda. However numerous and various may be the differences under which the numerous modifications in form and structure of the arthropod body are exhibited, equally regular appears to be the division of the body in the various orders and families, and as constant and immutable the number and relative size of the somites within the more restricted compass of the genera and species. With respect to the Cyclopida, I endeavoured in a former work ('Zur Anatomie und Entwickelungsgeschichte der Copepoden. Archiv f. Naturg.,' 1858) to determine the law of uniformity in the morphological development of the body, and to this work I must refer in the explanation of the present abnormal instance. This differs, chiefly, in the number of the somites and their appendages from the normal arrangement in the fully formed Cyclopida, inasmuch as in the cephalo-thorax the fourth thoracic ring, and the appendages belonging to it, are entirely wanting. The abdomen, on the contrary, preserves its full number of somites, and in its whole structure renders the specific identity of the form with *C. serrulatus* probable; a supposition which is also supported by the size of the caudal setæ. On the other hand again, the first pair of antennæ is so short and compressed that the animal appears far rather to belong to a form arising in the cycle of develop- of a species of *Cyclops* characterised by seventeen-jointed antennæ. These organs possess only eleven joints, and, in fact, of the same proportionate size by which, at the stage of development when they consist of eleven rings, the first pair of antennæ is characterised (l. c., tab. ii, fig. 32). The three pairs of feet, of which the first arises from the common anterior division of the cephalo-thorax, support, it is true, double branches; but, nevertheless, appear to correspond in the degree of development, since the branches are composed of only two rings (fig. 2). The rudimentary pair of feet is indicated by a simple hook, supporting a single seta, and thus differs essentially from the same part in *C. serrulatus*.

Although the deficiency of a thoracic somite and pair of feet is in itself sufficient to indicate that the abnormal condition must have arisen in an early stage of development, the incomplete larval state of articulation in the segmental appendages which do exist places it beyond doubt that we have to do with an instance of arrested development. But when we call to mind the process of development through which the young Cyclops must pass after it has gone through the Nauplius-like larval condition (l. c. p. 70, the tabular summary), and remember the morphological characters which are presented in the successive phases in the articulation of the appendages appropriate to each stage in the segmentation of the body, we are led to refer for the explanation of the form now before us to deviations arising in the very earliest stages of its development. For even in the immature form, characterised by the existence of only five somites, we find rudiments of parts which are equivalent to the absent fourth thoracic somite and its pair of appendages. These parts, therefore, must either have been entirely wanting, or at the next sloughing of the integument, accompanied with the simultaneous failure of the new differentiation, instead of the absent succeeding ring, must have become the origin of the rudimentary (fifth) thoracic somite and its pair of feet.

Now, whilst in the further course of development the segmentation of the abdomen proceeds to its normal termination, the antennæ and pairs of feet remain in one of the last stages of development, and never attain to their complete form.

The morphological stage, therefore, of the form in question, in respect of the articulation of the appendages, corresponds to one of the latest stages of development; whilst the absence of the fourth thoracic ring, and corresponding pair of feet, must be explained by reference to the differentiation being interrupted at an early period. But the duplex characters of the separate parts of the body remains a remarkable fact, and I cannot but express the notion that I may be describing a form produced from two distinct species, in whose duplex nature must at once be sought the cause of the deviations in development. It is to be hoped that further investigations may serve to solve this not uninteresting question.

II. *On the Structure of* Nicothoë (figs. 3, 4, 5).

Besides Audouin, and Milne-Edwards,* Kroyer,† Rathke,‡ and Van Beneden § have contributed to our knowledge of this Copepod, which is parasitic on the branchiæ of *Astacus marinus.* Although the above zoologists have studied the subject at different periods, and to some extent under different points of view, their observations collectively afford a tolerably correct account of the structure, development, and habits of this interesting parasite. At the same time there are still some points, particularly with respect to the form and nature of the oral organs, which, owing to the difficulty attending the examination, have remained almost unnoticed, although the importance of a knowledge of these organs for the proper estimation of the systematic position of the animal is sufficiently obvious. More recent examination, moreover, has shown that even its structure has not been described in all respects exactly as it is, and that that part of the subject is by no means exhausted; I am, therefore, induced to think that there is some justification in my attempting to correct and complete what has been already done in it. What has especially induced me to draw the attention of naturalists again to the

* 'Ann. d. Sc. nat.,' i, ser, tom. ix.
† 'Naturhistorisk Tidiskrift,' Bd. ii.
‡ 'Nov. Act.,' tom. xx.
§ 'Ann. d. Sc. nat.,' iii, Ser, tom. xiii.

subject of *Nicothoë* is the discovery of the male form, which has hitherto escaped observation. The creature, at any rate, regarded by Van Beneden as the male *Nicothoë* has probably no connection with our species, and perhaps represents another Entomostracon, found accidently associated with the female *Nicothoë*. It must be confessed that no direct proof of the male nature of the form about to be described, and which was discovered by Prof. Leuckart on the branchiæ of *Nicothoë*, and submitted to me (in a microscopic preparation) for examination, has been afforded by observation of sexual congress, or the discovery of the male organs. Nevertheless, it appeared to agree so completely with the female *Nicothoë* in all the principal characters, including even the absence of the alæform thoracic appendages, that no doubt can be retained as to their specific identity. But since, according to Rathke's observations, rudiments of the thoracic alæ in the female exist even in the earlier stages of development, and, on account of the growth of the sexual organs, constitute an important and never-failing character of the female, and as, moreover, the observed form possesses the full number of somites, and thus represents a perfectly mature sexual condition, it can only be regarded as the male of *Nicothoë*.

In the first place, with respect to the segmentation of the female body, which, in its general form, has been sufficiently well described by the writers above cited, I have to remark that, up to the present time, the structure of the *head* and *thorax* has not been rightly understood. That portion of the body which projects free above the alæform lateral appendages by no means represents the head alone, but is, in fact, constituted of the head together with the first thoracic ring, from which the first pair of bifurcated, swimming-feet arises. The three following somites, therefore, which remain distinct only on the dorsal surface, in the form of three corresponding zones, represent not the three first thoracic somites, but the second, third, and fourth, whose fully jointed feet are attached close to each other, immediately behind the first. Another segment, from protrusions of which, according to Van Beneden, the monstrous alæ are constituted, does not in general (uberhaupt) exist. I have fully satisfied myself that the lateral sacs are developed from the ventral and lateral surfaces of all the three free thoracic rings, whose original distinction from each other is recognisable only in the three dorsal zones just mentioned. The last thoracic segment is rudimentary, like the corresponding fifth thoracic ring in *Cyclops*, and is represented by a narrow zone distinguishable only on the ventral aspect, and from which the single-jointed abortive feet of the fifth pair arise. The abdomen is, in like manner, identical, as regards the number of somites, with the corresponding part in *Cyclops*. The first and second rings are fused into a common, considerable-sized division, characterised by the opening of the sexual organs. This is succeeded by three gradually smaller and smaller rings, the last of which supports the fork with the caudal setæ. The segmentation of the body, therefore, in *Nicothoë* corresponds in all respects with that of *Cyclops*. And precisely the same may be said of the form assumed to represent the male *Nicothoë* (fig. 3), which differs from the female of the same length chiefly in the absence of the lateral thoracic projections. The external integument constitutes a thick chitinous carapace, which in some parts is perforated by pore-canals, disposed with bilateral symmetry. These are most clearly seen in the frontal region, and exist, in fact, in the same number, and arranged in the same manner, as they are in the analogous situations in the female. These openings serve, as perhaps do all the larger canals in the carapace of the Arthropoda, for the insertion of cuticular organs, and, in the present case, of short, delicate chitinous filaments connected through the pores with the tissue of the matrix. Otherwise, also, the carapace is by no means of uniform constitution, seeing that, especially at the points of insertion of the limbs, various thickenings of the chitinous covering, such as plates, ridges, &c., afford firm supports to the lateral appendages. At the fore part two spherical elevations of the carapace represent the refractive parts of the visual apparatus, formed alike in both sexes. This consists, as in the *Saphirinæ*, of a simple cornea, but which in the present case is immediately succeeded by the pigment body with the percipient nervous part. The other thickenings of the carapace are confined to the ventral aspect of the cephalic and thoracic portions, on which, owing to their constant and symmetrical arrangement, they mark out definite regions to which, with as much reason as in the various regions of the body in the Decapoda, special designations might be assigned. The most complex of these regions are the areæ between the pairs of feet corresponding with the so termed ventral vertebræ (Bauchwirbeln) of *Cyclops*.

Of the appendages, are first to be noticed the first pair of antennæ, which project from the frontal region (fig. 3 *a*), and which in both sexes possess the same number of joints, consisting, as correctly represented by Kroyer, of ten rings. Within their insertions spring the second antennæ (fig. 4 *b*), in the form of three-jointed appendages, which are formed into a kind of pincers, by the insertion of a moveable seta at the base of a styliform process on the terminal joints. Van Beneden has also noticed this pair of appendages corresponding to the inner antennæ, but has described it as the first pair of jaw-feet, following Milne-Edwards. ('Ann. d. Sc. Nat.,' tom. xxviii, "Sur l'Organisation de la bouche chez les Crustacés suçeurs.") The oral organs were very correctly understood by Rathke, although that observer was unable to obtain a satisfactory view of their form, and consequently has given no figure of them, as he himself states. They represent, as was first recognised by Rathke and Van Beneden, a suctorial proboscis, to which succeed two pairs of clasping organs, representing the jaw-feet. The suctorial proboscis (fig. 4), as compared with the corresponding parts of the mouth in the Siphonostomata, appears short, and compressed into an acetabuliform organ, in which I have in vain sought to trace its original composition out of a *labium* and *labrum*, as can be so readily made out in *Pandarus*, *Nogagus*, and *Caligus*. I must particularly state, that the more intimate relations of this suctorial disc have not been rendered perfectly clear; all that I can assert positively is, that two pairs of appendages are concerned in it—two serrated jaws (fig. 4 *c*) and two setigerous palpi (fig. 4 *d*). The former appear to be curved at an obtuse angle, and in the skeleton are affixed by peculiar chitinous rods, which project symmetrically on the sides of the acetabulum, below which they are united by an arched, horny piece (fig. 4). The palpus is inserted next to the piercing seta; it is also based on a firm, chitinous rod, and appears as a single-jointed papilla, which, together with several short points, supports two considerable-sized curved setæ. The two pairs of jaw-feet occupy the lower half of the cephalic portion, and they are separated from each other by hard skeleton-plates, of a defined symmetrical form. Those of the first pair are constituted of two joints, and support at their apices two strong clasping-hooks; whilst the second, as I, in contradiction to Rathke and Van Beneden, must assert, is five-jointed. The last three joints, furnished each with a hook-like seta, might easily, it is true, be taken for a single joint, particularly in the female, in which it is only under a strong magnifying power that they can be recognised as distinct.

With respect to the constitution of the other limbs, and the structure of the abdomen, I shall reserve what I have to say for a more detailed account, since the figures here given will suffice to show the peculiarities.

III. *On the Division of the Body, and on the Oral Organs of the Parasitic Crustacea* (figs. 6—12).

Notwithstanding the valuable researches in recent times of Burmeister, Rathke, Kroyer, Van Beneden, and others, in the subject of the parasitic Crustacea, we are by no means, as yet, fully acquainted with the structure and morphological divisions of the body in these creatures. It is only by explaining the significance of each division of the body, and of each member in every genus and species, that we shall be enabled to lay a foundation for any correct estimation of the relations between the parasitic Crustacea and the free Copepods, as well as of the mutual relations of the separate forms to each other. With this object in view, I endeavoured, on a former occasion (*vide* my work, 'Ueber den Bau und die Entwicklung parasitischer Crustaceen,' Cassel, 1858), to explain the structure of *Chondracanthus* from the morphological conditions presented in the young condition, and, at the same time, approached the subject of the division of the body in *Lernanthropus* and *Kroyeria*. But I was unsuccessful in indicating the relation of the oral organs to the corresponding parts in the *Copepoda*; and was also unable, from the limited amount of materials at my disposal for observation, to arrive at any general considerations embracing the separate families. These deficiencies have been supplied in the following observations.

It is well known that Milne-Edwards and Audouin have attempted to point out the existence of a definite law governing the number of limbs in the Siphonostomata—a term under which, since Blainville, have been included the higher, distinctly annulated parasitic Crustacea*—starting with the idea that the differences in the formation of the limbs in the Crustacea arise only in modifications of similar (or homologous, parts. Most Crustacea, it was said, lead a free life, and feed upon solid substances, and are, therefore, provided with masticatory organs; the parasitic forms, on the contrary, are nourished only on fluids, and consequently must have the homologous organs transformed into a suctorial apparatus.

* The proof of the incorrectness of this term, which has been overlooked by Milne-Edwards ('Hist. Nat. des Crustacées'), although it had been pointed out by Wiegmann ('Grundriss der Zoologie,' 1832), is derived simply from the oral armature of the Lernæopoda and Lennææ, which have an equally good title to be termed Siphonostomata.

But as almost all theories respecting the limbs, which have been propounded in the case of the Arthropoda, have broken down from the circumstance that the original equivalence of the whole body has been assumed *à priori* for all the Arthropoda, or, at any rate, for considerable sections of them, and the observed modifications made to fit into the scheme so constructed; so the fault of every observer has consisted in this, that they have imagined all the Crustacea to be segmented according to the same plan, and have consequently taken the number of segments in the Malacostraca as explanatory of the entomostracan structure. If we wish to arrive at a correct theory of the limbs, we shall have first to obtain, in each case, the proof from development that a similar plan *is* followed in the construction of the body, and shall have to set out from groups of limited extent, and in these to trace the identity of structure, before we can arrive at more general results.

Milne-Edwards and Audouin have drawn the parallel between the limbs of *Pandarus* and those of the Decapoda; and have applied, in reference to the prehensile organs (second antennæ), the hypothesis first started by Oken, that the jaws were feet advanced towards the head. They declared that the maxillary organs existing in and around the suctorial proboscis (composed of the *labium* and *labrum*) were the equivalents of the mandibles and two pairs of maxillæ; the hook-like clasping organs to be the backwardly placed first pair of maxillary feet; the four clasping-hooks anterior to the eight, and thoracic feet, as the second and third pairs of maxillary feet, assuming at the same time the abortion of the second antennæ.

Erichson probably had this attempt at an explanation before his mind when he formed his scheme from the limbs of the Hexapoda, which, according to him, was to be found repeated in subordinate modifications in all the other groups of Arthropoda, and which, in the case of the Entomostraca, he employed by regarding the second antennæ of *Cyclops* as advanced thoracic feet.

The views of Audouin and Milne-Edwards, respecting the oral organs of *Pandarus* and the Siphonostomata, otherwise met with no general reception. Rathke was as little disposed to agree with them as Burmeister, who very properly assigns to the Entomostraca their own place among the Crustacea; whilst Van Beneden, and even Gerstäcker ("Beschr. zweier neuer Siphonostomen," Troschel's 'Archiv,' 1854), it would seem, without adducing any proof, held the opinion that the second antennæ were advanced jaw or thoracic feet. But since it has been shown, as the indubitable result of numerous researches in the Entomostraca, that they have nothing in the number and conformation of their somites common with the Malacostraca, the notion of the French observers would at once be contradicted. On the other hand, when we regard the relation of the parasitic Crustacea with the free Copepods, and their exact correspondence in the mode of segmentation and number of somites, as we have shown to be the case, for instance, in *Nicothoë* and *Cyclops*, it will not be in vain to attempt to draw a parallel between the limbs in the two series of Crustacea, and at the same time to explain, morphologically, the differences in structure observable in the various families and genera.

In all the Copepoda which present a distinct division of the body into the full number of somites, we may distinguish four pairs of oral organs—two mandibles, two maxillæ, and four jaw-feet, the latter fulfilling the functions of seizing and masticating the food. The same number is also found to exist in the *Saphirinæ* (*vide* 'Beiträge zur Kenntniss der Entomostraken,' 1 Heft, 1860, Marburg), which may be regarded to a certain extent as stationary parasites (*Saphirina salpæ,* in the branchial cavity of the Salpæ), and as constituting in their habits the transition between the free Copepods and the parasitic Crustacea. These forms, it may be remarked, all possess the characteristic *labium* in the form of an azygous plate partially overlapping the jaws.

In *Nicothoë* we may also count four pairs of oral organs, of which the four maxillary feet (fig. 3 *e, f*), in conformation and position, precisely correspond with the jaw-feet of the Copepoda. There remain, therefore, the two piercing setæ and the palpi, whose homology with the mandibles and maxillæ might at first sight be doubted, although one might be justified in explaining the differences in form, as associated with the diversity in the mode of life, on the assumption that they were functional differences. But since we are able in numerous parasitic Crustacea to reduce the oral organs not only to the same number, but also to demonstrate a gradual approach in the form of the piercers to the mandibles, and of the palpi to the maxillæ, it would seem no longer possible to doubt the correctness of our explanation. The *Caligincæ* and *Pandarinæ,* whose oral organs, as I have satisfied myself in the case of *Caligus, Nogagus, Pandarus, Cecrops,* &c., were very well and accurately known, as regards their number and structure, to Burmeister, in the construction of their oral armature have a general resemblance to *Nicothoë*. Besides the conical proboscis, the altered oral hood of the larva, which in the present case is constituted of a *labium* and *labrum*, which surrounds the oral orifice as a sort of groove, we find four pairs of members in the piercers, the pair of palpi and the small and large jaw-feet. But the homology of these parts with those in *Nicothoë* can the less admit of doubt, since the whole division of the body follows the same law, and the number also of the antennæ and thoracic feet in the groups above named corresponds. The morphological peculiarities, which distinguish these families of parasites from the Cyclopidæ, are limited to the incompleteness in the number of abdominal segments, and the shield-like shape of the thoracic carapace.* In the Dichelestiniinæ, also, we meet with the same form and development of the oral armature, and may be satisfied of the existence of a similar degree of segmentation, inasmuch as the abdomen may be seen to become gradually more and more abbreviated (*Lamproglene, Kröyeria*).† But in this family we may perceive still another retrogression. The arrest in the morphological completion, if I may be allowed to use such a term, is no longer limited to the abdomen, but invades the thorax, whose segments in *Dichelestium*, though still, it is true, distinct, nevertheless are deficient in the last pair of members, or, in *Lernanthropus*, are even fused together into a continuous division of the body, sharply defined from the interior part of the cephalo-thorax, and on which the two first thoracic feet are supported in the form of two branched swimming-feet; whilst the two last are elongated into sacciform eminences.

In *Clavella*, lastly, a genus which has hitherto been admitted into the family of the *Chondracanthæ*, although in the oral armature it corresponds with *Dichelestium*, the last two pairs of limbs are entirely wanting on the thorax; and in this instance all the thoracic somites are fused together, only the two first rings of the thorax, which are furnished with pairs of feet, being separated from the succeeding ones by a constriction. Hence the abdomen appears to be completely aborted.

With respect to the family of *Chondracanthæ*,‡ we have on a former occasion referred to the genus *Chondracanthus*, from

* The numerous processes and appendages on the cephalo-thoracic portions of the *Caliginæ*, &c., which formerly led me to conclude that the antennæ and oral members were subdivided into a great many lateral and median pieces, are, for the most part, to be referred to chitinous processes of the carapace.

† *Vide* Rathke on *Dichelestium sturionis*, as well as my "Observations on *Kröyeria, Lernanthropus, Clavella*."

‡ The other forms included in this family appear almost all to belong to other groups.

its structure, to the Copepoda, and observed that the degree of segmentation presented in it corresponded with that of *Lernanthropus*. But, as marking a further stage of retrogression, we see also the anterior pairs of feet transformed into misshapen, unjointed sacculi, which participate in the production of the reproductive materials.

In this case, in the oral organs, the beak-like proboscis is wanting, and, as in the *Saphirinæ,* they are composed of pointed, more or less curved, chitinous rods, whose number we could not estimate at more than three pairs. Since the two lowermost pairs, from their whole aspect, are jaw-feet, and the first in form correspond with the mandibles, we find that the *palpi* or *maxillæ* are wanting. Closer examination, however, shows the existence, between the mandibles and the first pair of jaw-feet, of a rudimentary appendage, which, although it was formerly noticed by me, and even described as a *palpus,* I, nevertheless, did not then regard as the equivalent of the second maxillary pair. But the explanation of the palpi as the second pair of oral members may be regarded as the more certain, since they not only correspond with them in position, but because the preceding cephalic members are homologous with the two pairs of antennæ.

The Lernæopodæ stand at a still lower stage of morphological completeness, as in them, as a rule, all division of the body into somites is wanting. In rare cases (very clearly in *Lernæopoda Galei*), it is true, the first thoracic somites may be distinguished as separate rings, but in this family the thoracic members in general are no longer developed; although the rudiments of them are present in the early larval condition, in the form of swimming-feet,* in the full-grown Lernæopod they are no longer to be found, even in the form of unjointed processes. The limbs which do exist represent the antennæ, maxillæ, and jaw-feet, and consequently are all cephalic members, although in a very retrograde condition. The first antennæ are simple and few-jointed appendages, and, in opposition to the antennæ of the second pair, have interchanged the external insertion with the internal (fig. 7 *a*). The latter, that is to say, are situated on the frontal region, on both sides of the anterior antennæ, and constitute two-jointed, clasping organs, supported on strong, chitinous frames (fig. 7 *b*), which have been described by Nordmann as "Kiefer" (jaws), and by Van Beneden as "machoires." Moreover, that these parts correspond with the second pair

* Kollar's 'Annal. d. Wien. Museums,' and Nordmann's 'Mikrographische Beiträge,' 2 Heft.

of antennæ, which in many of the Siphonostomata are also converted into clasping organs, is shown beyond doubt by the circumstance that the latter in some instances present two branches, and consequently resemble in some degree the pair of two-branched members which exist in the larval stage of life. But in *Lernæopoda Galei* (fig. 10), I find that the second pair of antennæ are two-branched; and the same is the case, according to Nordmann's figures, in *Tracheliastes polycolpus* and *Achtheres percarum*, and, according to those of Kollar, in *Tracheliastes stellifer* and *Basanistes Huchonis*, being regarded by both authors as pincer-like jaws. To this clasping apparatus succeed the proper oral members, consisting of the mandibles enclosed in a conical beak, and armed towards the point with a definite number of lateral teeth. As towards the base they expand into a broad surface, they approach in their general form the mandibles of the Cyclopidæ, between which and the slender piercing setæ of the Siphonostomata they constitute a sort of intermediate form (figs. 7, 8 *c*, 9 *c*). On the sides of the conical beak, which, like that of the Siphonostomata, consists of a flattened *labium* and a curved *labrum*, arise the equivalents of the maxillæ, the *palpi*, which also in their form gradually approach those members, and are produced into several setigerous processes (figs. 8 *d*, 9 *d*).

The anterior jaw-feet in the different species, which are sometimes close to the oral orifice (*Anchorella*, *Lernæopoda*, *Brachiella*), sometimes inserted as the base of the clasping arms, and at a considerable distance from the mouth (*Achtheres*, *Basanistes*, *Tracheliastes*), present, in their morphological construction, in all respects the characters of a first pair of jaw-feet (fig. 7 *e*). Behind these arise the last pair of limbs of the Lernæopoda, which, like the sacciform thoracic feet in *Chondracanthus*, are wholly unjointed, and are fused together, either throughout their entire length or at the point, into a common organ of attachment.

These arm-like members, to which the family of the Lernæopoda owes its appellation, correspond homologically with the jaw-feet of the second pair. The same transformation of the segmental appendages into unjointed processes extends even to those of the head. That this is the correct explanation of them is already rendered probable, by that of the members above noticed; but it is fully confirmed by the structure of the dwarf male, and of the *Nauplius*-like larva. The male Lernæopods, with which I am acquainted, belonging to several species (*L. Galli*, *Anchorella uncinata*, *Brachiella Triglæ*), from my own researches, do not differ very far in the structure of the antennæ and oral organs from the corresponding females; it is only in the formation of the jaw-feet that they present any considerable difference. Whilst in them the arm-like clasping organs of the female are wanting, there succeeds to the first pair of maxillary feet, which are like those in the female, a second pair, which correspond with the preceding in structure (fig. 6 *f*), and in their position supply the place of the coalesced arm-pair. Moreover, it may be remarked (besides Kollar), V. Nordmann has made us acquainted with young forms of *Achtheres* and *Tracheliastes*, which, besides the first antennæ, are provided with three pairs of clasping-feet, the second antennæ, and the four maxillary feet. From this the distinguished observer concludes that the first pair is transformed into the jaws (second antennæ), whilst the last pair grow together at the point, and become the arm-like appendage. The mandibles and palpi on the conical beak have unfortunately been overlooked; but, as I perceive from Kollar's figures, they are always present at this stage.

From these considerations, if we now endeavour to establish characters for the interesting family of the Lernæopoda, in the first place we must give up as a character the absence of any segmentation of the body, which has been taken by Milne-Edwards as a distinction between the *Chondracanthæ*, *Lernæopoda*, and *Lernææ*, and the Siphonostomata, since in *Lernæopoda Galei* the first two thoracic rings are manifest as distinct segments; and, besides this, in all the genera the anterior division of the cephalo-thorax appears sharply defined from the posterior. We have, indeed, to consider the slight, incomplete articulation of the body, the more or less complete fusion of the rings; but, together with this, especially the abortive condition of the abdomen, the absence of all thoracic limbs, the coalescence of the second jaw-feet in the female into an arm-shaped organ of attachment, as well as the conformation of the oral organs allied to that existing in the Siphonostomata. It appears to me, also, that the structure of the second antennæ, which project in the form of pincer-like clasping-hooks on the sides of the frontal region, is common to all the genera and species belonging to this subdivision.

Lastly, in the family of the Lernææ we meet with the last and lowest stage in the morphological development of the body and of the limbs existing in the group of parasitic Crustacea, or even, it may be said, in the whole type of the Arthropoda. It is true that, according to V. Nordmann and Milne-Edwards, vestiges of thoracic members are present in some species, as, for example, *Peniculus* and *Penella*, and some analogy in the whole habit may be perceived with some Siphonostomata; but the true Lernææ, and Lernæocera decidedly occupy a lower stage than the Lernæopoda, since, together with a complete want of segmentation in the body, the cephalic members more closely approach the larval condition.

In Burmeister's figures of *Lernæocera cyprinacea*, I find, in the cephalic members, that the second pair of antennæ is composed of many-jointed branches, and are consequently almost identical with the second pair of feet in the *Nauplius*-form. In the oral organs, on the other hand, the jaws lodged in the suctorial tube appear to be formed like the mandibles of the Cyclopidæ, and the contiguous palpi are also of considerable size. The jaw-feet, on the contrary, appear to be replaced by those two pairs of arms, the smaller of which corresponds to the maxillæ, whilst the second and larger two-branched pair corresponds to the jaw-feet. If we imagine the two external fleshy arms to be grown together at the points, we shall have the attachment-organ of the Lernæopoda, and which, moreover, in some forms, *e. g.*, *Brachiella impudica*, also supports lateral appendages. The absence of articulation has also extended to the first jaw-feet. The oral organs in *Lernæa branchialis* would also, perhaps, admit of a similar explanation; of which organs, it must be confessed, we are at present in want of an accurate representation. In the genera *Peniculus*, *Penella*, and *Lernæonema*, the cephalic members are still more simplified; at any rate, neither Nordmann (*Penella sagitta*, *Peniculus pistula*) nor V. Beneden (*Lernæonema Musteli*) have pointed out definite oral members in the female sex, although the antennæ of both pairs are replaced by corresponding appendages. In the genus *Lophoura Edwardsi* (*Lepidoleprus cœlorhynchus*), of which Professor Kölliker has sent me for examination the only specimen as yet met with, I did not find the least trace of oral members; the antennæ assumed the form of unjointed processes; the mouth appeared to be surrounded by stunted chitinous rods (figs. 11 and 12). Lastly, we find among the *Lernææ* creatures which, together with a wholly unjointed body, are also deprived of antennæ, and in their outward form present a striking resemblance to the Trematoda; I mean, the parasitic *Sacculina*, Thomps. (*Peltogaster*, Rathke) which is attached to the abdomen of the *Paguri* and anourous Crustacea, and which was regarded by Diesing as a Trematode under the generic name *Pachyobdella*. It was the observation of the Nauplius-like larva, with which, in fact, Cavolini was acquainted in the last century, together with the investigation of its organization (*vide* particularly R. Leuchart, "Einige Bemerkungen über *Sacculina,* Thomps," Troschel's 'Archiv,' 1859), which first afforded the proof of the Lernæan nature of this remarkable Arthropod.

Consequently, in the multiple forms of parasitic Crustacea we find an almost uninterrupted series of gradual transitions, from the stage of organization presented in the free-swimming Copepods down to the sacciform *Sacculina,* which exhibits no trace of segmentation nor of segmental appendages. The segmentation of the Cyclopidæ is most completely represented in the family of the *Ergasilina,* in *Nicothoë, Bomolochus, Ergasilus,* &c. *Bomolochus, Doridicola,* and *Chalimus,* in the scutiform development of the thorax, point to the families of the Caliginæ and Pandarinæ; whilst *Ergasilus, Pagodina, Eudactylina, Notopterophorus,* and *Notodelphis,* from the more delicate structure of the carapace and more extended form of the body, approach the Dichelestiniinæ. At a lower stage we find a fusion of the abdominal rings and abortion of the abdomen, as in *Kroyeria, Caligus, Sciænophilus, Nogagus, Dinemura, Pandarus, Cecrops, Læmargus, Lamproglene.* A further retrogression is manifested in—1, the absence of thoracic feet, with a complete segmentation of the thorax itself—*Dichelestium, Anthosoma;* 2, in an imperfect division into somites of the thorax, *a,* accompanied with transformation of the last pair of limbs into saccular processes—*Clavella; c,* with a simultaneous transformation of the anterior thoracic members into unjointed sacculi—*Chondracanthus.* In a still further stage of degradation, together with the complete absence of an abdomen, the thoracic members are entirely wanting—*Lernæopoda,* —whilst the last cephalic members, the second jaw-feet, are degraded into an unjointed appendage, and fused into the well-known adhesion-organ. At first the two anterior thoracic somites are still apparent as distinct rings—*Lernæopoda Galli;* but all appearance of division in the thorax disappears, which is distinguishable from the head only by a sharpish border, as in the *Chondracanthæ, Tracheliastres, Brachiella, Anchorella,* &c. In the Lernæoceræ and Lernææ, the anterior jaw-feet are also reduced to hook-like prominences, whilst the fusion and transformation of the posterior pair into an organ of adhesion no longer exist. But, beyond this, the complete disappearance of both these members, together with that of the *maxillæ* and *palpi,* marks the transition to the last and lowest stage, which among the parasitic Crustacea is represented by the Trematode-like *Sacculina,* Thomps.

If we throw the results of our considerations into a general form, the morphological differences among the fully formed parasitic Copepoda will appear to be similarly connected with those with which we have become acquainted in the separate stages of development of the free Copepoda. In the same way that the latter, by a continual multiplication of the segmental appendages and segments of the body up to the highest subdivision of the abdomen, proceed one from another, in like manner we perceive in the former almost similar degradations, until at last the organization of the earliest larval form is, as it were, presented as the result of the continued retrogression, which ultimately reaches even to the complete loss of the Arthropod character.

On the Common Nervous System (Kolonialnervensystem) *of the* Bryozoa (Polyzoa), *exemplified in* Serialaria Coutinhii, n. sp. By Fritz Muller.

(From Wiegmann's 'Archiv.' 1860, p. 311.)

In animals living associated in a common colony or stock, movements of the entire growth or of individual animals may often be observed—movements which, though spontaneous, do not appear to depend upon the will of the individual, but to be carried out by them in obedience, as it were, to a command from a higher quarter. This is the case with the Polyzoa. In a species of *Pedicellina,* in which the cell is supported upon a rigid peduncle, $3\frac{1}{2}$ mm. long, affixed by a thicker moveable socket, the motion of the peduncle continues unchanged for a whole day after the removal of the animal itself. In a far smaller species of the same genus, which frequently occurs as a parasite upon other Polyzoa and Hydroida, the peduncles, which are moveable throughout their entire length, begin to move in the most active manner at a time when the animal at the summit is scarcely distinguishable in the form of a bud. I also remember noticing in *Mimosella gracilis,* Hincks, common and simultaneous movements of the distichously arranged cells. Now, since in these animals, as in other Polyzoa, the existence of nerves has been demonstrated, it may reasonably be supposed that a nervous system exists not only in each Polypide, as the agent of its individual spontaneity, but that a similar system also exists for the performance of the common or associated movements of the polyzoary

The demonstration of this nervous system, it is true, will be excessively difficult in the majority of the Polyzoa; the difficulty of course being increased in proportion with the diminutive size, greater amount of calcareous matter, and consequent want of transparency in the test, and diminished under the opposite conditions. In this respect there cannot perhaps be a more favorable subject than a species of *Serialaria*, by no means rare in the sea of Santa Catharina, whose polyzoary consists throughout of thin-walled, almost perfectly transparent joints or internodes, an inch or more in length. In this species, in fact, a general or common nervous system is more plainly manifest than I remember elsewhere to have met with, except in the case of the *Salpæ*.

As the sole object of the present paper is the exposition of this system of nerves, I shall confine myself, in describing the animal, simply to the particulars necessary for the recognition of the species and the due understanding of what follows, and shall, therefore, pass over the intimate structure of the polypide. The branched polyzoary of *Serialaria Coutinhii*, Müll, spreading on seaweeds over a space of three or four inches, is composed of cylindrical joints, which attain a length of more than 40 mm., and a breadth of 1·35 mm., the successive joints gradually diminishing in thickness until the terminal twigs are not more than 0·1 in diameter. The branches divide trichotomously, in such a manner that from the extremity of each branch three twigs of unequal size arise, the two thicker ones being continued in nearly the same plane with the primary branch, whilst the third and smaller one stands at an angle of about 60° with the others. The mode in which this kind of branching arises is readily seen in the extreme ramifications of the polyzoary. At the extremity of a branch, in the first place, a solitary bud arises, forming, as it were, simply a continuation of the branch (Pl. XI, fig. 1 *a*); but this is subsequently pushed more and more to one side (fig. 1 *a*) by a second bud (fig. 1 *b*), which soon makes its appearance close to the former, the angle between the branches thus formed often exceeding 120°. The third, still younger branch (fig. 1 *c*), arising between the other two, and growing in a direction perpendicular to the plane in which they lie, usually does not perceptibly interfere with their direction, so that they remain pretty nearly in the same plane with the primary branch. Occasionally, though in all cases at a much later period, and long after the former branches have already themselves become branched, a far smaller fourth branch makes its appearance opposite the third (fig. 1 *d*), and very rarely even a fifth may arise, but I have never seen the number to exceed this. The relative age of the branches is usually clearly manifested in their comparative thickness and length, as well as in the amount of their subsequent branching.

The joints themselves are soft and flexible, but at the same time elastic, not unlike, in this respect, portions of intestine distended with water and tied at each end. The delicate but strong walls, which, from their insolubility in boiling caustic potass, are probably composed of a chitinous material, are, as well as the contents, nearly as clear as water. A slight degree of yellowish opacity is caused by the presence of a pigment with which the inner surface of the membrane is coated. The youngest branches appear the least transparent, whilst in the older ones the view is often intercepted by animal and vegetable parasitic growths of various kinds.

From observations on other Ctenostomatous Polyzoa, I am induced to think that the individual joints or internodes are separated by transverse dissepiments.

The polyzoary adheres to *fuci*, &c. by means of much-branched radical filaments, which arise sometimes at the extremity of a branch in place of a twig (fig. 2 *a*), sometimes at indeterminate points of the stem, especially between the cells (fig. 2 *b*); at their extremity they expand into flattened lobes, which spread out on the surface of the seaweed.

The cells are placed in longitudinal series at the upper parts of the branches, the lower portion of which is left bare throughout a greater or less extent. The series of cells are sometimes closely crowded and continuous, sometimes interrupted by a few short intervals, whilst in some cases again (in the oldest branches) the cells are placed in only a few isolated groups. On the youngest terminal ramuscules, the row of cells is usually placed on one side only, as in *Serialaria cornuta* and *S. lendigera*, Lam.; but in the others they form two series, more or less exactly opposite.

The cells are membraneous, and when full grown about 0·6 mm. long, of an attenuated form, diminishing gradually in diameter from 0·2 to 0·1 mm. They are seated on a rounded base, in an oblique position, leaning towards the extremity of the branch; and they are furnished at the summit, where the wall is continuous with the tentacular sheath, with a circlet of delicate, flattened, colourless setæ from 0·04 to 0·05 mm. long. When the polypide is forcibly retracted, fully a third of the cell is inverted, and it then assumes more of an oval shape. The old, uninhabited cells, whose summit is always inverted, are thicker and shorter, and of an ellipsoidal form.

The animal [polypide] is furnished with eight tentacles

0·3mm. in length; and it is so placed in the cell that the side on which the intestine is situated looks towards the distal end, and that on which the pharynx lies towards the origin of the branch. When the polypide is strongly retracted, the invaginated portion of the cell is directed obliquely towards the intestinal side, where it comes in contact with the middle of the uninvaginated cell-wall. From this point the tentacular sheath passes transversely towards the pharyngeal side, along which it descends to the bottom of the cell.

Attention to these positions, as well as to the direction in which the new cell-buds are formed, greatly facilitates the appreciation of the true position of parts in small fragments as they lie in the field of vision of the microscope. The other relations of the polypides do not concern the comprehension of the colonial nervous system, to the description of which I shall now turn.

The nervous system of each branch consist of—1st, a considerable-sized ganglion situated at its origin; 2dly, of a nervous trunk running the entire length of the branch, at the upper part of which it subdivides into branches, going to the ganglia of the internodes arising at this part, and 3dly, of a rich nervous plexus resting on the trunk, and connecting the ganglia just mentioned, as well as the basal ganglia of the individual polypides.

The basal ganglia of the branches (figs. 3—5 G) are placed exactly at the line of separation between the primary and secondary branches and the axis of the latter. They are usually of a globular form, or slightly elongated and fusiform, and of a granular (minutely cellular?) structure. Pale and transparent in the youngest ramuscules, they soon assume a faint yellowish colour, and lose their transparency. In size they vary from 0·03 mm. in diameter (as measured in a very young twig, not more than 0·2 in length) to more than 0·1 mm.

From the basal ganglion a *nerve-trunk*, of nearly uniform thickness (from 0·01 to 0·05 mm., according to age), runs in a straight line nearly to the end of the branch (figs. 3—5 S), though not in its axis, but more or less near that side on which the first row of cells is produced, and which may briefly be described as the *superior*. The trunk is in most cases single, but occasionally divided into two closely contiguous or, in parts, slightly separated cords. More rarely (in old branches) it is broken up, for a greater or less extent, into a long-meshed plexus, composed of three or four principal cords. The nerve is of a pale colour, and presents a delicate, smooth contour.

The basal ganglia and the nerve-trunks, with favorable illumination, may often be readily seen, even with a pocket lens.

On the upper side of the trunk, sometimes closely covering it, sometimes spread over it in wide reticulations, rests a plexus of more delicate nerves (figs. 3—5 P), which spreads out laterally towards the line of origin of the polypide cells, and is richly developed, especially at the extremity of the branch between the basal ganglia of the succeeding internodes. In this terminal plexus, however, besides the branches going to the ganglia above mentioned, at least one arch appears to be formed between each two of the branches springing from the smooth main nerve-trunk (fig. 4 *h*). The nerves composing the plexus are distinguished from the main trunk principally by the circumstance that their surface is rendered uneven, and more or less nodulated or tuberculated, by the presence of nucleated cells. Chromic acid causes the disappearance of these cells; and the nerves, in consequence, acquire sharper and even outlines, upon which, however, the *nuclei* of the dissolved cells may still be perceived in the form of minute, strongly refracting granules. This plexus is particularly well developed on those parts of the branches upon which the cells are placed; and it is especially complicated in the older branches, in which a series of successive generations has taken place. Towards the origin of the branch, the plexus does not usually spread laterally beyond the nerve-trunk, from which it can then hardly be distinguished. In this case, on viewing the nerve from above, it will be found to present an uneven border on either side; whilst on a side view, the uneven contour of the plexus will be seen above, and the smooth border of the nerve-trunk beneath. In this sterile portion of a branch, sometimes no peripheral nerves at all can be perceived, sometimes only a few isolated filaments, usually passing in a backward direction; and occasionally even a tolerably well developed plexus may be noticed, which, however, in this case spreads vertically upwards from the trunk, whilst the expansion of the plexus in the neighbourhood of the cells is more or less horizontal. With respect to the latter plexus, it may also be remarked, that occasionally, though by no means constantly, its filaments may be seen to coalesce into a somewhat stronger cord running beneath the line of origin of the cells.

It remains to notice the connexion of the above described common nervous system with the individual polypides. This connexion is not always readily made out, which arises from the circumstance that in order that the region under examination should not be concealed by the cells, which, in most cases, are closely contiguous, the latter must be so disposed as to lie on the side. But in this case the part to be examined is brought, in the first place, close to the border of the cylindrical branch, and secondly, into almost the same plane with the cutaneous pigment; and, consequently, for both these reasons, it is often nearly opaque. The stomach, moreover, of the retracted polypide is usually in the way of a distinct view. Nevertheless, in almost every branch, one or another polypide or, more readily still, budding cells will be found, in which the nervous connection in question will be unmistakably presented. At the point of junction between the cell and branch, and projecting half into the one and half into the other, a spherical ganglion, from 0·04 to 0·05 mm. in diameter (smaller in young buds), will be seen lying. This ganglion is connected, on one side, with the nerves of the plexus, whilst from the other I have several times, in the full-grown polypide, fancied that I could see a nerve proceeding to the intestine; and this is certainly the case in the buds. A connexion between this basal ganglion and the œsophageal ganglion of the polypide may be supposed to exist, but this I have not been able to trace.

The radical fibres, also, whether they arise at the extremity of a branch, or in the line of a series of cells, or elsewhere, also have each its basal ganglion and longitudinal nerve-trunk. At their first appearance the polypide-cells and the branches of the polyzoary are not distinguishable from each other in any essential particular beyond their place of origin, whilst as regards the radical fibres even this distinction does not obtain. In these three structures may be perceived a happy exemplification of Leuckart's doctrine of polymorphism.

It may be expected that a similar common nervous system will be found in other Polyzoa, in which the cells are seated on a distinct rachis;* whilst in those forms in which one cell springs from another [Cheilostomata and Cyclostomata] ganglia may be supposed to exist, at any rate, in the base of each cell, and connected with each other by nerve-filaments.

[The author adds that, since the above was written, he had found the basal ganglia of the branches and the nerve-trunk in various *Ctenostomata*, Busk; but that up to the present time he had failed to discover any indubitable trace of a common nervous system in the other Polyzoa.]

* [All the Ctenostomata.]

REVIEWS.

Outline of British Fungology. By the Rev. M. J. Berkeley, M.A. London: Reeve.

In his preface the author says, "The object of this work is to furnish materials for the correct determination of the larger British fungi, and such only as require nothing more than a common lens for their examination. In consequence, all microscopic details have, as far as it was possible, been avoided." At the same time, any work issuing from the pen of Mr. Berkeley demands a notice from us. Even the largest and commonest forms of fungi cannot be fully understood without the aid of the microscope, and the more completely they are investigated by its aid, the more instructive they become. We would call the attention of our readers to the fact, that a large field of interesting inquiry lies before them in the investigation of the structure and functions of the fungi. Minute organisms, which play an important part in the great operations of nature, belong to this group of plants, and it is only by the application of the microscope that we can hope to discover the nature of the laws which regulate their existence and development. Mr. Berkeley, in a few introductory chapters, gives a sketch of the various points of interest which the investigation of the fungi, as a family, presents to the student of nature.

The habitats of fungi are very curious, and, as they have been found under the most unlikely circumstances, the pursuit of this department of inquiry offers a subject of considerable interest to the microscopic inquirer. Mr. Berkeley concludes this part of his work with the following remarks:

"Two other circumstances, however, require a few lines before I close this chapter. The first of these is the occurrence of mould in the inside of bread a few hours after it is baked. This was at one time notoriously the case with the coarse 'pain de nutrition,' or barrack-bread, at Paris. A beautiful red mould appeared in its very centre within an incredibly short space of time. It was, however, found that the spores of certain fungi would bear moist heat equal to that of boiling water without losing their power of germination. They have also considerable powers of resisting frost, but the exact limits in either case under varying circumstances have not at present been ascertained.

"The other point is the apparently sudden development of fungous matter on cooked provisions, whether animal or vegetable, in very hot weather. As the fungus thus produced is of a bright blood-red, and often spreads in little jets as spirted from an artery, it has been supposed to arise from a rain of blood. The production is not, however, so uncommon as is supposed, and may be seen almost every year on some of the larger and more perfect fungi when in a state of decay, though in small quantities. When in abundance it is very beautiful, and in hot weather it may be cultivated with great ease on rice paste. The growth of these productions is, however, very capricious, and I have this autumn in vain attempted to cultivate it, which is the more provoking, as its real affinities and structure are at present very obscure.*

It may be added, in conclusion, that the fungi which attack animal substances are for the most part far from nice in their choice of a place of growth; but some which produce disease in animals are attached to particular insects, and a few which grow on decaying hoofs, horns, bones, feathers, wool, or hairs, are never found in any other situations. Leather for a long time seemed to be exempt from any fungi save the commonest species of mould, but Messrs. Broome and Currey have lately found a pretty *Ascobolus* on this substance when exposed to decay."

The subject of the propagation of fungi has often been discussed in these pages, and many of our readers may be glad to read in Mr. Berkeley's own words his views on this subject. After speaking of the propagation of fungi by pores and sporidia as homologous with the buds of higher plants, he says:

"Besides these propagative bodies, other extremely minute bodies are produced either on threads or in distinct perithecia or cells in certain fungi, as *Bulgaria inquinans*, *Hysterium*

* Together with the blood-rain, gelatinous spots of a bright yellow, blue, pink, gray, white, &c., often appear on the rice paste, identical in structure with the red. The matter which appears on meat in damp weather seems to be similar. The whole subject requires further investigation.

Rubi, &c., which from analogy are supposed to have something to do with the impregnation of the normal fruit. In this case the organs which contained them are called antheridia, or spermogonia, and the bodies themselves spermatozoids. It is very doubtful at present whether the cells which project from the gills in *Agaricus, Coprinus, Boletus*, &c., are of the same nature, but it must be remembered that in many cryptogams the mode of impregnation far more closely resembles that in animals than that in phænogams, and therefore it does not follow that a more perfect type may not exist amongst the lower than amongst the higher fungi. Sometimes amongst the ascigerous fungi, as in *Nectria inaurata*, there are asci containing, the one eight sporidia, the other a multitude of minute granules. These secondary asci may perhaps with as much justice be considered antheridia as the bodies mentioned above. It is observable, however, that in the other cases the spermatozoids are always produced at the tips of delicate threads or their branchlets, while these little bodies are produced freely in the sacs like sporidia. It is to the Messieurs Tulasne that we are chiefly indebted for this knowledge, as also for the curious facts which I am about to mention.

"In many of the parasitic fungi, belonging to the same section as the wheat mildew and bunt, a very curious process takes place. The reproductive organs, which from analogy are commonly called spores, do not directly propagate the plant. These bodies however germinate, and often at definite points, exactly after the fashion of pollen-grains, and after a time produce on their threads secondary and sometimes tertiary spores capable of germinating. It is by these that the plant is really reproduced

" In the bunt the process is easily observed. If a portion of the spores be laid on a piece of damp flannel or on a slip of glass, and properly secured from evaporation, a white floccose matter is soon seen upon them, and when examined by the microscope it is found that the spore first gives out an obtuse thread, which produces at the apex a coronet of curved delicate appendages like the spores of a *Fusisporium*, to which genus they were referred before their true character was ascertained; these soon become connected by lateral threads, and ultimately produce little oblong, somewhat oblique cells, which germinate and reproduce the plant. The analogy between this and the devolopment of pollen-grains on the one hand, and the formation of the prothallus in the higher cryptogams, is very curious."

The following paragraph contains a useful hint, which we hope our medical friends will consider well. By the precipitancy with which they have described every fungoid growth they have observed as a new species of fungus, they have done much to bring discredit on the whole inquiry of the relation of these organized bodies to diseased structures:

"A large treatise* has been written by Robin, relative to their effects on animals, and there are multitude of scattered memoirs on the same subject; but, unfortunately, the fungi which occur in the diseases of man, or other members of the animal kingdom, have seldom been examined by persons intimately acquainted with these fungi, so that the species or even genera in question are often doubtful. It is, however, certain that many of those which are found on different parts of the mucous membrane of animals, in a more or less advanced stage of growth, are, like the fungi of yeast, referable to common species of mould. It is not probable that in these cases fungi originate disease, though it is pretty certain that they frequently aggravate it. The spores of our common moulds float about everywhere, and, as they grow with great rapidity, they are able to establish themselves on any surface where the secretion is not sufficiently active or healthy to throw off the intruder. Where the spores are very abundant, they may sometimes, like other minute bodies, obstruct the minute cells of the lungs, but there is no reason to believe that they induce epidemic diseases, such as cholera or influenza, according to an opinion once somewhat prevalent, whatever their abundance may be, or however easily they may be collected, as some assert, at the mouths of sewers, or in other situations likely to produce miasma."

There is no doubt that some definite forms of fungi, as, for instance, *Sarcina Ventriculi*, inhabit the human body; but experiments are yet wanted to show that many other forms referred to as species really deserve that position. Of course it is important to record all forms which those fungi assume, as at particular stages of their development they may become diagnostic of disease.

The culture of fungi appears to be as certain as that of most plants, and even those minuter forms on which the microscopist may be expected to exercise his skill. Thus Mr. Berkeley says:

"As regards matters of science or curiosity, the reproductive bodies of many fungi can be made to germinate very readily by placing them in fluid in an insulated cell, or by

* 'Histoire Naturelle des Végétaux Parasites qui croissent sur l'Homme et sur les Animaux vivants.' Paris, 8vo. 1853. Par Charles Robin.

simply putting them upon a slip of glass under an air-tight bell-glass. In cases where they do not germinate, there is some fault in general either in the temperature or degree of moisture; or sometimes because mere water is not sufficient, without an admixture of sugar or some other organic matter. Many species of mould may be raised very easily upon paste made with ground rice under a bell-glass, and some fungi may be brought to perfection on rotten wood in the same condition. The well-known ergot may be induced to produce its very curious perfect form (pl. 23, fig. 7), by simply sowing the infected grains in a garden-pot, and avoiding extremes of dryness or moisture.* Even some of the species which are parasites on living leaves may be propagated either by direct sowing of the spores on the young leaves, or watering the soil in which the plant proposed to bear the parasite grows, as in the case of the yellow rose rust, with water in which infected leaves have been duly steeped."

The Introduction is full of interesting matter on the subjects to which we have alluded. We heartily wish the present volume a successful sale, so that we may hope to see the author encouraged to produce an equally interesting volume on the microscopical forms of British fungi. No one knows so much about them as he does, and it is really a disgrace to the boasted intelligence of our age that the knowledge which men have acquired by great labour and peculiar genius should not be disseminated, for the want of a government or a public to appreciate the value of their work.

Marvels of Pond Life; or, a Year's Microscopic Recreations. By Henry J. Slack. London: Groombridge.

Mr. Slack has kept a diary of his observations with the microscope, and has dared to publish the result. We say "dared," because we think it required a little courage on his part to publish a series of observations which many persons more competent than himself would have shrunk from. Yet the beginner with the microscope will be grateful to Mr.

* Mr. Currey has induced the ergot of the common reed to fructify by keeping the stem immersed in water.

Slack for all the details which he has presented to him in this little book, and which the more dignified philosopher might think almost entirely beneath his notice. What really interests the great mass of the world is not the advancement of science, but little peeps at the wonders of nature, for which alone their limited or one-sided education has fitted them. It is not because a man has been educated at one of our universities, that he requires for his delectation in natural science short descriptions of natural objects in Latin. No, he too must begin with the child; and, if he would learn the mysteries of organization, must take his dipping-bottle to the pond side, and feel an interest, in common with Mr. Slack, in marvelling over the structures he has thus secured. We shall not, therefore, attempt to be critical on Mr. Slack's volume, but express our welcome at the heartiness with which he enters into microscopical work, and the interest he has succeeded in throwing into his researches. Of course, as his investigations were confined to fresh water, the great mass of his observations are on the infusorial animalcules and the rotifers. Here is his account of catching one of the rarer forms of the last class:—

"When the Floscules or other tubicolar rotifers are specially sought for, the best way is to proceed to a pond where slender-leaved water-plants grow, and to examine a few branches at a time in a phial of water with a pocket lens. They are all large enough to be discerned, if present, in this manner, and as soon as one is found others may be expected, either in the same or in adjacent parts of the pond, for they are gregarious in their habits. With many, however, the first finding of a floscule will be an accident, as was the case last April, when a small piece of myriophyllum was placed in the live-box, and looked over to see what it might contain. The first glimpse revealed an egg-shaped object, of a brownish tint, stretching itself upon a stalk, and showing some symptoms of hairs or cilia at its head. This was enough to indicate the nature of the creature, and to show the necessity for a careful management of the light, which, being adjusted obliquely, gave quite a new character to the scene. The dirty brown hue disappeared, and was replaced by brilliant colours; while the hairs, instead of appearing few and short, were found to be extremely numerous, very long, and glistening like delicate threads of spun glass.

"Knowing that the Floscules live in transparent gelatinous tubes, such an object was carefully looked for, but in this instance, as is not uncommon, it was perfectly free from extraneous matter, and possessed nearly the same refractive power as the water; so that displaying it to advantage required some little trouble in the way of careful focusing, and many experiments as to the best angle at which the mirror should be turned to direct the light. When all was accomplished, it was seen that the floscule had her abode in a clear transparent cylinder, like a thin confectioner's jar, which she did not touch except at the bottom, to which her foot was attached. Lying beside her in the bottle were three large eggs, and the slightest shock given to the table induced her to draw back in evident alarm. Immediately afterwards she slowly protruded a dense bunch of the fine long hairs, which quivered in the light, and shone with a delicate bluish-green lustre, here and there varied by opaline tints.

"The hairs were thrust out in a mass, somewhat after the mode in which the old-fashioned telescope hearth-brooms were made to put forth their bristles. As soon as they were completely everted, together with the upper portion of the floscule, six lobes gradually separated, causing the hairs to fall on all sides in a graceful shower; and when the process was complete, they remained perfectly motionless, in six hollow, fan-shaped tufts, one being attached to each lobe. Some internal ciliary action, quite distinct from the hairs, and which has never been precisely understood, caused gentle currents to flow towards the mouth in the middle of the lobes, and from the motion of the gizzard, imperfectly seen through the integument, and from the rapid filling of the stomach with particles of all hues, it was plain that captivity had not destroyed the floscule's appetite, and that the drop of water in the live box contained a good supply of food."

Mr. Slack has illustrated his remarks with woodcuts, and several very beautifully executed plates accompany the objects he describes. We recommend Mr. Slack's volume as a gift-book for the encouragement of young microscopic observers.

Lectures on the Diseases of the Kidney. By S. J. Goodfellow, M.D. London: Hardwicke.

We do not notice Dr. Goodfellow's book for the purpose of criticising or recommending his diagnosis or treatment of diseases of the kidney, but to draw attention to the fact that he has appreciated and used the microscope in ascertaining their nature. Although this may be saying nothing more than ought to be said of the production of every intelligent physician, yet we feel that so large a proportion of medical literature devoted to the exposition of disease is utterly worthless for the want of microscopic investigation, that we are glad to be able to notice a work in which the microscope has been employed as a necessary instrument of research. In fact, no class of diseases illustrate more fully the use of this instrument than those which affect the kidney. It was not till Bowman, by the aid of the microscope, had elucidated the true structure of the kidney, and pointed out the functions of its different parts, that the full significance of Bright's discovery of the relation between the composition of the urine and the morbid conditions of the kidney, began to be fully understood and appreciated. Nor has microscopic investigation been confined to the structure of the kidney or it might have been more difficult to connect the living indications of diseased structure with the nature of such structure observed after death; but the microscope has been applied to the urinary secretion, and this product constantly passing away is made to indicate not only the diseased conditions of the kidney, but their progress from hour to hour and day to day. It will be, therefore, evident that those who attempt to treat disease of the kidney without the use of the microscope are really practising in the dark, and, for all the good they are likely to do, they are only on a par with any uninstructed person who would undertake to treat disease without understanding its nature. Of course Dr. Goodfellow's book will not teach those ignorant of the use of the microscope how to employ it, but those already capable of using the instrument, will find in his volume the points indicated in which it becomes indispensable to the use of the medical man who wishes to understand the nature of the diseases he treats.

A Manual of Botany. By Robert Bentley, F.L.S. London: Churchill.

After the valuable manuals of Lindley, Balfour, and Henfrey, the critic may be forgiven for asking, What need could there be for another? We imagine that this is a question which the publisher rather than the author ought to answer. If the publisher, who is the great middle-man between the author and the public, thinks that another manual of botany will pay, then it is his business, and all the critic has to do is to see that the public is likely to get its money's worth. Now, Churchill's manuals have been a great public benefit, and they would have been imperfect without a manual of botany. The editor of an encyclopædia might as well omit the article botany because it had been done in all other encyclopædias, as for Mr. Churchill to omit a manual of botany because so many good ones exist. Having said thus much as an apology for both publisher and author, we would now draw attention to the histological portion of Professor Bentley's manual. As in all other parts of his book, Mr. Bentley does not present himself as an original observer or discoverer, but as a teacher of what is known upon the subject; and in turning over the various parts of the manual devoted to microscopic investigation, we must confess that he has given a very fair interpretation of the facts in the structure and functions of plants which are elicited by the aid of the microscope. Mr. Bentley has evidently been more anxious to make his book an orthodox volume, available for all classes and examinations, than a work representing or attempting any advance in the science of botany. We think, however, he might have consulted more frequently original papers—and many such have appeared in our own pages—with advantage.

This work is got up in the same excellent style as all Churchill's manuals, and is illustrated with upwards of eleven hundred wood engravings, executed with great skill by Mr. Bagg.

Common Objects of the Microscope. By the Rev. J. G. Wood. London: Routledge.

The great feature of this book is a series of illustrations by Tuffen West, but they are so crowded together as to render them exceedingly inconvenient for use, nor are they printed so well as to do justice to Mr. West's celebrity as a microscopic artist. The objects have not, however, been selected for the purpose of illustrating "common objects" alone, but of offering to the public the largest number of illustrations at the lowest price. The text has been written as an explanation of the plates; and when we say that above four hundred objects are described, as well as an account given of the microscope and how to use it, in 127 pages, it will be seen that little space has been given for that kind of description which a beginner requires. Indeed, we think too much has been attempted in this volume; and that had there been fewer illustrations, and more letter-press, it would have better served the demand for a cheap introduction to the microscope.

PROCEEDINGS OF SOCIETIES.

DONATIONS TO THE MICROSCOPICAL SOCIETY.

May 8th, 1861.

	Presented by
Bulletins de l'Académie Royale de Belgique, 1861 .	The Academy.
Annuaire de l'Académie Royale de Belgique, 1861 .	Ditto.
Transactions of the Linnean Society, Vol. XXIII, Part 1	The Society.
Journal of the Proceedings of the Linnean Society, Vol. V, No. 19	Ditto.
The Photographic Journal, Nos. 104, 106, 107, 108 .	The Editor.
Recreative Science, Nos. 21, 22 . . .	Ditto.
The London Review, Nos. 37, 38, 39, and 40 .	Ditto.
The American Journal of Science and Art . .	Ditto.
Notes on the Generative Organs, and on the Formation of the Egg, in the Annulosa, Part 1. By J. Lubbock, Esq.	The Author.
The Annals and Magazine of Natural History, Nos. 40 and 41	Purchased.

June 10th.

C. Woodward, Esq., F.R.S., On Polarized Light. Third Edition	The Author.
Quarterly Journal of the Geological Society, No. 66 .	The Society.
Recreative Science, No. 23 . . .	The Editor.
Photographic Journal, No. 109 . . .	Ditto.
London Review, Nos. 45 to 49 . . .	Ditto.
The Annals and Magazine of Natural History, No. 42	Purchased.

W. G. SEARSON, *Curator*.

ROYAL SOCIETY.

On the STRUCTURE *and* GROWTH *of the* TOOTH *of* ECHINUS. By S. JAMES A. SALTER, M.B. Lond., F.L.S., F.G.S. Communicated by THOMAS BELL, Esq. Received March 5, 1861.

The author commences his paper by stating that the researches upon which it is based were made more than four years since, and then without the knowledge that the structure had been previously investigated by others.

An abstract of the *literature* of the subject (contained in very narrow limits) is then given.

In 1841 Valentin, in Agassiz's 'Monograph on the Echinoderms' (*Anatomie des Echinodermes*), published a description and many good figures of the minute anatomy and growth of the Echinus-tooth.

Professor Quekett, in his 'Lectures on Histology' (1854), referring to the minute *mature* anatomy of the organ, states its ultimate structure to resemble bone and dentine of vertebrata.

Dr. Carpenter, in his work 'On the Microscope,' speaks of the tissue of the tooth as essentially of the same nature as the shell of the Echinidæ generally (1856).

Lastly, Professor W. C. Williamson describes the subject more fully than his predecessors, entering into the question of the development of the tooth both generally and histologically (though apparently in ignorance of Valentin's Essay), in a paper on the "Histology of the Dermal Tissues," &c., in the 'British Journal of Dental Science,' 1857.

The coarse anatomy and relations of the Echinus-tooth are then described, and the question is discussed as to how far the organ resembles and how far it does not resemble the incisor tooth of a Rodent Mammal, to which it has constantly been likened.

Some remarks then follow on the method of investigation, which the peculiar physical characters of the structure render very difficult.

Before describing the histology of the mature tooth, the author premises some succinct remarks upon the several elementary parts that are formed at its growing extremity, and by which its complex structure is built up—showing how the shape and plan of these elements determine the microscopical appearances of the several regions of the tooth as seen in different sections.

These elementary parts are—(1st) the *Primary plates*, which consist of a double series of triangular sheets of calcareous matter, and which constitute the physiological axis of the tooth, about which and connected with which the four secondary elements are developed. These latter are (2nd) the *Secondary plates*, lappets of similar calcareous sheets attached to the outer edge of the primary plates; (3rd) the *Flabelliform processes*, elaborate reticulations of calcareous fibres ending in fan-shaped extremities; (4th) the *Keel fibres*, certain long cylindrical rods with club-shaped ends of the same chemical nature, which pass towards the enteric region of the tooth in their growth; and (5th) the *Enamel Rods*, which are minute, very short developments of the same character, and which are formed in the opposite direction. Thus far a primary and secondary stage of formation are represented: a third stage, that of consolidation, now occurs in the development of (6th) the *Soldering particles*, multitudes of minute discs of carbonate of lime which appear over the whole surface of the previously formed elementary parts, and by which they are soldered together, the intervals between these (in a certain sense) constituting the tubular character of the mature tissue.

The primary plates, secondary plates, and the proximal portion of the flabelliform processes are stated to constitute the body of the tooth—the distal extremities of the flabelliform processes the *skirtings* of the enteric region of the body of the tooth; the keel fibres wholly form the keel; while the short enamel rods compose the thin white layer on the dorsal surface of the tooth—the enamel.

The histology of the tooth is remarkable as exhibiting apparent inconsistencies in different lines of section. A vertical section of the tooth presents the appearance of vertebrate bone, lacunæ, canaliculi, and lamellæ; while a transverse section displays some regions resembling dentine (the body of the tooth), and others having the closest similitude to an oblique section of the shell of some Mollusca, such as *Pinna*.

The author then proceeds to describe in detail and with particularity the form and progressive growth of the several elements of the tooth, as they are met with in examining the growing extremity, and proceeding from it towards the mature structure, as long as the elements are susceptible of isolation and individual examination. The anatomy of the soldering particles, and their relation to the production of the cavitary structure of the tooth, is specially dwelt upon. The soldering particles are supposed to be isolated at first, but as they enlarge they become connected by a thin film from their upper and under faces. This occurs before the final consolidation of the tissue, and before the soldering particles are indissolubly connected with, and themselves indissolubly connect, the contiguous elements of the tooth. At this stage these particles are still susceptible of isolation, and they may be separated *en masse*, being held in relative position by the films that connect them. The soldering particles and the connecting films thus constitute a tubular system, which has an independent existence before the final consolidation of the tissue, and this tubular system is introduced between, and interpolated among, the previously existing elementary parts of the tooth.

The author concludes by expressing a coincidence of opinion with Dr. Carpenter, that the minute structure of the tooth is essentially of the same nature as that of the shell of the Echinidæ generally.

Hull Micro-Philosophical Society.

The annual meeting of this Society was held in the committee-room of the Hull Literary and Philosophical Society, on the 6th September, preliminary to the fourth sessional course of microscopical exhibitions and discussions, when George Norman, Esq., was re-elected President, and the other officers were appointed. The number of members is already twenty-two, being at present limited to twenty-five. The Society progresses steadily in the cultivation and diffusion of microscopical science. The subjects approved for the sessional course of 1861-62 are "On the Markings of Diatomaceæ," &c. &c.

The instruments and lenses of this Society are usually by the first makers, and a cabinet is in course of preparation for the deposit of specimens illustrative of the most interesting and important subjects, for the use of its members; whereby affording every facility for the cultivation of a department in science of such a practical and general application in the age in which we live.

The members of the Society assemble at a quarter before eight, p.m., once every fortnight during the winter, and only monthly during the summer, separating usually about ten, p.m. Refreshments of all kinds excluded, as interrupting the legitimate objects of so brief a period of sedentary and refined pursuit.

Once or twice during the summer the members indulge in some distant excursion for the day, mostly selecting some locality abounding in microscopic objects, animal or vegetable, as forest, lake, estuary, &c., &c.; occasions generally attended with joyous anticipations and consummation.

Wm. Hendry, *Hon. Sec.*

The Bradford Microscopical Society.

At the meeting, July 4th, R. H. Meade, Esq., exhibited some fine entomological objects with the binocular microscope, which shows this class of objects to great perfection. Mr. Sands also showed some slides of mummy-cloth.

A resolution was passed, that the members have an excursion to some of the neighbouring localities.

August 1st.—The President (R. H. Meade) read a very interesting paper "On the Structure of the Eyes of Animals."

September 5th.—At this meeting it was resolved, that the Society give its annual soirée in October next; Mr. Behrens, Mr. Horsfall, and Mr. Rimmington to be the committee of management.

P. Miall, Esq., M.R.C.S., read a paper "On the Structure of Bone."

The Southampton Microscopical Society.

We have received the address of the President, Dr. Joseph Bullar, delivered at the first meeting of this Society. If the meetings are carried on with the spirit and intelligence, with which the distinguished President has written his address, we may expect to find the Southampton Society foremost amongst our local societies in the prosecution of microscopical research. We should have been glad, had our space permitted, to have given the whole of Dr. Bullar's admirable address, but we must be content to give the conclusion only:

"The social aspect of our Society commends it. It is a pleasant way of spending an evening where there is a scientific object of natural interest, and, at the same time, a social gathering of many having the same tastes and objects, and therefore the same sympathies. The anatomy of an insect, too, is a more harmless occupation than the minute dissection of a neighbour's natural history. Tea and coffee, pleasant chat with those of like tastes, and then the table covered with microscopes, and the specimens explained by one, and passed round for each to examine, calling out animated talk on subjects worth discussing, or a short paper read and discussed on the subject illustrated, are civilizing. For science is a civilizer. It refines the tastes and elevates the thoughts, as it is the search after truth for truth's own sake. And in this age, when the progress of the nation and of the world is estimated by the money value of exports and imports (and in this aspect the world's progress is prodigious and annually increasing), the danger must lie in estimating all things in reference to money rather than to truth. Now, science is a counteracting force. It neither brings wealth to its true cultivators, nor can wealth buy scientific tastes nor scientific fame. It belongs to a higher region than "the diggins." It must breathe "a purer ether, a diviner air." And those who are engrossed in commerce would often do well, for their own content and happiness, by seeking, in the recreations of science, a complete change of action, thought, and feeling. Obviously the eye-service which the microscope requires trains the eye to minute and discriminative observation, and the hand to delicate accuracy. It leads on, if used scientifically, to the improvement of the scientific powers. The memory, the investigation of causes, the estimation of evidence, the power of distinguishing and of generalizing may be called into activity. But the mind has other and deeper needs than these. The senses lead to the awakening and culture of deeper powers inherent in the soul itself, and the microscope may excite and cultivate, not only the sense of the true, but of the beautiful. Constable, the landscape-painter, said that, pictorially, nothing in nature was ugly; and surely we may say the same microscopically. The higher the magnifying powers, the more minutely extensive the investigations, the more beauty do we see. Even in the unhealthy secretions, in what look to the unscientific eye like repulsive fluids, in the very disorganizations which slowly ruin this goodly human frame, the microscope discovers forms of the highest geometrical accuracy, as well as of the most delicate beauty. And this beauty and consummate finish are everywhere, and are found farther and deeper as our powers increase of observing them. Here, too, at every step, we find the limitation of our own powers and the illimitable field of nature; the infinite contrasting with our finite, teaching us 'the moral lesson of science—humility.'"

Microscopical Soiree, given to the Members of the British Association at the Meeting at Manchester, *5th September*, 1861.

The local executive committee decided upon giving a series of *soirées* to the members of the British Association during their meeting at Manchester, and the Free Trade Hall was engaged for the purpose; a permanent exhibition for the week was arranged, consisting of glazed cases containing specimens of geology, botany, and zoology, mechanical models, philosophical instruments, Indian fabrics, local manufactures, &c.; various drawings and diagrams, and a choice collection of large paintings, surrounded the walls of the gallery. It was determined that three principal *soirées* should be given, and, in addition to the above exhibition, one evening should be devoted principally to microscopical objects, one to telegraphic apparatus, and another to objects of natural history. The special feature for the evening of Thursday, September 5th, was an exhibition of microscopes, under the management of a sub-committee of the microscopical section of the local Literary and Philosophical Society, assisted by Dr. T. Alcock and Dr. William Roberts.

Tables for the microscopes were arranged in three of the principal rooms in the building; two tables, each sixty feet long, were placed along the centre of the large hall; two tables, each twenty-five feet long, under the platform; and a curved table, fifty feet long, across the end of the gallery. In the assembly and drawing rooms upwards of four hundred feet of front table-space was provided, and four tables, each sixteen feet long, across the larger of the two rooms. Altogether, one hundred and fifty microscopes, most of them first-class instruments, were lent for the occasion; upwards of ninety private instruments, of which eighteen were of recent binocular construction, were contributed by gentlemen resident in the city and neighbourhood; the remainder, of which about thirty were binocular, were exhibited by makers of microscopes in London and the provinces.

In order to diminish the risk of damage to objects and instruments, it was determined by the sub-committee to show, for the most part, objects with low powers, and, to avoid loss of time and confusion in changing objects, that most of the microscopes should exhibit only one specimen during the evening; it was considered that if one minute were devoted to each object, two hours and a half would be required to examine the hundred and fifty microscopes collected together.

In the large hall sixty microscopes were arranged to exhibit a series of objects carefully selected from the various departments of nature. The series commenced with a specimen of granite, the oldest of the rocks, shown by polarized light; the scale was gradually ascended by specimens of quartz containing gold, various crystals, and specimens of coal and oolitic limestone, which connect minerals with vegetable and animal forms. The vegetable kingdom was represented, first, by the simplest cell, the yeast plant; then by an alga, a fern, various woody sections, petals and pollen; also a few objects to show the dubious but connecting links between the animal and vegetable kingdoms, as *Volvox globator*, a desmid and a diatom; then the lowest acknowledged animal forms were represented, by sponges and Foraminifera, and Mollusca, advancing to parts of insects and mammals, followed by injected sections of the human finger and brain; finally, works of art, comprising the micro-photographs of the eminent chemists, Davy, Wollaston, Faraday, and Dalton, the series being crowned by the 'British Association Circular' for 1861, photographed for the occasion by Mr. Dancer, comprising the names of the officers for the year, representatives of that society, which cultivates the knowledge of the works of the Creator, the material portions of which this exhibition was designed to illustrate.

Where each was excellent of its kind, it is difficult to particularise specimens; but in the mineral kingdom, that, perhaps, unequalled specimen of hypersthene described in the 'Quarterly Journal of Microscopical Science' for April, belonging to Mr. H. N. Janson, of Exeter, and kindly lent by him for the occasion, should be first mentioned. Amongst other objects, a curious fungus, found growing upon a leaf; Lagenæ belonging to Professor Williamson, and described by him in the 'British Foraminifera,' published by the Ray Society; the dissected larva of a silkworm, prepared by Mr. A. G. Latham; the ovipositor of the saw-fly, belonging to Mr. Samuelson, of Liverpool; and the palate of a cowry, prepared by Dr. Alcock, were particularly noticed.

In the gallery, under the special charge of Dr. Wm. Roberts, secretary of the physiological section, objects relating to anatomy and physiology were exhibited by about a dozen private microscopes. Amongst others were some remarkable specimens prepared by Dr. Beale, F.R.S., J. Lockhart Clarke, Esq., F.R.S., of London, and by Professor Hyrtl, of Vienna, exhibited by Dr. E. Percival Wright, of Dublin.

In a small anteroom the Rev. St. Vincent Beechey exhibited a number of objects with the polariscope, illuminated by the oxyhydrogen light. In the same room the Rev. Mr. Kingsley, of Cambridge, showed in operation his apparatus for photographing microscopical objects by the oxyhydrogen light.

Near the entrance to the drawing room Messrs. Williamson and Binney exhibited, by means of magnifying glasses, large transparent sections of the fossil vegetables from which coal has been formed, from the lower Lancashire coal fields.

In the drawing room, under the charge of Mr. J. G. Lynde, assisted by most of the owners of the instruments, eighteen first-class microscopes were exhibited with objects, which were changed several times during the evening, and which required high powers and special manipulation. The wheel-and-anchor spicula of the Synapta were sent alive for the exhibition, by Mr. Robert Patterson, of Belfast, but the animal died in the closed bottle before the meeting.

The assembly room was set apart for the use of the makers, accommodation being provided for sixty microscopes, five feet apart, with gas for their illumination. Messrs. Smith, Beck and Beck exhibited twenty-five microscopes, thirteen of which were of the binocular construction on Mr. Wenham's principle; each microscope showing the one object named in the catalogue. Mr. Beck, by proper illumination, showed in the binocular, with an eighth objective, the markings on the *Navicula angulatum.*

Mr. Ross exhibited ten binocular and single microscopes, with a variety of objects in successive changes.

Mr. Dancer, of Manchester, exhibited nineteen microscopes, thirteen of which were of the binocular construction with a new arrangement, in which the tubes diverge at equal angles, and with equal light in each tube; he also exhibited a number of choice objects, as crystallization in process, &c.

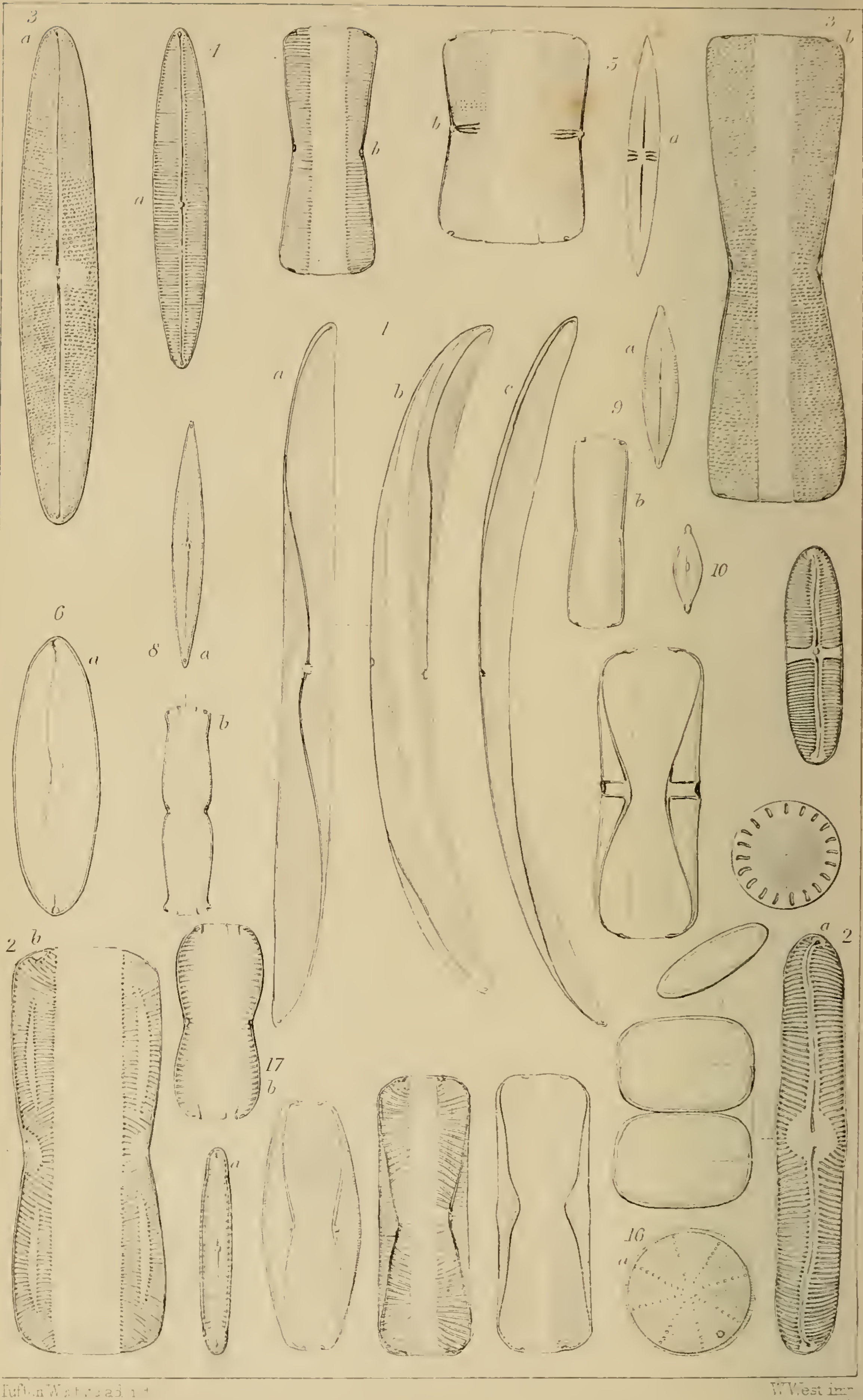
Mr. Darker, of London, exhibited his series of selenite plates, and objects to illustrate their use, with polarized light.

The mode of illumination of the objects contributed not a little to the success of the *soirée;* in the assembly and drawing rooms gas was provided, but in the large hall, as before stated, small paraffin lamps were used, which gave an excellent bright and clear flame, whose intensity was softened by a slip of pale-blue glass placed under each transparent object. These lamps will, no doubt, come into extensive use for the microscope; they are cheap, clean, give little or no trouble, and the oil sold by the Paraffin Light Company is not explosive, as was proved by experiments before the sub-committee previous to deciding upon its use; a lighted match dropped into the oil is immediately extinguished.

The general arrangements of the *soirée* were placed under the charge of the following gentlemen composing the Local Microscopical Sub-Committee:—Arthur G. Latham, Esq., Chairman; Dr. Thomas Alcock; J. B. Dancer, Esq., F.R.A.S.; James G. Lynde, Esq., M. Inst. C.E., F.G.S.; Dr. William Roberts; George Mosley, Hon. Secretary.

Upwards of 2000 persons were present on the evening of Thursday, September 5th, and there certainly never was a more magnificent display of microscopes. Too much praise can hardly be given to the local sub-committee for the admirable manner in which everything was arranged.

A catalogue of the objects exhibited was prepared by the sub-committee, and published in the programme of the proceedings of the Association.



Tuffen West del. W. West imp.

DESCRIPTION OF PLATE I,

Illustrating Dr. Donkin's paper on the Marine Diatomaceæ of Northumberland, with a Description of several New Species.

Fig.			
1.—*a*, *b*, & *c*,	*Pleurosigma falcatum*,	n. sp.,	Donkin.
2.—*a* & *b*,	*Navicula Trevelyana*,	,,	,,
3.—*a* & *b*,	,, *Clepsydra*,	,,	,,
4.—*a* & *b*,	,, *truncata*,	,,	,,
5.—*a* & *b*,	,, *Northumbrica*,	,,	,,
6.—*a*,	,, *hyalina*,	,,	,,
7.—*a*,	,, *cruciformis*,	,,	,,
8.—*a* & *b*,	,, *arenaria*,	,,	,,
9.—*a* & *b*,	,, ,,	small variety.	
10.—*a*,	,, *gregaria*,	n. sp.,	Donkin.
11.—*b*,	*Amphora ocellata*,	,,	,,
12.—*b*,	,, *naviculacea*,	,,	,,
13.—*b*,	,, *lineolata*,	,,	,,
14.—*a*,	*Systephania Anglica*,	,,	,,
15.—*a* & *b*,	*Druridgia geminata*,	,,	,,
16.—*a*,	*Eupodiscus tenellus*,	De Bréb.	
17.—*a* & *b*,	*Navicula retusa*,	,,	

× about 400 diameters.

DESCRIPTION OF PLATE II,

Illustrating Dr. J. Braxton Hicks's paper on the Development of the Gonidia of Lichens, in relation to the Unicellular Algæ.

Fig.

1.—*Gonidia*, becoming surrounded by the fibre.

2.— „ segmenting, and proceeding to form "*Soridia*."

3.—A *Soridium* submitted to pressure.

4.— „ opened, in which the *Glæocapsa*-change is first commencing.

5.—Two *Soridia*; (*a*) two mother cells in one mucous envelope (*b*) issuing from them.

6.—Another form of the *Glæocapsa*-change.

7.—Two unchanged *Gonidia*, with *Glæocapsa*-cells in the binary plan of segmentation.

8.—Mass of *Cladonia-Glæocapsa*, in which many varieties of segmentation are shown cotemporaneously: (*a*), simplest result of segmentation; (*b, b, b*), globular mother cells; (*c*), oval mother cells; (*d, d*), smaller (younger?) mother cells.

9.—(*a*), Group of oval mother cells, inclosed in a common mucous layer; (*b, b*), smaller mother cells in various conditions; (*c*), results of breaking up of mother cells.

10.—*Cladonia-Glæocapsa*, showing the quarternary form of subdivision-segments yet without separate sheath of mucus.

11.—Mass of *Cladonia-Glæocapsa*, in which a great variety of forms are shown :(*a, a*), resembling *Hæmatococcus rupestris*, Hass. (*Glæocapsa polydermatica*, Kütz.); (*b, b*), mother cells of large size, each in separate single envelope; (*c, c*), small mother cells, having two or three mucous sheaths.

12.—*Lichen-Palmoglæa.* Mucous envelope dense, and of a purple colour. The layer surrounding each cell at first purple, as at *a*; afterwards that colour is confined to the exterior.

13.—(*a, b, c*), Various state of same after immersion in water.

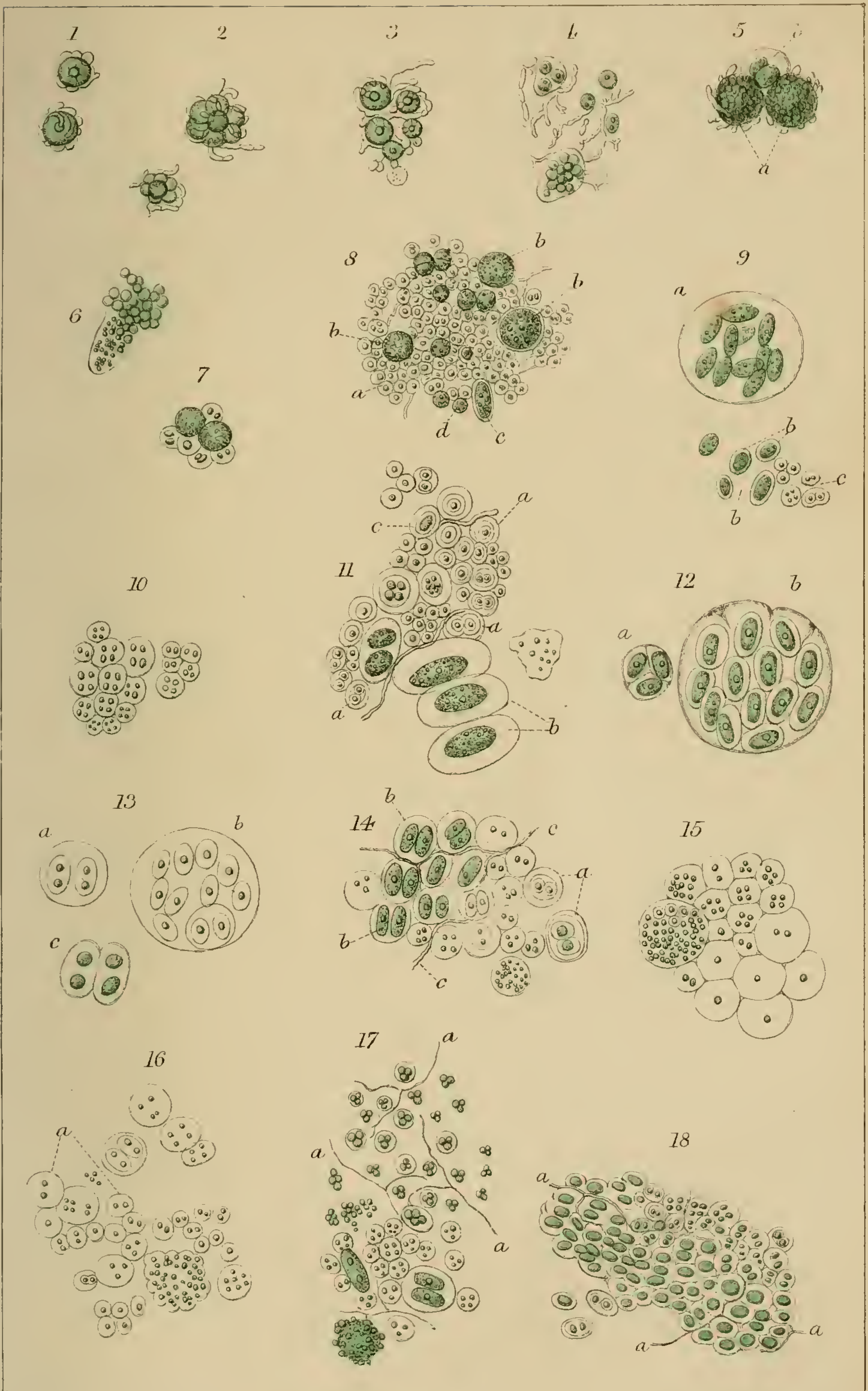
14.—Mass of *Lichen-Palmoglæa*, after dissolution of the purple mucous sheath: (*a*), *Glæocapsa polydermatica*, Kütz.; (*b*), *Palmoglæa*; (*c, c*), fibres of the original *Soridium*, now more delicate, dipping between the subdivisions.

15.—Increase of diameter of mucous layer, and decrease of that of cell, by frequent division, the effect of humidity.

16.—Changes in the same direction, like *Hæmatococcus minutissimus* (Hass.).

17.—Mass of *Palmoglæa*, *Glæocapsa*, and other kindred forms, derived from *Cladonia-Gonidia*; (*a, a, a*), the fibres now very delicate.

18.—Portion of mass produced by the alteration of the gonidial layer of the mature Lichen (*Cladonia*).



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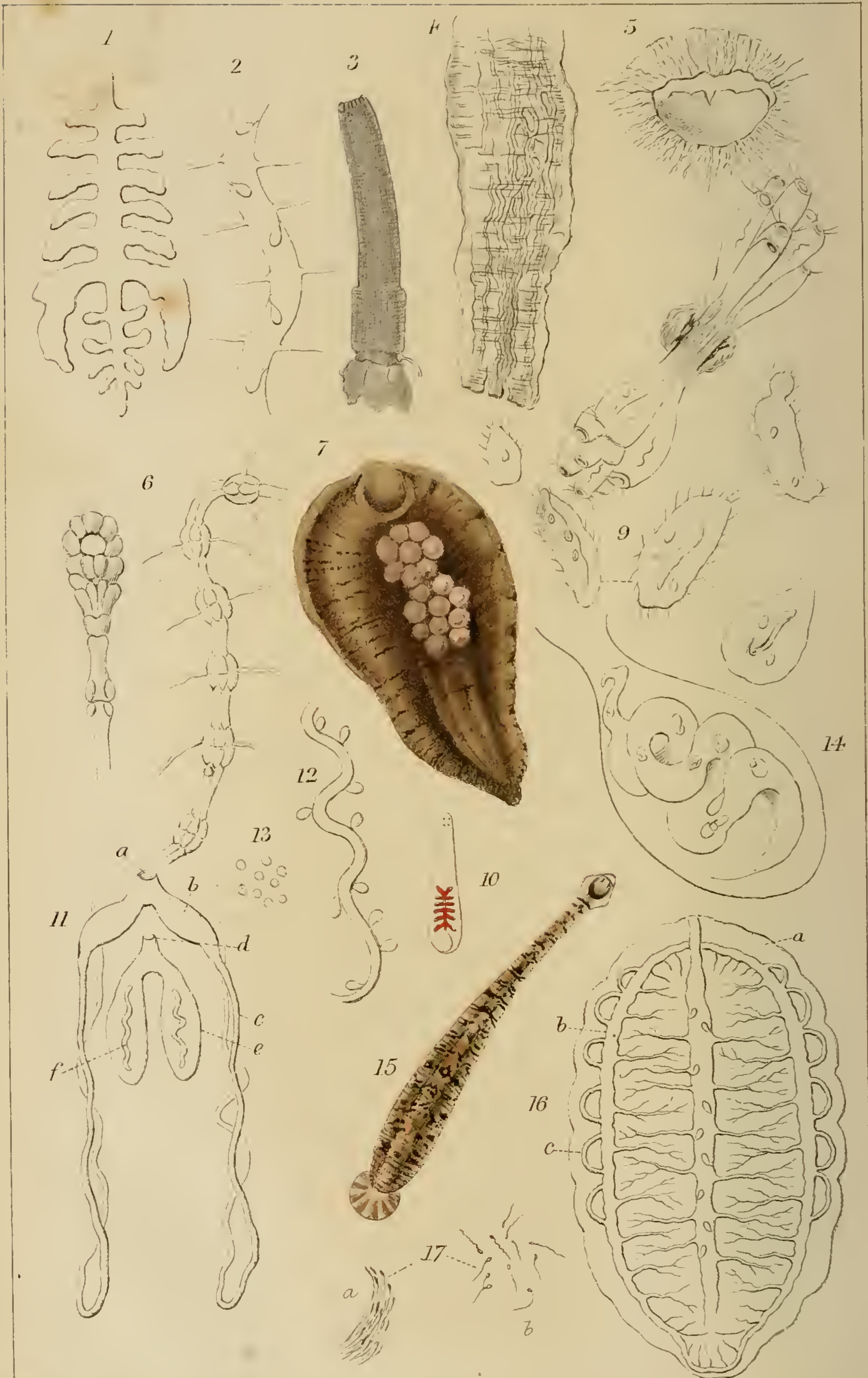

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DESCRIPTION OF PLATE III,

Illustrating the Rev. W. Houghton's Remarks on the Glossiphonidæ, a family of *Discophorous Annulata*.

Fig.

1.—Diagram illustrating the digestive and intestinal apparatus of a *Glossiphon: a*, stomachal cæca; *b*, intestinal cæca.

2.—Diagram showing a portion of the great dorsal vessel, with the valve-like processes and branching channels.

3.—Tubular proboscis of *Glossiphonia complanata*, magnified about 20 diameters.

4.—Portion of the same, magnified 350 diameters.

5.—Cup-shaped plate from the neck of *G. bioculata*, magnified 25 diameters.

6.—Nervous system of a *Glossiphonia: a*, cephalic portion; *b*, a portion from the middle of the body.

7.—*Glossiphonia complanata* in the act of incubating, magnified 3 diameters.

8.—A colony of parasites, *Epistylis* (?), common on the cervical plate of *G. bioculata*.

9.—Entozoan infusoria, from intestine of a *Glossiphonia*.

10.—A young *Glossiphonia*, showing the red cæca, slightly magnified.

11.—Generative system: *a*, *b*, *c*, male organ; *d*, *e*, *f*, female organ.

12.—Ovary with attached vitelli, magnified about 4 diameters.

13.—Vitelli, natural size.

14.—Portion of the membranous covering (ovisac?) of the ovary, with the latter contained in it.

15.—*G. marginata*, magnified 4 diameters.

16.—Diagram, showing (*a*) large contractile dorsal vessel; *b*, lateral vessels *c*, vessels leading from *b* to the margin of the body.

17.—Spermatozoa: *a*, hedge-like mass; *b*, free spermatozoa.

Note.—I am indebted to R. Chattock, Esq., of Solihull, for the drawings (from my rough sketches) on the accompanying plate.

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DESCRIPTION OF PLATE IV,

Illustrating Mr. G. Rainey's Paper on some further Experiments and Observations on the Mode of Formation and Coalescence of Carbonate-of-Lime Globules, and the Development of Shell-tissues.

Fig.

1.—Shows globules of carbonate of lime, with amorphous matter in the centre.

2.—Two globules with amorphous matter between them.

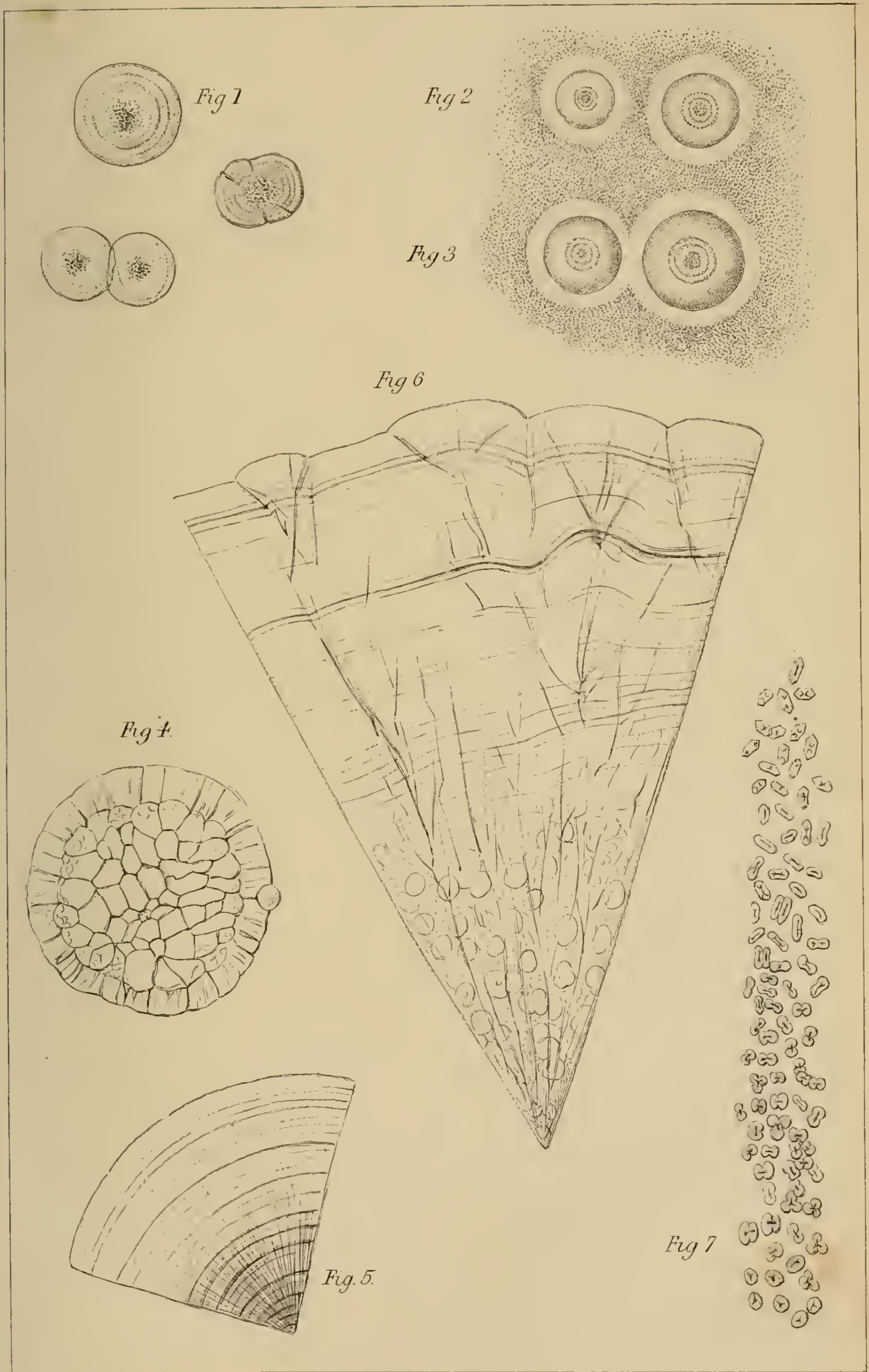
3.—The same two globules increased in size, and the intervening amorphous matter removed.

4.—Globules of carbonate of lime, with small globules in the centre, surrounded by a layer of coalesced globules.

5.—The half of an otolithe of a Stickleback.

6.—The half of an otolithe from a small White-bait.

7.—The carbonate of lime deposited on a slide, showing the crystalline form gradually passing into the globular.



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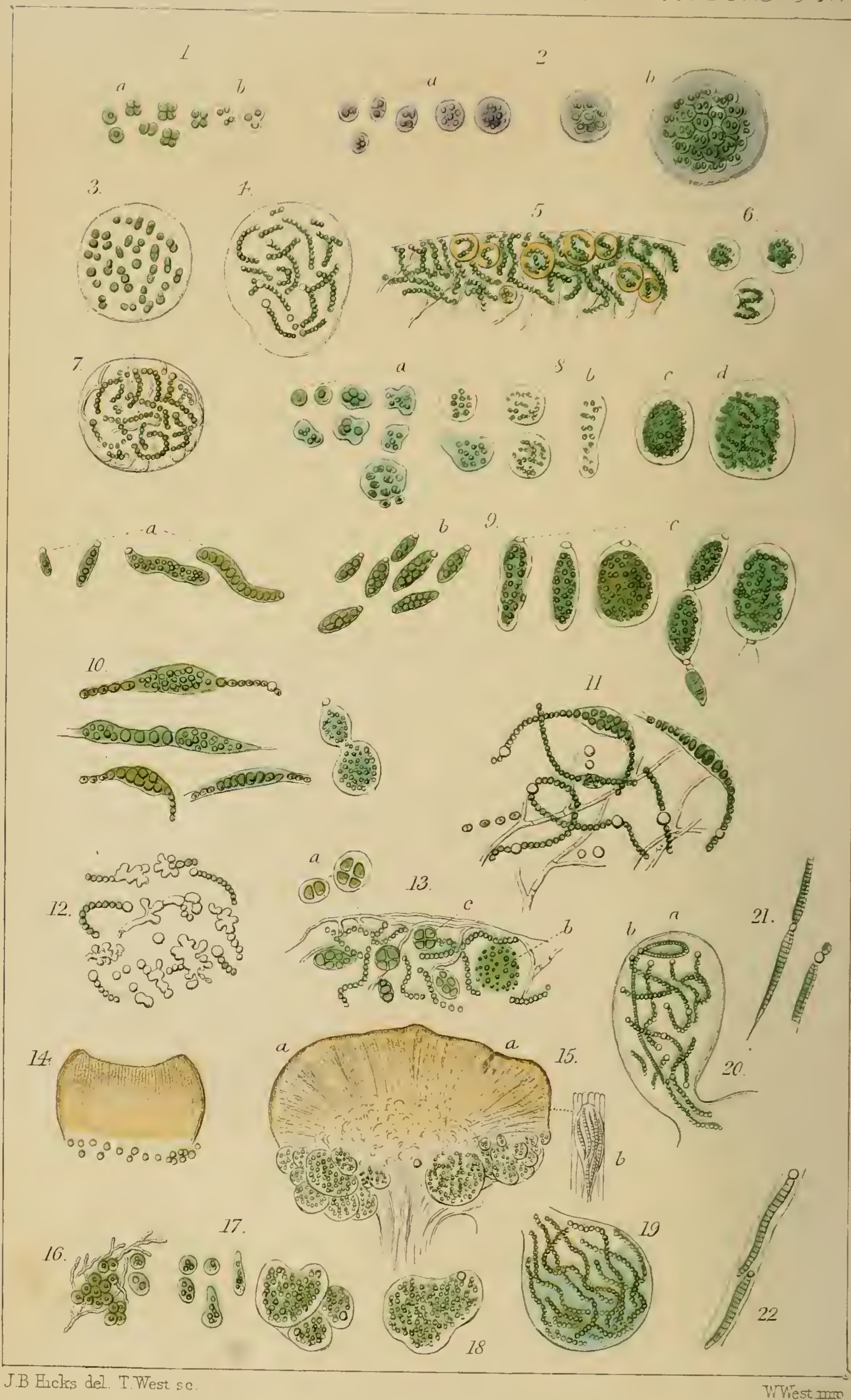

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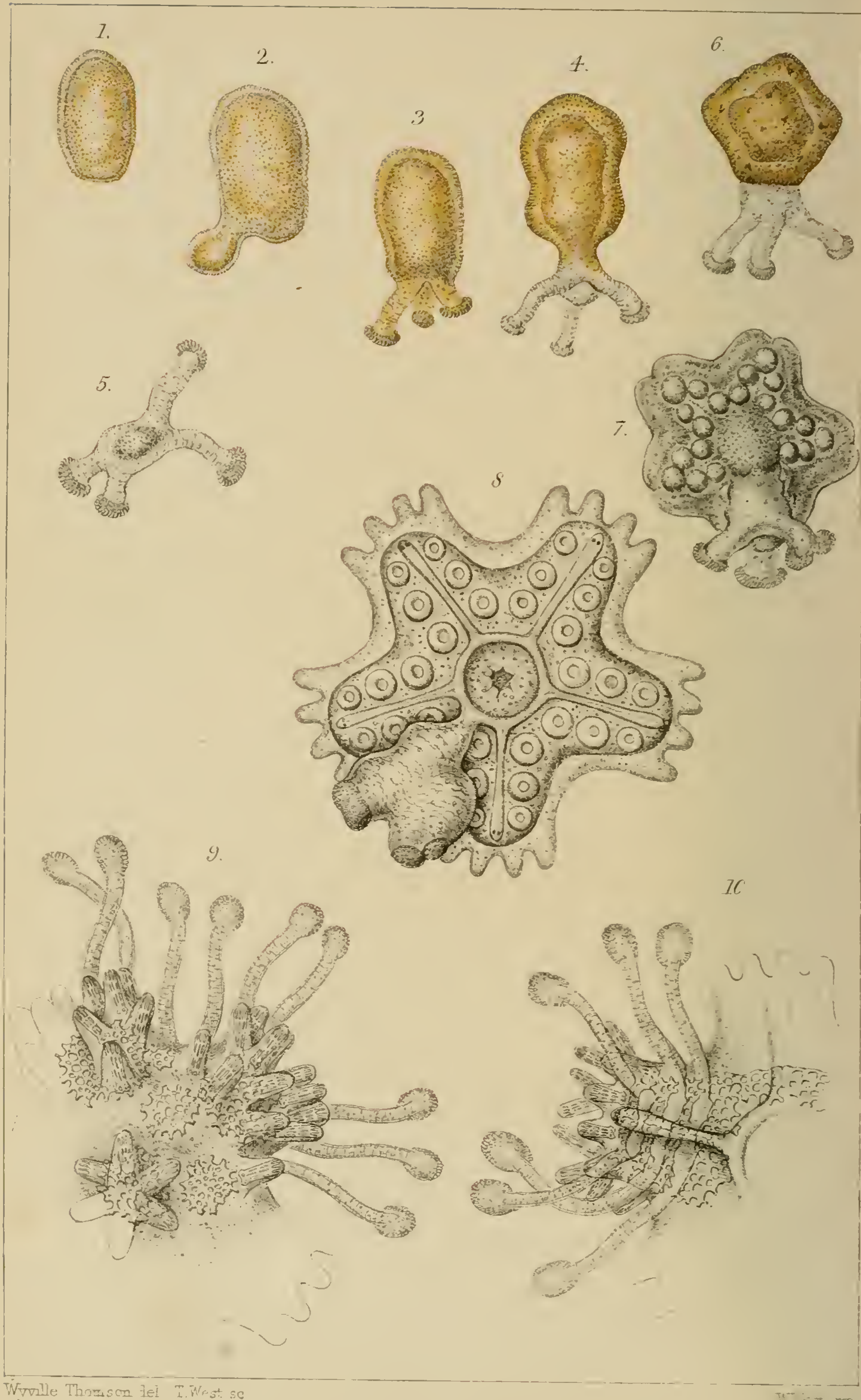
DESCRIPTION OF PLATE V,

Illustrating Dr. J. Braxton Hicks's paper on the Development of the Gonidia of Lichens in relation to the Unicellular Algæ, &c.

Fig.

1. Collema-gonidia. *a*, as Chlorococcus ; *b*, Glœocapsoid.
2. One form of development of Collema-gonidia into Nostoc. *a*, early changes ; *b*, later ditto. Mucous coat of both dark purple.
3. Ditto, ditto. Mucous coat now colourless.
4. Commencing Nostoc.
5. Section of Collema thallus, including early Nostoc balls.
6. Nostoc balls after extrusion.
7. Young Collema from Nostoc balls.
8. Collema- and Nostoc-gonidia developing into Nostoc.
   - *a*. Early (Glœocapsoid) bodies.
   - *b*. First appearance of linear arrangement.
   - *c*. Early Nostoc ball, in which the vesicular cells (heterocysts) are first appearing.
   - *d*. True Nostoc.
   - *e*. Cells of a Gleocapsoid mass undergoing binary segmentation.
9. Changes occurring within young Nostoc.
   - *a*, *b*. Approaching the linear Nostocachcæ.
   - *c*. Some reverting to Nostoc.
10. Changes of the moniliform threads (sporidia?) within mature Nostoc, ultimately reverting to Nostoc.
11. Formation of colourless fibre of Collema within Nostoc.
12. „ epidermic layer on surface of Nostoc.
13. Section of Collema, the Glœocapsa change proceeding within the thallus.
    - *a*. Gleocapsa formed from them after extrusion.
    - *b*. Segmentation going on to form a large mass.
    - *c*. One in quarternary subdivision.
14. Section of young Apothecium of the Gymnocarpous Lichen (fig. 14), with unchanged Gonidia.
15. Section of mature Apothecium; the Gonidia changed into Nostoc masses ; *b*, a Theca with spores.
16. Portion of gonidial layer of same; the Gleocapsoid change commencing in one.
17. Different stages of the Gonidia of same towards Nostoc.
18. Ditto, more advanced.
19. Fully formed Nostoc from Gonidia, as in fig. 15.
20. Nostoc, including a bluish-green articulated thread, arising from a vesicular cell.

21, 22. Nostocachcæ, found in close relation with Nostoc.



Wyville Thomson del. T. West sc.

DESCRIPTION OF PLATE VII,

Illustrating Professor Wyville Thomson's paper on the Embryology of *Asteracanthion violaceus*.

Fig.

1.—Embryo about four hours after complete segmentation.

2.—Embryo four hours later.

3.—Embryo about nine hours later.

4.—Embryo twenty-four hours old.

5.—Embryo and appendages thirty-six hours after complete segmentation.

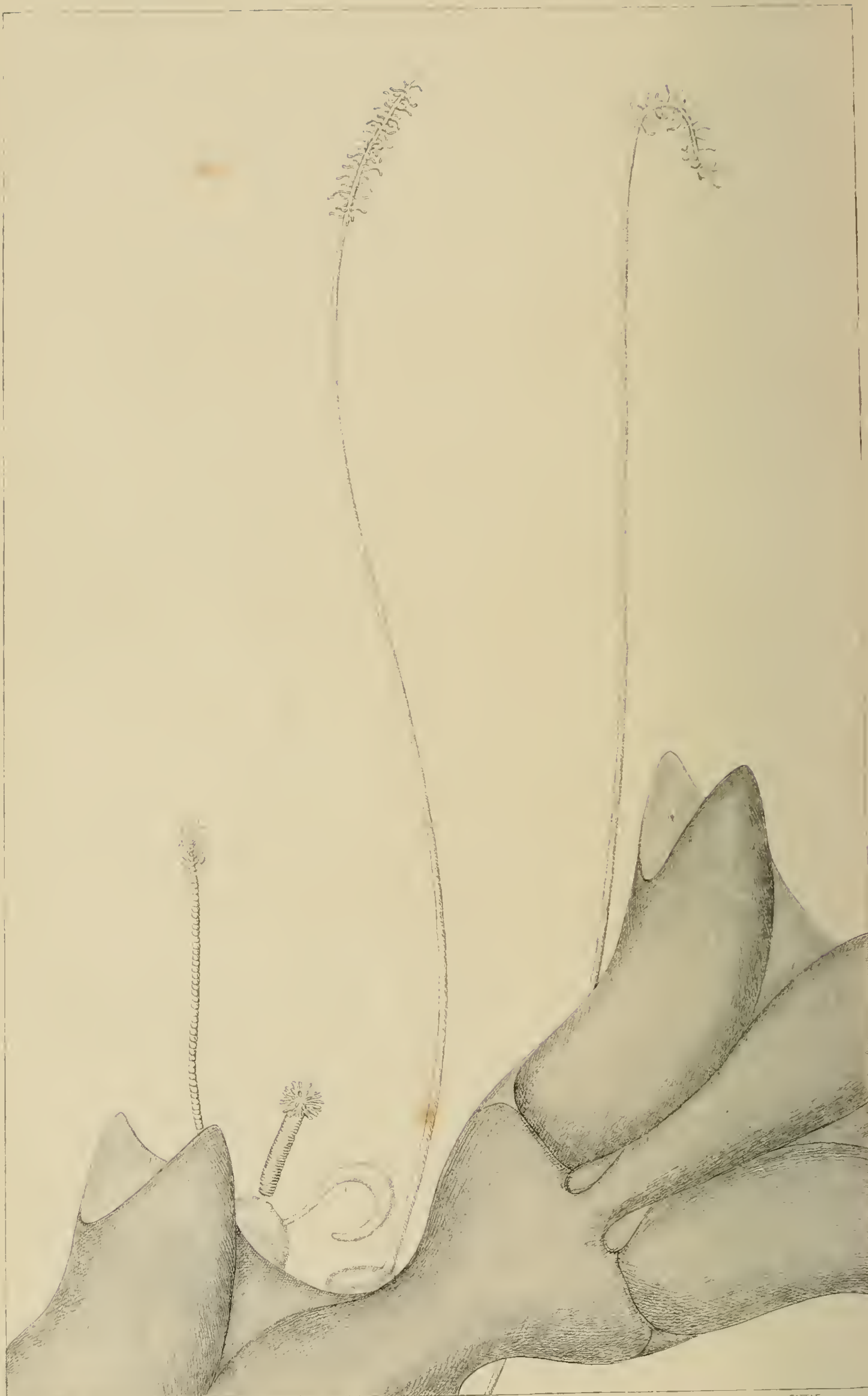
6.—Peduncle and appendages, which have separated by a natural process of fission from an embryo about a week old.

7.—Embryo and fully developed peduncular appendage about eight days after segmentation of the yelk.

8.—Embryo five weeks after complete segmentation, showing the remains of the peduncle, much atrophied, hanging attached to the ambulacral vascular ring.

9.—Upper surface of embryo about twelve days after segmentation, showing the arrangement of the superficial calcareous plates, &c.

10.—Lower surface, showing the arrangement of the ambulacral plates.



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DESCRIPTION OF PLATE VI,

Illustrating Dr. Strethill Wright's communication on
Ophryodendron abietinum.

The Protozoa are represented seated in the angle between two cells of *Sertularia pumila.*

Fig.

1.—*O. abietinum*, with contracted proboscis and gemma (?)

2.— ,, with proboscis extended, and without gemma.

3.—Proboscis more fully extended, and searching for food.

4.— ,, half retracted.

DESCRIPTION OF PLATE VIII,

Illustrating Dr. J. B. Hicks' paper on the Diamorphosis of Lyngbya, Schizogonium, and Prasiola, and their connection with the so-called Palmellaceæ.

Fig.

1.—*Lyngbya muralis* giving off Gonidia.

2.—Ditto, ditto, enlarged, containing vacuoles and bands of green protoplasm.

3.—Ditto, ditto, with narrow curved cells, with homogeneous contents.

4.—Gonidia of Lyngbya segmenting in various manners. Smallest cells $\frac{1}{7000}$th inch diameter, *a* reverting to linear growth.

5-7.—Various stages of growth of Lyngbya.

8.—Ditto, showing tendency to become moniliform.

9.—Lyngbya proceeding to collateral segmentation.

10.—Portion of a band of Lyngbya (schizogonium) of four rows of cells.

11.—The same, collateral subdivision having proceeded to form numerous distinct rows.

12.—The same, having formed a wavy frond of 1 to 3 inches diameter; giving off segmenting Gonidia (*a*,*a*,) the cell-contents of some (*b*,*b*) being fasciated.

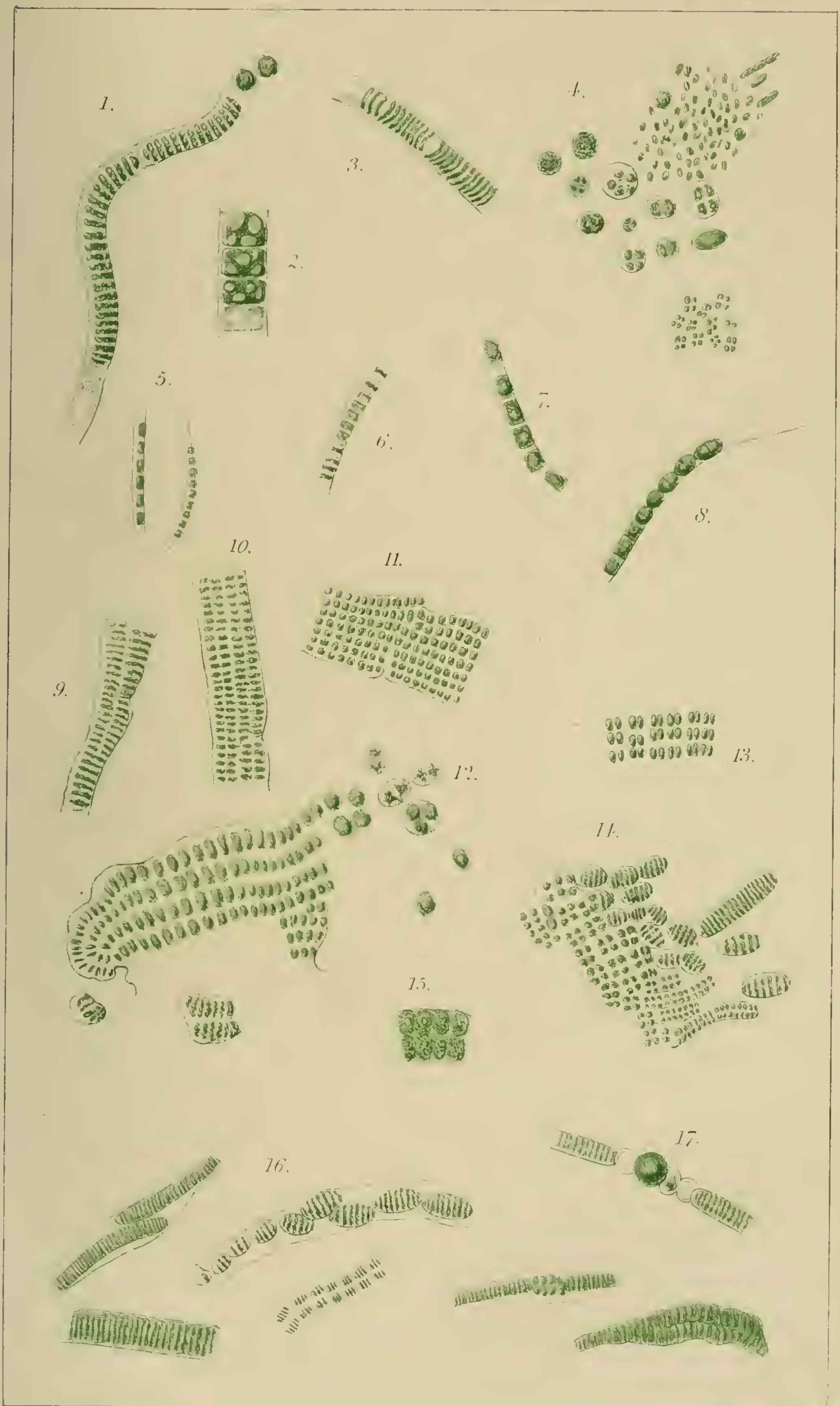
13.—Portion of same, showing subdivision of cells in multiples of the quarternary forms.

14.—Portion of a frond, the cells of which are reverting to linear growth.

15.—Ditto, highly magnified cells, with granulated contents.

16.—Various forms of Lyngbya, whose separated gonidia are segmenting linearly as in fig. 14.

17.—Modifications of cell-growth in Lyngbya.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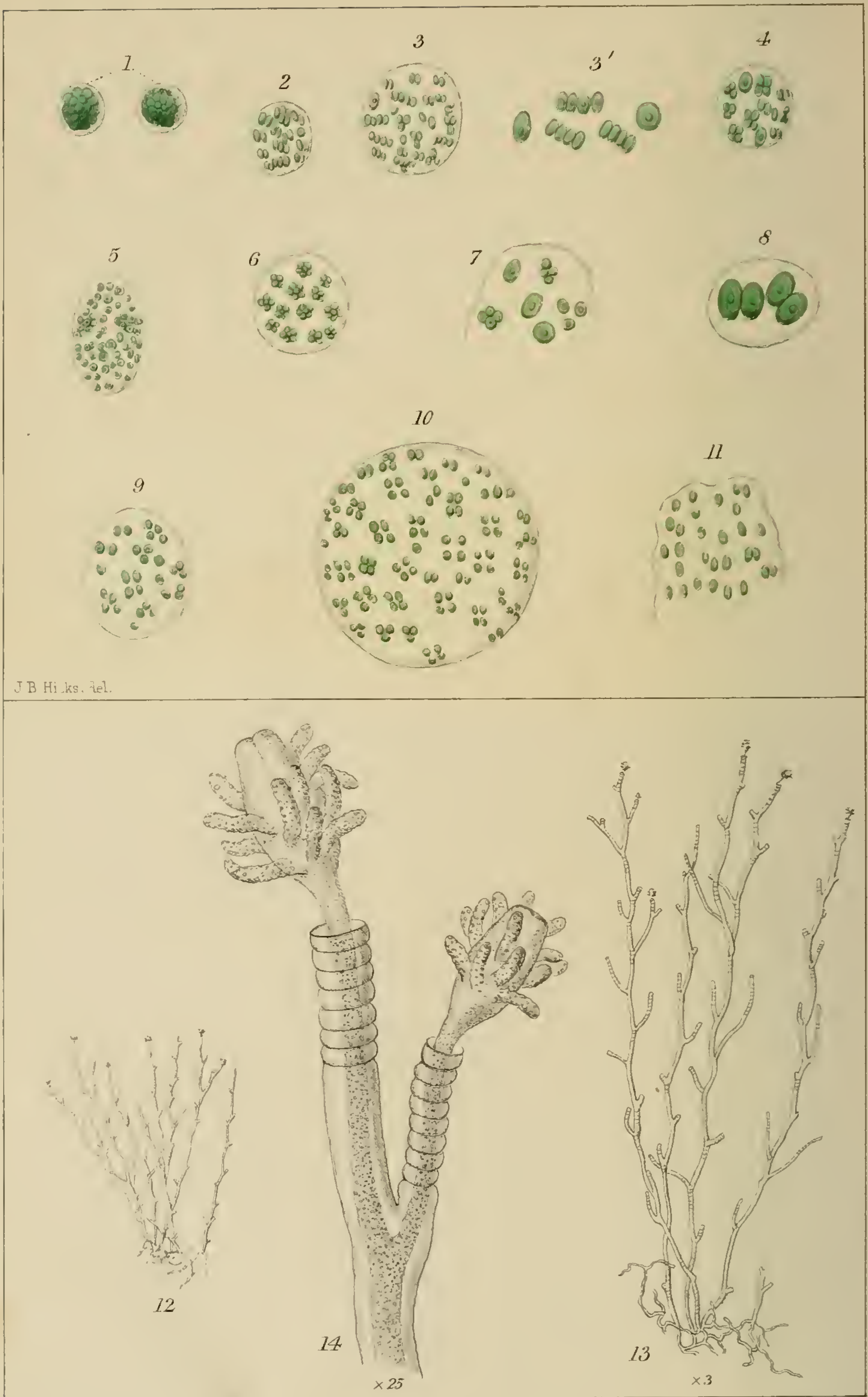


Kirchenpauer & T W. sc.

W. West. imp.

DESCRIPTION OF PLATE IX,

Illustrating J. Braxton Hicks' paper on the Motionless Spores (Stato-spores) of *Volvox Globator,*

Showing consecutive stages of segmentation of Zoospore into Motionless Gonidia (Stato-spores).

Fig.

1.—First stage, similar to the first stage of formation of ordinary gemules.

2—11.—Succeeding stages of the condition.

Illustrating Senator Kirchenpauer's paper on a New Hydroid Polype belonging to the Genus *Cordylophora,* Allm.

Fig.

12, 13.—Natural size.

14.—Two of the capitula, with a portion of the branches.

DESCRIPTION OF PLATE X,

Illustrating C. Claus's paper on the Morphology of the Copepoda.

Fig.

1.—An instance of interrupted development in *Cyclops*.

2.—A pair of two-branched swimming feet.

3.—*Nicothoë Astaci*. The letters signify (as also in the other figures).

a. First pair of antennæ.
b. Second pair of antennæ.
c. Mandibles, or piercers.
d. Maxillæ, or palpi.
e. First jaw-foot.
f. Second ditto.
g, h, i, k. The four pairs of feet.
l. Rudimentary pair of feet.

4.—The oral organs of *Nicothoë*, × 300 diam.

5.—The female *Nicothoë Astaci*, as viewed through a lens.

6.—The male of *Brachiella Triglæ*, with especial regard to the oral organs. (The sexual organs were not completely made out.)

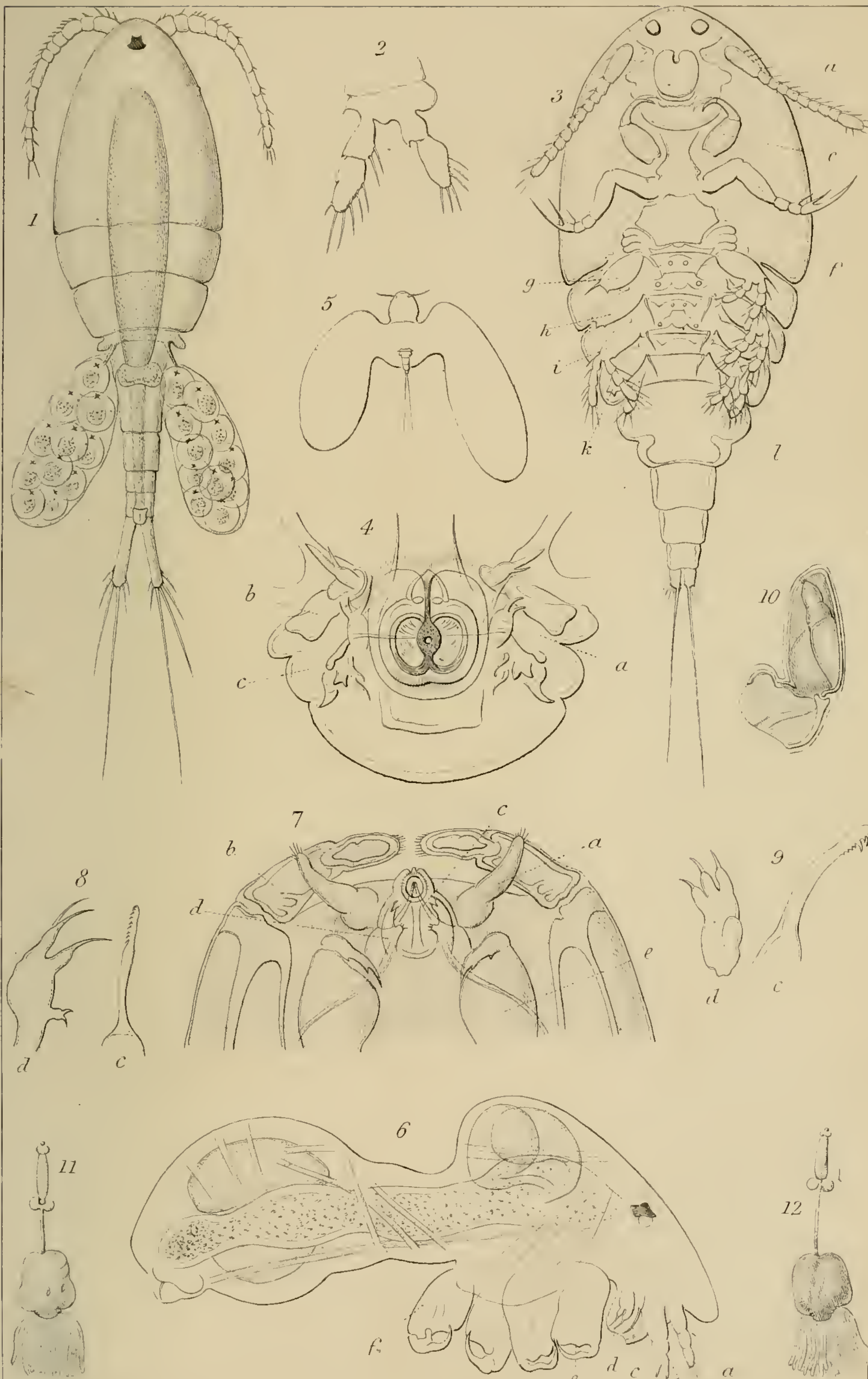
7.—Anterior extremity of the body of *Anchorella uncinata* (*Gadus Morrhua*).

8.—Mandibles and maxillæ, the jaws and palpi of the same form, × 300 diam.

9.—Maxillæ and palpi of *Lernæopoda Galei*.

10.—The second antennæ of *Lernæopoda Galei*.

11 & 12.—*Lophoura Edwardsi*, on the dorsal and ventral aspects, from drawings by Kölliker.



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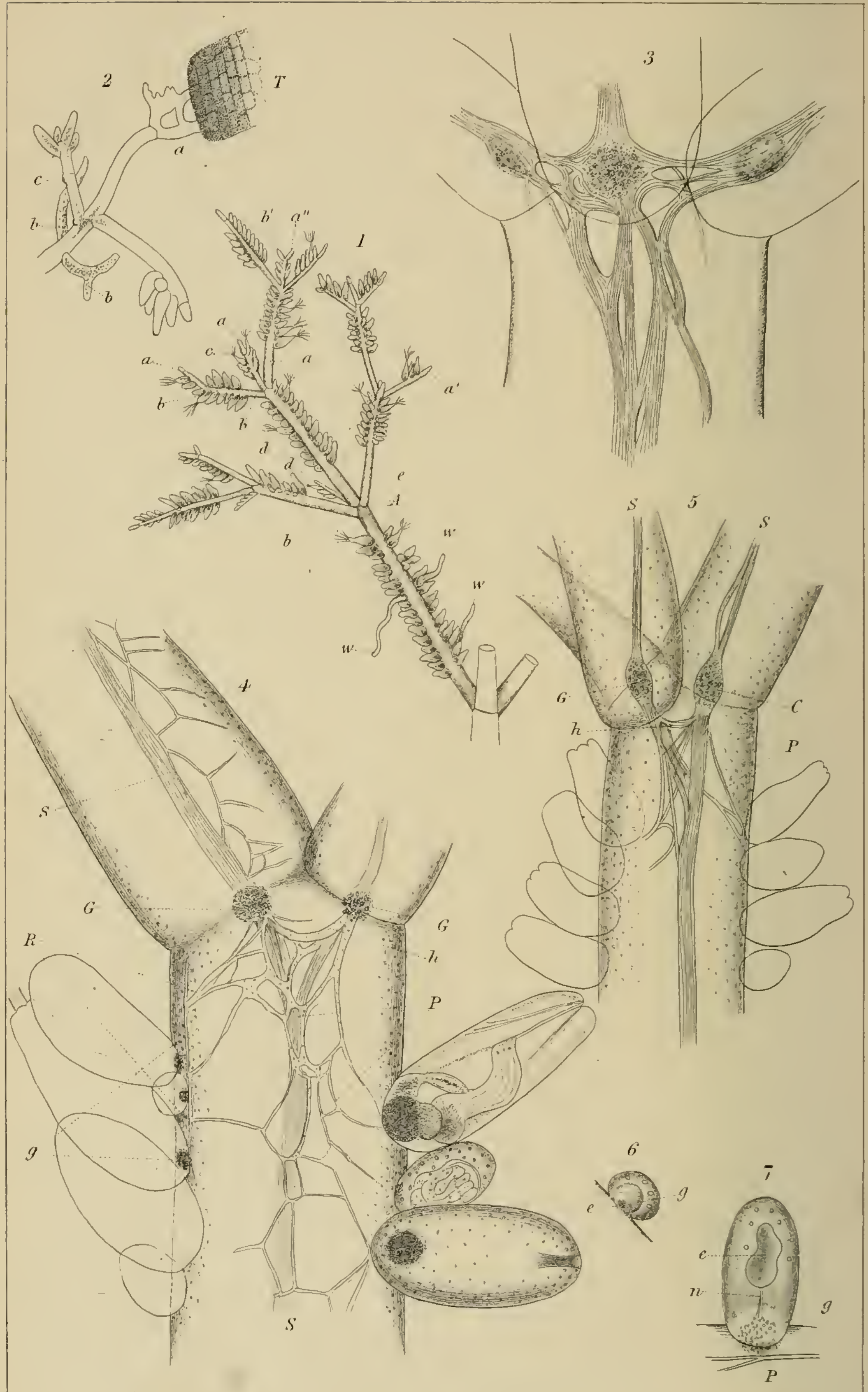

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DESCRIPTION OF PLATE XI,

Illustrating Fritz Müller's paper on the Common Nervous System (Kolonialnervensystem) of the Bryozoa (Polyzoa), exemplified in *Serialaria Coutinhii,* n. sp.

Fig.

1.—A portion of *Serialaria Coutinhii,* F. Müll. × 6 diam.

- *a.* The first.
- *b.* The second.
- *c.* The third.
- *d.* The fourth, branches springing from the extremity of the internode. W. Young radical fibres.

2. Branch with radical fibres. × 12 diam.

- *a.* Growing on *Fucus,* T.
- *b.* Young radical fibres.
- *c.* Wart-like buds of ditto.

3—5.—Common nervous system of the *Serialaria.* Figs. 3 and 4 are × 20 diam., fig. 5 × 50 diam. Fig. 3 represents the nervous system of the internode, shown in A, fig. 1; fig. 4 represents the same from the extremity of a branch, giving origin to only two as yet unbranched twigs. In these figures, G is the basal ganglion of the branch; *g,* the basal ganglion of the polypides; *h,* nerve forming an arch between the primary branches of the trunk; S, the nerve-trunk of the branch; P, the plexus resting upon the trunk; and R, the peripheral cord of the plexus running beneath the line of origin of the series of cells. Fig. 4 shows the nerve-trunk and plexus from above; fig. 5, from below.

6.—Polypide-bud, 0·06 mm. in diameter. *g,* basal ganglion; *e,* rudiment of the polypide.

7.—An older polypide-bud. *g.* basal ganglion; *e,* rudiment of polypide *n,* nerve passing from one to the other; P, nerves of the colonial nerve-plexus. Figs. 6 and 7 are × 90 diam.

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TRANSACTIONS.

On the Self-division *of* Micrasterias denticulata. By Mr. Lobb.

(Read October 10th, 1860.)

In the month of April last, Dr. Millar, Mr. Mummery, and myself, went out collecting in Epping Forest, near High Beech, where the Doctor has a residence; and he being well acquainted with the localities, we soon filled our bottles with *Volvox globator, Volvox aureus, Actinophrys sol* and *viridis,* Difflugia, Floscularia, Diatomaceæ, Desmidiaceæ, &c. And I may here take the opportunity of saying, that I know of no place so prolific in microscopic gatherings as Epping Forest, which exceeds even the noted bog at Fisher's Castle, Tunbridge Wells. On examining, the next morning, the Desmidiaceæ, I was favoured with a beautiful view, from commencement to termination, of the self-division of *Micrasterias denticulata,* occupying altogether three hours and a half; the result was to make me feel that Mr. Ralfs is wrong in the figure he gives of the same in his highly valuable work on the British Desmidiaceæ (fig. 1, pl. 7). So humble an individual as myself may well pause on differing from so high an authority, but in this instance I am compelled to do so, and am happy to say that I am not alone in so doing, Mr. Tomkins and Dr. Millar having both witnessed the same, and both of them perfectly agree with me. Mr. Tomkins saw it first, myself next, and lastly Dr. Millar.

The self-division commences by the exudation of a small, perfectly hyaline, membranaceous globule from each half-frustule; very soon a small portion of granular endochrome is seen issuing forth into the globules from the original half-frustules. (See Pl. I, fig. 1.)

The next stage exhibits the globules dividing into three lobes, the endochrome increasing in quantity, sometimes gradually extending itself as in fig. 2, and sometimes entering, as it were, in two streams from the thickened sides of the end lobes of the parent half-frustules, as in fig. 3.

In the next stage the three lobes divide into five; the end lobe remaining unaltered in figure, and only increased in size. (See fig. 4.)

This is followed by the incision of the central and basal lobes, and the central lobes being considerably larger than the basal the whole assumes somewhat the appearance of being composed of seven lobes. (See fig. 5.)

After this a further incision of the central and basal lobes takes place (see fig. 6); then the sinuation of the end lobes, and the denticulation of the whole completes the division (see fig. 7); then separation follows.

In each stage the endochrome increases, but never extends throughout; the hyaline portion becomes less, the frustule is gradually filled, and when self-division is completed, there still remains a perfectly hyaline portion all round the cell.

The figure in Mr. Ralfs's work represents the first exudation from the parent frustules as very large, and filled with a light colouring matter of the same density throughout, leaving no portion hyaline. There is no division into lobes, no incision, no denticulation, no granular endochrome; and all these are so natural, and so perfectly in keeping with the parent frustules, that I do feel justified in differing even from so high an authority, and am compelled to say, that if ever such a self-division was witnessed, it must have been an abnormal one. Having seen many frustules in the course of self-division, and on different occasions, I can with confidence assert, that I have never seen any deviation from the method now described: there is a slight variation in the spreading of the endochrome, which, it should be observed, is always granular.

The self-division only requires to be witnessed, to show that what I have stated is correct; and, should any one observe the phenomenon from its commencement to its close, as I have done, he will, with me, assert that a more beautiful object can hardly be seen even by a microscopist.

There was one object which struck me very forcibly, on looking over the gatherings from Epping Forest, and which I have endeavoured to figure, magnified only seventy-five diameters. It differs, in several respects, from *Actinophrys sol*, though there is some resemblance, both in its circular figure and in the rays that issue from the disc; the central disc is perfectly hyaline, excepting the cell-walls, the cells of the inner disc being larger than the cells (if I may so term them) of the outer disc. It may, or it may not, be new, but I have never seen it figured.

On a Portable Field *or* Clinical Microscope.

By Lionel S. Beale, M.B., F.R.S., &c.

(Read December 10th, 1860.)

This instrument was originally designed for microscopical investigation in connection with medicine, but it has been found applicable to microscopical inquiry generally. Its simplicity and cheapness strongly recommend it for the purposes of teaching. Like some other instruments which have from time to time been proposed, it is composed of draw-tubes like a telescope; but the arrangement of the stage, and the plan adopted for moving the slide, when different parts of the objects are submitted to examination, differ entirely, as far as the author is aware, from those usually adopted. The instrument consists of three tubes, *a, b, c; a* carries the eye-piece, is four and a half inches long, and slides in *b*, which is of the same length, but only slides up to its centre in the outer tube *c*. Tube *b* carries the object-glass. There is a bolt on tube *c*, which can be fixed by aid of a rack and tooth, at any height, according to the focal length of the object-glass. This arrangement prevents the risk of the object-glass being forced through the preparation while being focussed. At the lower part of the body is a screw clamp for fixing the preparation in any particular position, and an aperture for throwing the light on opaque objects. The preparation is kept in contact with the flat surface below by a spring, which allows the requisite movements to be made with the hand.

That part of the object which it is desired to examine can easily be placed opposite the object-glass, if the instrument is inverted. Next, the focus is obtained by a screwing movement of the tube *b*; and if it be desired to examine any other parts of the object, this is easily effected by moving the slide with one hand, while the instrument is firmly grasped by the other. Delicate focussing is effected by drawing the tube *a* up and down. By this movement the distance between the eye-piece and object-glass is altered.

Any object-glass may be used with this instrument. I have adopted various powers, from a *three-inch*, magnifying *fifteen diametres*, to a *twelfth*, magnifying *seven hundred* diameters.

In the examination of transparent objects ordinary daylight, or the direct light of a lamp, may be used; or, if more convenient, the light may be reflected from a sheet of white paper, or from a small mirror inclined at the proper angle, and placed on the table.

In examining objects by reflected light, sufficient illumination is obtained from an ordinary wax candle placed at a short distance from the aperture, just above the object. But the most beautiful effects are obtained by using the Lieberkuhn with direct light.

The slide, as has been stated, is kept in contact with the lower part of the instrument, which I have called the stage, by a spring which is therefore made to press on the *back of the slide.* On the other side of the stage the little screw and clamp are placed so that the specimen may be fixed in any position that may be desired.

In using this microscope the slide with the object to be examined is placed upon the stage, the thin glass being upwards towards the object-glass, while the spring is made to press upon the *under* surface of the slide. The little screw is removed. The slide may now be moved in every position, and any particular object to be examined can readily be placed exactly under the object-glass. Tube *a* is withdrawn about two thirds of its length. The tube *c* being firmly held with the left-hand, *b* is grasped with the right, and with a screwing motion the object-glass is brought to its proper focus. The specimen having been fixed with the little clamp, and the bolt arranged at the right height, the instrument may be passed round a class. This microscope seems to be well suited to field-work and botanical purposes. It is not heavy, and, including the powers and an animalcule cage, will easily pack into a tube or case six and a half inches long and two inches in diameter. I constantly use it in clinical teaching. Urinary deposits, specimens of sputum, &c., may be examined by the patient's bedside, and their characters demonstrated to the class. Lately, I have fitted the instrument to a little stand, on which a light has been placed in a suitable position, and the whole has been passed round in class, while the characters of the object shown were being described. When the arrangements are perfected, I believe this form of instrument will be found very valuable for demonstrating the microscopical characters of objects to a large number of persons assembled in classes.

The instrument can be seen at Mr. Matthews', Portugal Street, Lincoln's Inn.

On some Undescribed Species *of* Diatomaceæ.

By George Norman, Esq., of Hull.

(Read November 14th, 1860.)

(Communicated by F. C. S. Roper, F.L.S., F.G S., &c.)

In purposing to give, in this and future short papers, figures and descriptions of new forms of Diatomaceæ from my cabinet, I trust that no apology is needed, but rather, by so doing, to be of service to diatomists.

As a general rule, it may not be deemed advisable to describe a new form from scanty materials, or from single specimens; but when a form occurs that cannot easily be confounded with any described species, the sooner it is made known the better, in order that others may have their attention drawn to it.

I gladly make use of this opportunity to call the attention of those who have facilities for obtaining from their correspondents in Australia, the Pacific Islands, West Indies, &c., the alimentary matter of Ascidians and other molluscs. It will be seen that some of the forms described in this paper are from an Ascidian gathering from the west coast of Australia.

For this gathering I am indebted to the kindness of Dr. J. D. Macdonald, of H.M. Surveying Ship Herald. The great bulk of non-diatomaceous matter in this gathering being calcareous, it was readily cleaned by means of acid; and turned out to be by far the richest in new and undescribed forms of any gathering I have had an opportunity of examining.

Among the beautiful forms, are such as *Navicula bullata, Campylodiscus diplostictus*, &c.; there are a great many which I am unable to refer to any existing genera.

The stomach-contents of the larger Mollusca, such as *Strombus* and *Tridacna*, would, doubtless, be found to be mainly diatomaceous in their nature.

Even land molluscs seem to derive part of their nutrition from the endochrome contained between the siliceous valves of Diatomaceæ, for on recently examining the fæcal matter of our common garden-snail, *Helix aspersa*, I noticed, among other forms, a good many valves of *Nitzschia Amphioxys*, a species which Ehrenberg has found in a great number of samples of soil from various parts of the world, and which seems to have a wider geographical range than any other species that I am acquainted with.

Again, the tadpole of the common Frog seems to be almost exclusively diatominivorous in the selection of its food. I lately examined the stomach-contents of some specimens which had been kept for a few weeks in a small glass tank, when the mass was found to consist of fully sixty per cent. of Diatomaceæ.

These circumstances are mentioned here merely for the purpose of attracting the attention of those who have the opportunity of studying the subject more fully. It is also quite possible that such investigations may tend to clear up the yet, I believe, disputed point, as to the vegetable or animal nature of these beautiful organisms.

1. *Astrolampra Stella*, n. sp., Norm. (Plate II, fig. 1).—Valve of six rays, rays club-formed in the centre and gradually becoming linear towards the margin. Outer edge of disc divided into twelve punctate divisions.

Habitat.—Sierra Leone, in a gathering kindly communicated by Mr. F. Kitton, of Norwich.

This remarkable disc, I place, provisionally, in *Astrolampra*, its structure having little in common with that genus. The unsymmetrical appearance may be, and in all probability, is owing to my specimen being a double valve, for in the centre is seen a series of six indistinct rays, which I have endeavoured to give in the drawing.

Altogether it is a remarkable form, and, probably, ought to constitute a new genus.

By giving it a place in this paper, I hope to call the attention of those who have correspondents at Sierra Leone, to urge them to send material from the coast in that locality.

2. *Surirella Baldjikii*, n. sp., Norm. (Fig. 2).—Valve panduriform, canaliculi conspicuous, widening out towards the margin, absent in constricted portion. Centre of valve a smooth cruciform space; the transverse limb being broader than the longitudinal one, and approaching the margin of the valve at its constricted part. Margin of valve striated; striæ 40 in ·001″.

Marine, in a deposit from Baldjik, near Varna.

This deposit is full of beautiful and interesting forms, many of which are new and undescribed. The piece of earthy deposit I picked out of a cargo of bones discharging in the docks. The captain of the vessel informed me that the cliffs about Baldjik are wholly composed of this white-coloured earth.

It will be worth while obtaining a larger supply of this material, which is the same that yielded the beautiful little form which Mr. Brightwell has described as *Odontidium Baldjikii*.

3. *Coscinodiscus fuscus*, n. sp., Norm. (Fig. 3).—Valve convex, depressed in centre; granules arranged in radiating lines, diminishing in number at intervals, thus forming distinct zones. Granules 20 in ·001″; diameter of valve ·0043″ to ·0067″.

Marine, stomach of Ascidians, North Sea.

Valve, under a low power, opaque, brownish black, lighter in centre, where it is green. At first sight it reminds one of *Eupodiscus Ralfsii*; but the colour is much darker, the granules much smaller, and more crowded together. In this respect it appears to be half way between *E. Ralfsii* and a disc which I found in considerable quantities on bones from Constantinople, and which has been doubtfully referred to *Eupodiscus subtilis*.

The want of anything like a marginal nodule in the species now described, relieves me of any uncertainty as to its proper generic position; hence I refer it, without hesitation, to *Coscinodiscus*. Hitherto it has occurred only in one or two ascidian gatherings, and then only sparsely.

4. *Nitzschia vitrea*, n. sp., Norm. (Fig. 4).—Frustule hyaline, broadly-linear, extremities truncated; valve linear-lanceolate, slightly constricted in centre, and somewhat produced at the ends; puncta conspicuous, bead-like. Striæ very obscure, 58 in ·001″. Length of frustule ·0025″ to ·0055″.

In brackish water, Hull.

It is not often that one has the good fortune to detect a new British form. The present one, however, cannot be referred to any of the species given in Smith's 'Synopsis.'

The only locality that has hitherto yielded it is a small ditch of water influenced by high spring tides. The same locality furnishes *Nitzschia Brébissonii*, *vivax*, and *bilobata*.

5. *Aulacodiscus Sollittianus*, n. sp., Norm. (Fig. 6).—Disc large, colourless, processes very prominent (about six), submarginal. Granules in radiating lines, 9 in ·001″, absent in centre valve and around base of processes.

In a deposit from Nottingham, Maryland.

Diameter of valve ·009″; processes large, and, under a low power, appearing as if they had rings attached to them.

This fine species I have great pleasure in dedicating to Mr. J. D. Sollitt, whose long services with the microscope, conjointly with Mr. Robert Harrison, have, I think, been insufficiently recognised.

Unfortunately it is very scarce in the small quantity of the deposit I have hitherto worked upon. I expect soon to have a large quantity of the material, when it is to be hoped that it may prove more abundant. The blank centre, large size, and unusual distance from the margin of the nodules, together with the large blank spaces around the same, render this a well-marked species.

Judging from the occurrence, in abundance, of the various species of *Heliopelta* in this deposit, together with *Eupodiscus Rogersii, Craspedodiscus elegans, Aulacodiscus Crux, Sceptroneis caduceus, Triceratium solenoceros, condecorum, undulatum,* and *acutum,* there can be little doubt that it is identical with the Bermuda earth of Professor Bailey, the locality of which has hitherto remained in much doubt. For the small quantity received I am indebted to Messrs. Sullivant and Wormley, of Columbus, Ohio. The deposit was discovered, I believe, by Dr. Johnson, of Baltimore, near Nottingham, in Maryland, not far from the Patuxent River, and within a moderate distance of Piscataway, where the well-known rich deposit occurs.

Bermuda Hundred, on the James River, in Virginia, is distant about a hundred miles from Nottingham, but as all the waters of this district find their way into the great Chesapeake Bay, it is quite possible that the locality suggested by Dr. Arnott may have furnished the sample of Bermuda earth originally sent to this country by Dr. Bailey. I understand, however, from Messrs. Sullivant and Wormley, that Dr. Johnson had examined the country at Bermuda Hundred without finding any deposit whatever. When the larger supply of the Nottingham material arrives, I shall be glad to supply my friends with a portion.

6. *Eupodiscus ovalis,* n. sp., Norm. (Fig. 7).—Valve elliptical, nodule single, submarginal; granules arranged in radiating lines, crowded near the margin, sparser towards the centre. Colour, tawny brown. Length of valve ·0020″ to ·0035.″

Marine, stomach of Ascidians, Shark Bay, Australia.

This species approaches *Eupodiscus fulvus,* differing, however, in the elliptical shape, altered position of the nodule, which in the latter is nearer the margin, and also in the arrangement of the granules, the disc being divided into regular segments by the longest lines of granules.

7. *Navicula bullata,* n. sp., Norm. (Fig. 6).—Valve elliptical, extremities slightly produced. Striæ in a marginal and two central bands; marginal bands of unequal width. The smooth space between the striated bands studded with a line of circular bosses. Striæ moniliform, 14 in ·001″. Length of valve ·0065″; breadth ·0030″.

Hab.— Stomach of Ascidians, Shark Bay, western coast of Australia; kindly communicated by Dr. Macdonald.

This singularly beautiful form is exceedingly rare in the above-mentioned gathering. It belongs unquestionably to the group of forms of which *Nav. lyra* is the type. The remarkable row of bosses on the smooth bands renders it distinct from any known species.

It may be remarked that, in describing the structure of *Coscinodiscus fuscus* and *Aulacodiscus Sollittianus,* I have designated the markings on the valves "granules," instead of adopting the usual method of calling them areolæ, or cells. Hitherto, I believe, most authors have adopted the latter designation in describing the various species of *Coscinodiscus, Aulacodiscus, Eupodiscus,* &c., and have, by so doing, in my opinion, overlooked the real nature of the construction.

Dr. Wallich has done good service in pointing out the true structure of the markings of *Pleurosigma,* and I feel convinced that all the above-mentioned discs are constructed on the same plan, differing only in the form of the elevations or granules, and their arrangement on the surface of the valve.

In *Pleurosigma* the markings are four-sided elevations; while in *Coscinodiscus, Eupodiscus,* &c., they are circular when not crowded, but assuming the irregular or hexagonal form when pressing on each other. The same structure appears to exist in *Biddulphia, Isthmia,* &c., and probably in all diatoms, not even excepting *Triceratium favus,* the raised portions of silex only differing in form.

On examining a valve of *Coscinodiscus gigas,* or *lineatus,* for instance, with a good one fourth or one twelfth, we find the colour of the valve, in the interstices between the granules, to be pink, whereas the granules themselves are white, or colourless.

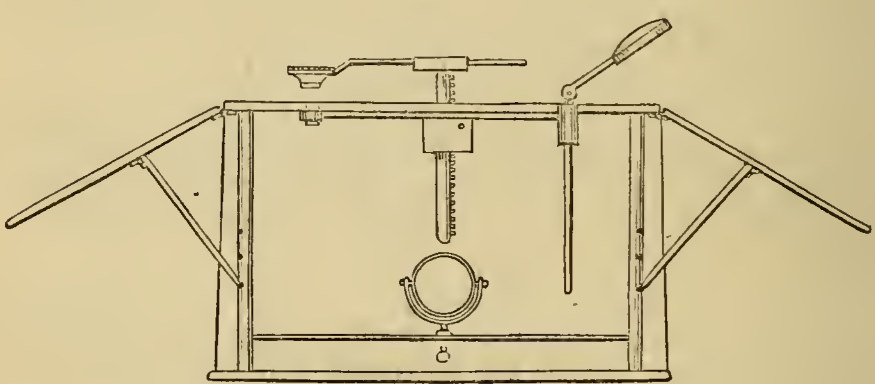
The true structure, however, is better seen in valves where the granules are more circular, and not so much crowded together. Here the structure will be apparent at a glance.

On a Dissecting Microscope, &c. By James Smith.

(Read November 14th, 1860.)

This microscope, the general design of which I hope, with the assistance of the accompanying drawings, to make sufficiently plain, I consider to be a modification of the one known as Slack's Dissecting Microscope, and which is figured and described in Quekett's 'Practical Treatise.' It may be as well to state in the first instance, that the chief novelty in the construction of my instrument, is the method of fixing on the hand-rests to the stage, by means of hinges—and in such a manner that, when not in use, they fold down at the sides—thus giving the advantage of fixed rests, available in a moment, while, at the same time, the microscope, when they are let down, is not larger than it would be if they were altogether separate from it. They also, when not in use, form with the other parts, a box (as in Mr. Slack's model) in which the dissecting troughs and any other accessory apparatus may be packed away, when necessary.

No. 1.



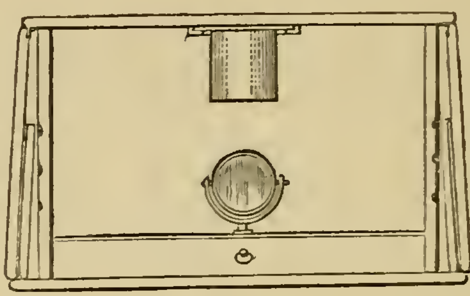
The above drawing shows a front elevation of the microscope as set up for use, and in the following brief description I shall endeavour to give as clear an idea of it as I can, only premising that I have given the various measurements for the sake of greater distinctness, as I presume that the actual size of any particular instrument must, in some measure, depend upon the requirements of the operator. I think, however, that the one hereafter described will be found very convenient for all ordinary purposes.

In the first place, the stage, which consists of a stout piece of mahogany, or a plate of brass, is about seven inches long, by five broad—and it is attached to a good firm base, also of mahogany, by four brass or wooden pillars about five inches high (the two front ones being shown in the drawing), which serve the double purpose of supporting the stage, and of giving the requisite elevation to the hand-rests, by means of notches cut in their sides into which the supports fit. These hand rests are about five inches square and one fifth of an inch thick and are fixed to the sides of the stage by hinges, so that they can be placed at any angle required, by means of the supports, which are two pieces of wood or metal fastened to the rests, as shown in the drawings; these supports are shaped so as not to interfere with the hands in adjusting the mirror, this being one of the points that I have specially kept in view in designing the instrument.

The other parts more immediately in connection with the stage are the condenser and the arm for holding the magnifying lenses; the former is attached to the front of the stage by a moveable arm in which it slides up and down, and when not in use it can be taken out of the socket and put away in some convenient place; the horizontal arm carrying the lenses has the usual rack-work and pinion adjustment, and may either slide in and out as figured in the drawing, or also be fitted with a rack-work movement—the arm is turned on one side in order to show a slight bend at the end, holding the glasses, which I think will sometimes be found convenient, when rather a deep trough is being used the sides of which would otherwise prevent the lenses from being brought into focus with the bottom, a circumstance that has in more cases than one proved troublesome to me, as either a lower power had to be used or the subject shifted to a shallower trough. Upon the base of the microscope is a drawer for holding the lenses, knives, and other dissecting instruments, including a small glass syringe, which I find an extremely useful addition to the apparatus. Above the drawer is placed the mirror, which has two sockets, one in the centre for ordinary illumination, and one in the front for oblique light, by which the object under dissection is brilliantly illuminated on a dark ground—a plan in many instances most effective. A very convenient way of doing this would be by putting the mirror upon a socket moving in a groove—so that it could be at once placed in any required position, or when not in use pushed up to the back of the instrument, and thus be altogether out of the way when the space is otherwise needed.

Drawing No. 2 shows the microscope as it appears with the rests let down and when not in use—and it is made complete as a box by a piece of wood (similar to that forming the back)

No. 2.

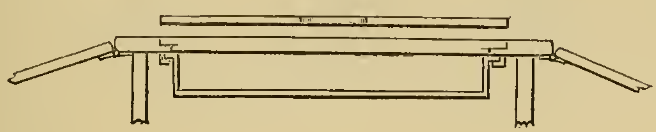


which drops into a groove in front of the drawer and is fastened by small hooks at the top to the stage, and upon this piece the condenser can conveniently be fixed by catches when the instrument is packed up I have thought it better to make this front a separate part, as it might sometimes be found very much in the way if permanently fixed on by hinges. I have not shown it in the drawing, thinking it unnecessary to do so.

Drawing No. 2 also shows the small dark tube devised by Dr. Carpenter, for facilitating dissection without the aid of the glasses, and described at page 192 of his work on the Microscope. This tube (the adding of which as a part of my apparatus I am indebted to him for suggesting) has a piece of ground glass fitted into the bottom, and can either be used for the purpose more immediately intended, or for softening the light, which is often very necessary when working at night with a lamp or candle.

As a fitting addendum to the description of my microscope, I may here give that of a modification of the ordinary dissecting trough, suggested to me by Professor Busk, who has kindly permitted me to add it to my paper. The new trough is made by cutting a small piece (say for example one inch long and a quarter of an inch in width) out of the centre of a gutta-percha one, and inserting in the hole thus left a piece of glass, so as to be on a level with the surface; by this arrangement, the object to be dissected, after being cut open, can be fastened down over the glass by pinning it to the gutta percha on either side, and in this way it can be illuminated either by the condenser or the mirror, as may be found necessary, an advantage too obvious in many instances to need further comment. As pieces of glass of several widths would be required to suit objects of different sizes, thus necessitating the employment of several troughs fitted up in this manner, it has occurred to me, that in case this might form a ground of objection with some to the plan, the same purpose might be answered by simply fitting slips of glass of the sizes most generally useful into flat pieces of gutta percha, which would go into any of the ordinary glass-bottomed troughs, and thus easily be substituted the one for the other.

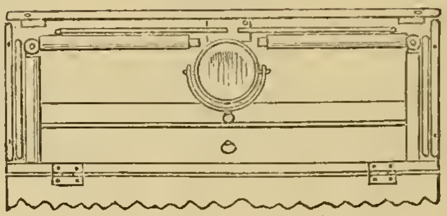
No. 3.

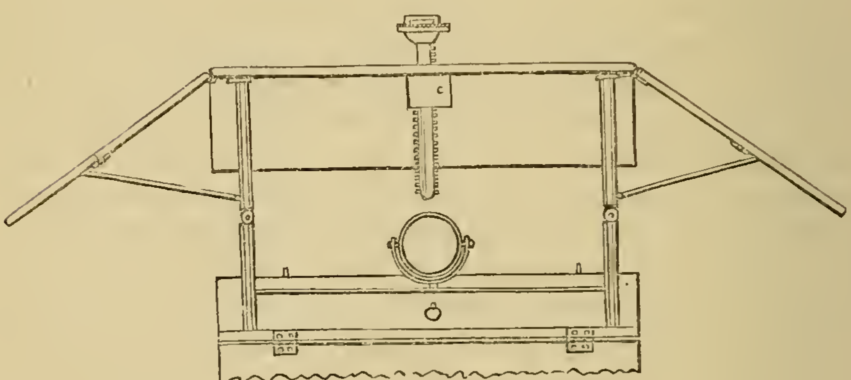


It now only remains for me to notice the arrangement figured in the above drawing, which shows a sectional view of the stage of the microscope, under which is held, by two catches, a large trough, about an inch and a half in depth, and having a glass bottom; a piece of sufficient size is also cut out of the stage, and a moveable plate of glass, or metal, put in its place (as shown in the drawing), which is of course lifted off when the trough is used; another, and perhaps more effectual, way of getting at it would be, by making a portion of the stage nearly equal in length and breadth to the trough to slide in a groove, like the lid of a small box, which could just be pulled out when required. By this method, I think that many dissections, that in the ordinary way would be carried on apart from the microscope, might be made on it; thus allowing the hand-rests, mirror, condenser, and other appurtenances of the instrument, to be made use of more advantageously and with greater ease to the dissector than if a trough of this size were placed on the top of the stage. In order to make this arrangement as complete as possible, I further propose to fit a piece of gutta percha into the bottom of the trough, which could be taken out when wanted (and thus make it serve the place of two troughs); and also to make a small hole in it (fitted with a plug), so as to allow of the water being drained off when necessary into a vessel held below, without having to remove, or otherwise disturb the object under dissection in any way, which might thus, if requisite, be cleaned with a syringe, and after the plug was replaced, the trough could again be filled with clean water, and the dissection proceeded with. It will be apparent from the drawing that this trough can be easily removed when requisite.

NOTE.—It having been suggested to me at the close of the meeting that a more portable form of the microscope might be found convenient, I have endeavoured, as shown in the following drawings, to carry this out.

Nos. 4 and 5.





No. 4 showing the instrument when closed, and No. 5 as it appears when opened out for use; and as the general plan of this is precisely the same as the one previously described, it will be only necessary for me to say that I propose to make the supporting pillars work with hinges, which are prevented by a catch from going out of the perpendicular; these pillars (which, in this case, are joined together at sides by two cross bars for the purpose of giving them greater firmness) are made to fit into four corresponding sockets in the stage, which is now separate from the lower portion of the microscope. Any further detail will, I think, be unnecessary, as I have only attempted to indicate how the reduction in size might be effected without interfering with the distinctive features of my original plan.

On a new Combined Binocular *and* Single Microscope.

By F. H. Wenham.

(Read December 12th, 1860.)

At the meeting of this Society in June last, I exhibited and described an improved binocular microscope, on the principle of dividing the image by means of a thin achromatic prism fixed close behind the object-glass. The improvement on a former instrument (which had the defect of being pseudoscopic) consisted in refracting the right and left hand sections into the opposite eye, and by this transposition obtaining a true *orthoscopic* effect by an arrangement equally simple as before. Having since still further advanced the definition, by a modification in the construction of the prism, the performance was so superior to anything that preceded it, that several were made for parties who had seen the results, and which instruments proved satisfactory to their owners.

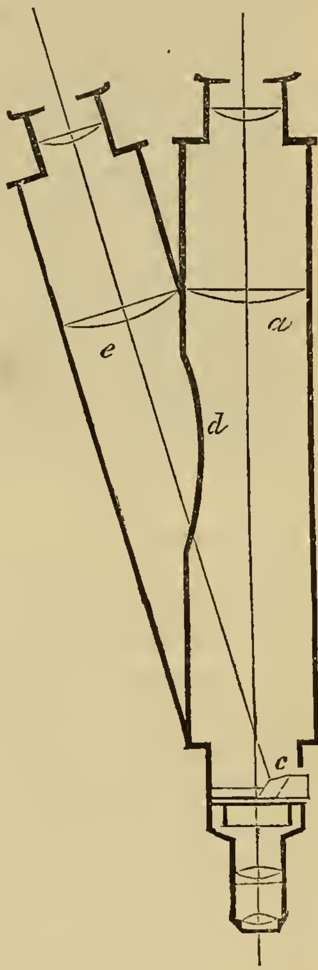
It appearing evident that the use of the binocular microscope was likely to become general, I have directed my attention once again to its improvement, and come before you this evening on the same subject, to announce the attainment of a degree of success in respect to convenience, simplicity, and improved definition, that, considering the nature of the principle, could not have been anticipated.

It is, perhaps, scarcely requisite to urge the advantage of being able to view minute organisms with the aid of both eyes together; for it is admitted that the single microscope affords but little appreciation of undulations of surface or bulk. We have even now a vivid recollection of looking through the microscope for the *first* time, as exhibited at the Society of Arts five and twenty years ago, by our member, Mr. Cornelius Varley. The objects were the wheel animalcule and the sap circulation in the *Chara*. Not having, at that time, the least knowledge of the instrument or objects, we formed no idea of bulk; but observing a moving object in a field of light, supposed the effect similar to the representations of a magic lantern, the then familiar toy of our youth.

The living organisms revealed by the microscope still possess a charm for us beyond all others, for herein can be traced the first links in the chain of creation. Quickly passing from the simple vital plant-cell to higher grades of development, we hover at length in pleasing uncertainty at the confines where the plant may be supposed to end and animal life commence. The waistcoat-pocket may conceal our menagerie, and any locality furnish objects. For example, at this season of the year, draw from the nearest hedge-side ditch a rotten leaf. "Drop it again," the unknowing would say in disgust, it is decomposing, and covered with a loathsome-looking slime; but remove a portion of this, and place it under the microscope, and marvellous is the living host displayed to view, consisting of *Diatomaceæ, Desmidiæ, Oscillatoria, Amœbæ, Rotifers*, &c., all assembled together in one dense crowd, perfect in beauty and cleanliness. An hour may pass away unheeded, in the interest caused by observing the movements of these creatures; but greatly is that interest enhanced by the aid of binocular vision; they appear then not as mere moving discs, but in all the reality due to life and substance.

The chief inconvenience of all the binocular microscopes hitherto made, besides distorted or imperfect definition, has been the necessity of a separate double body; and the constant trouble of shifting this for the single tube very much limits their utility. There is also the difficulty of cleaning the prisms, and a liability to their derangement. In the instrument I have now to describe these objections do not exist; for the effect, as a single microscope, is not in the slightest degree impeded or interfered with, and by a touch of the finger it is instantly converted into a binocular, or back again. The annexed diagram will explain the principle of action; A is the body of an ordinary microscope, moved perpendicularly relative to the stage, with fine motion, &c., precisely as it is commonly made. On the right-hand side, in the neck at B, is cut a square hole, through which a prism, C, having two reflecting surfaces, is made to slide, as close behind the object-glass as possible. This prism is held by the ends only in the sides of a small drawer, so that all the four polished surfaces are accessible, and should slide in so far that its edge may just reach the central line of the objective, and be drawn back against a stop, so as to clear the aperture of the same altogether, in which case the tube A acts without impediment as a single microscope. When the prism is thrust in more or less, it collects a portion of the rays and reflects them to the opposite side of the tube, at D, where an opening is to be made large enough to admit them all, under extreme conditions. Parallel with the direction of these rays is "grafted on" the supplementary tube E, with eye-pieces, &c., and in size corresponding with the main tube. The additional body may either be soldered permanently on to the other, or be made to draw on and off, a double collar holding them together at top, and a clip or bolt at the bottom. In the latter case, when the inclined tube is removed, a cover should drop neatly into the aperture, flush, and be secured by a bolt. But the additional body being no hindrance to the ordinary action of the microscope, it is best always to allow it to remain in place ready for instant use, as required. When the prism is drawn out to its limit, the main body acts just as the usual single instrument, and therefore needs no explanation; but on thrusting it in, a part of the rays are thrown into the eyepiece of the inclined body, and thus the right-hand rays of the object-glass are reflected into the left eye, and the remainder pass directly into the right eye, having nothing intervening to obstruct them in the due performance of their best effect. The prism need not, in all instances, be thrust in to its *fullest* extent, so as to take in the total half of the object-glass, but only partially, to the degree requisite for throwing the object up in relief. In the case of a difficult test the largest share of the direct aperture may be employed, while, by coaxing the illumination for the reflected portion, the instrument can be made to perform well on the diatomaceous tests.

Fig. 1.

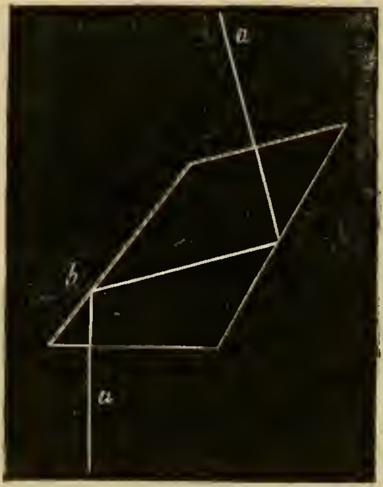


With respect to the illumination, in all cases where possible the opaque principle should be employed, as it gives to objects a far more natural appearance. When transmitted light is needed, a large, angular pencil should be used, otherwise the two fields cannot be equally lighted with the higher powers. I intend to have a split mirror made, each half capable of separable and independent adjustment for each body. The necessity for this will be shown with the *Podura*, for on bringing out the markings with the maximum distinctness for the reflected vision, the direct will be found deficient. On altering the mirror, equal distinctness can be obtained in the direct tube, at the expense of the other. If each tube, therefore, has its own independent mirror, this inconvenience will be obviated.

The adjustment for difference of distance between the eyes is effected as before, the draw tubes being at the minimum limit of proximity when close in, and by drawing these out to a small extent they accommodate for all positions of eyesight. This answers so well in practice as to need no amendment. It will be seen that the reflected rays have further to travel to reach the eye-piece (the radius of each tube being the same). The distance is just equal to that which they have to traverse across the interior of the prism; this causes a slight disagreement of focus between the two, which may be compensated for by drawing out the main tube about a quarter of an inch more than the other, but it would be preferable to make a small difference in the magnifying power of the eye-pieces, which can be simply done by an alteration of distance between their lenses, each eye-piece to be marked for its appropriate tube. By transposing them such an adaptation would often compensate for those whose eyes differ materially in focus, or one being long and the other short-sighted, which is a common defect.

The base into which the prism slides rotates to a small extent, for reflecting the image level with the centres of the eye-tubes; this is the *only* adjustment, and when set right is held fast by a binding screw in the side of the inner fine motion tube. The prisms having two opposite reflecting surfaces, possess the common property of such, that, however much tilted, the direction of the ultimate emergent ray cannot be altered. Great care and nicety is, therefore, needful in working them to the exact angles for the definite direction in which the ray is to be finally reflected, but this having been properly obtained, gives the double-reflecting prism this advantage, that it cannot be readily put out of adjustment. Fig. 2 is an enlarged outline of the prism; a ray of light, A, passing through the base, is totally reflected by the surface, B, towards C, at which surface it is again totally reflected in the direction required. Both the incident and emergent surfaces of the prisms must be perpendicular to the direction of its corresponding ray, as any refraction is objectionable, and the reflecting sides be arranged considerably within the angle of total reflection (which, for crown glass is about 48°). The base of the prism should be of a width only just requisite to include the half aperture of any object-glass, one quarter of an inch is quite sufficient; it should not exceed this for two reasons, first, that the greater the thickness of glass that the ray has to pass through, the more difference there will be in the magnifying power of the two bodies, and second, that a thick prism takes the ray more away from the centre of the main tube, and increases the convergence of the two, bringing the eyes nearly approaching to the disagreeable condition of a squint.

Fig. 2.



Both the transmitting and *reflecting* surfaces of the prism should be accessible for the purpose of wiping, for any particles or mildew adhering to the latter will prevent total reflection at the point of contact. If the prism is well made and polished, and of the smallest size possible for admitting the pencil, the difference between the direct and reflected image is scarcely appreciable, and with this standard of comparison a faulty prism will immediately be detected. By pressing back the spring catch or stop on one side of the prism-slide, it can instantly be withdrawn altogether, and as quickly replaced.

On Changes *of* Form *in the* Red Corpuscles *of* Human Blood.—By William Addison, M.D., F.R.S.

(Communicated by Dr. Lankester. Read December 12th, 1860.)

When freshly drawn, human blood is examined with a microscope, the form in which the red corpuscles appear is well known. The greater part of these bodies adhere together in rolls, a few floating singly in the blood-fluid, or *liquor sanguinis*.

(Plate III, fig. 1.) We may call this form the normal form. But occasionally, without anything having been added to the blood, the forms depicted as alkaline forms (fig. 2) may be seen.

These rough or prickly forms (fig. 2) are with certainty produced by fresh urine, by a weak solution of common salt, and by various liquids rendered slightly alkaline with solution of potash. On the other hand, the forms represented in fig. 3 are determined by adding to the blood a solution of sugar and liquids rendered feebly acid by hydrochloric acid, or by lemon or orange juice.

The tailed forms (fig. 4) occur when blood is submitted to the action of sherry wine.

Make a *saline solution* by dissolving one grain of common salt in two fluid drachms of water, and render it very slightly *alkaline* with solution of potash; also dissolve four grains of refined sugar in two fluid drachms of water, and render it slightly acid to litmus paper with the diluted hydrochloric acid of the London Pharmacopœia.

Receive a small drop of fresh blood upon a slip of glass, and place near to, but not touching it, a similar amount of the saline alkaline solution; also place in a like manner, on the other side of the blood, an equal quantity of the acid-sugar solution; drop down upon the three fluids a thin piece of glass, so that the alkaline fluid may come into contact with one side of the drop of blood, and the acid fluid into contact with the opposite side of it.

Upon examination with the microscope, the forms of the corpuscles which float out into the alkaline fluid will be found quite different from those which float out into the acid fluid. Those in the alkaline fluid have roughened outlines (fig. 2), whereas those in the acid liquid have smooth outlines, and a bright matter, of sundry forms, makes its appearance in their interior (fig. 3). If the corpuscles be followed as they continue to float out in the two fluids, we find them experiencing further, but different, changes of form. In the alkaline fluid the phases A, B, fig. 2, and in the acid fluid the phases C, D, E, fig. 3, will be seen. Again, take a small drop of blood and place close to it an equal quantity of the alkaline-saline liquid, drop down upon them a thin piece of glass, and when a multitude of the corpuscles have floated out into the fluid and have assumed forms fig. 2, add at an edge of the covering-glass a drop of the diluted hydrochloric acid, and these forms will be seen changing into the forms fig. 3. Lastly, take a drop of blood and place near to it an equal amount of the acid-sugar solution, let fall upon them a thin covering-glass, and after a little time numerous corpuscles will be found of the forms represented fig. 3, add at an edge of the covering-glass a drop of *liquor potassæ,* and forms fig. 3 will alter into forms fig. 2. The changes described may take place quickly or more slowly, according as the added fluid flows with more or less rapidity; in the latter case it will be remarked that the corpuscles in progress of change from one form to the other regain for a brief space of time their normal figure and appearance (fig. 1). We are able, then, by an appropriate application of alkaline and acid fluids to impress particular forms upon the red corpuscles of human blood, and we see them during the transition from one form to another regain their normal characters and aspect.

This property of change of form in the corpuscles of the blood is not of long duration, it remains with them but for a limited period after their withdrawal from the circulation, and some of the corpuscles appear to lose it sooner than others, for, after a little time, corpuscles of different forms are to be seen floating side by side in the same current, and the further addition of an alkaline or acid fluid destroys them, without inducing any further change of figure.

We have called forms fig. 2 alkaline, and forms fig. 3 acid forms, not because they are exclusively determined in the one case by alkaline and in the other by acid liquids, but because the alkali potash will change the normal form fig. 1, and also forms fig. 3, into the forms fig. 2, and, again, because the hydrochloric and other acids will alter the normal form, and also the forms fig. 2, into forms fig. 3, when they are properly applied.

In repeating these experiments, it will be seen that corpuscles which approach near to an edge of the covering-glass, whatever may be their form, lose thereby all power of further change.

Now forms *b*, fig. 2, which result from contact with alkaline and saline fluids, are like forms *d*, fig. 3, which are produced in acid liquids, the only difference between them being that those observed in alkaline are deeper coloured than those in acid fluids. Corpuscles of this form *b*, fig. 2, and *d*, fig. 3, are incapable of regaining the normal form. Ultimately, in alkaline fluids, the forms *b*, fig. 2, burst open, and the corpuscles are wholly dissolved; in acid liquids (fig. 3, *d*) they sometimes burst open suddenly, and sometimes suddenly increase in size, the contents of the corpuscles become colourless, and the enlarged capsules, with a granular matter within them, have very much the appearance of the white corpuscles of the blood (fig. 3, *e*).

Dissolve a grain of common salt and half a grain of bicarbonate of soda in two fluid drachms of water, mix this solution with half a fluid ounce of good sherry wine, and filter. This liquid produces the tailed corpuscles (fig. 4). A small drop of blood and an equal quantity of the vino-saline mixture must be placed side by side on a slip of glass, so that their edges may mingle when a thin covering-glass is dropped upon them. In about five or ten minutes numerous corpuscles, where they have floated out in the liquid, will be seen throwing out matter from their interior, two, three, four, or more minute molecular particles fringing their circumference. Some of these molecules separate from the corpuscles and float in the fluid, others elongate into tails, which wave about with a tremulous motion, in a very remarkable manner. These tails all have a little knob at their extremity. After a short time, or upon any motion in the fluid, the tails break away from the corpuscles, but their singular movements do not cease when this has happened. Sometimes a discoid enlargement forms on some part of the tail, and then the tail suddenly retracts itself into a larger granular and coloured particle. That the movements of these tails are of a peculiar kind, and not due to motion in the liquid, is shown by this—that all movement in them ceases entirely when they approach near to either of the edges of the covering, thin glass. In repeating this experiment, if the surfaces of the upper and under glasses come so close together as to press upon the blood-corpuscles—which is known by increase of their diameter—the tails will not appear. The corpuscles must be free from pressure, for the effects described to take place. Moreover, tails are not readily produced if the stand of the microscope and the glasses are cold; the phenomenon takes place much sooner, and the tails are longer, when the instrument and fluids have been for some time in a warm room.

The following have been found to succeed in producing the tailed forms of corpuscles (fig. 4):

1. Sherry wine.
2. Sherry wine and saline solution.
3. One part fresh urine and two or three parts sherry wine.
4. Port wine and quinine.—Dissolve with a gentle warmth one grain of sulphate of quinine in half a fluid ounce of port wine; set it by for two or three days, and then filter the liquid.
5. A mixture of the sherry wine and the saline solution with port wine and quinine.—This mixture seems to improve by keeping.

The following experiments have been tried:

1. One fluid drachm of the mixture No. 5 and one grain of sulphate of stryehnia, shaken together.—Tails produced.
2. One fluid drachm of No. 5 and one grain of acetate of morphia.—Tails produced.
3. One fluid drachm of No. 5 and liquor potassæ, just sufficient to remove the acid reaction of the mixed wines.—No tails appeared.

In all these experiments there is no mixing together of the blood and the extraneous fluid previous to the application of the covering-glass, hence there are various degrees of intermingling between the added fluid and the natural fluid of the blood, and it is only where these two fluids are mixed in certain unascertainable proportions that the specific phenomena are to be seen.

Blood consists of a fluid—the liquor sanguinis—and the corpuscles; therefore, before arriving at any conclusion from the preceding experiments, it will be necessary to consider the part played by the fluid element of the blood. The added fluids, when they come, undiluted by the liquor sanguinis, into contact with the red corpuscles, destroy them. The changes of form of the corpuscles are therefore effected, not by the extraneous or added fluid alone, but by a mixture of the added liquid and the liquor sanguinis; and we conceive it to be correct to regard the phenomena described as the results of a change in the quality of the liquor sanguinis, wrought by the added liquor. It is to an unascertained mixture of the extraneous fluid and the natural blood-fluid that the various aspects of the corpuscles must be ascribed. It is well known how speedily elements of diet, medicinal substances, and poisons, are found in the liquor sanguinis, and these experiments show that corpuscles which have been changed in their form from change in the quality of the liquor sanguinis may be altered back again to their normal form by a counteracting agent. But before any actual change of figure in the corpuscles occurs, we must suppose a disposition to the change, and therefore we may conclude that such a disposition may be removed by an appropriate—a counteracting agent. Lastly, we regard the facts as substantiating the doctrine that the fluid element of the blood has a pathology distinct from that of the corpuscles.

TRANSACTIONS.

Report on Slides of Diatomaceæ, *mounted by* E. Samuels, *for* Boston (U. S.) Society of Natural History, *and presented to the* Microscopical Society of London. By Charles Stodder.

(Read October 10th, 1860.)

The diatoms of our coast have been but little studied. These specimens will, on that account alone, possess considerable interest, though they have only been glanced at, for want of time. Those from Quincy appear most promising. The Milton slide contains almost entirely what Mr. Samuels considers a new *Himantidium.* The Bangor and Bemis Lake deposits are similar to other "sub-peat" deposits found all over New England, and described by Ehrenburg and Bailey. These have not been fully studied as yet.

The diatoms from the intestines of Holothurians and Echini are of great interest. They were taken from animals collected for our members, Mr. Jas. M. Barnard and Professor L. Agassiz. Some of the slides, prepared and mounted by Mr. Samuels, coming into my possession last spring, I noticed that they were very rich in genera and species, and that many appeared to be new. I sent specimens to our corresponding member, Mr. A. M. Edwards, of New York, who has paid much attention to this department of science for several years. His interest was excited by the specimens, and a larger quantity of the material was procured from Mr. Samuels, and also some directly from Mr. Barnard, and cleaned by Mr. Edwards, which, although but partially investigated as yet, has yielded a rich harvest of new forms, as well as many but recently published in Europe, together with a great number of old and well-known species.

The discovery of this source of supply of diatoms will yield important scientific results. We obtain specimens from localities otherwise all but inaccessible to the microscopist. We have ascertained that a great many species are common to the Sandwich Islands and to the Mediterranean; some species are found in the Sandwich Islands and the coasts, England, France, Nova Scotia, and Botany Bay; some common to Sandwich Islands, Zanzibar, and Florida.

Diatoms have been long known as the most cosmopolitan of all organism. The information afforded by these slides adds very much to our former knowledge of this character.

They seem to exist as species, almost independent of climate or locality.

Mr. Edwards has undertaken to make a list of the Sandwich Island forms, and to figure and describe the new species, with the view to publication by our society. I have examined these slides, prepared by Mr. Samuels, and have registered, with "Bailey's indicator," some of the new species of Mr. Edwards, as he has communicated them to me verbally or by letter, with his provisional names.

These slides have not been seen by Mr. Edwards, and I only am responsible for any errors or mistakes.

Mr. Edwards's new species are—

Synedra magna.
,, *pacifica.*
Triceratium circulare.
,, *elegans*, with 3 and 4 sides.
,, *undatum*, with 3, 4, and 5 sides.

These variations in the number of sides revive the question whether there is any generic distinction between *Triceratium* and *Amphitetras*. Mr. Brightwell has described several species of four-sided *Triceratium*, and the only distinction I can make out between *T. Wilksii* and *Amp. Wilksii* of Har. et Bai. ('Proc. Phil. Soc.') is the number of sides.

Among the rare or recently described forms in the Sandwich Islands, are *T. dubium* (Brightwell), found also on the coast of Florida, *Cocconeis fimbriata* (Brightwell), *Biddulphia reticulata* (Roper). The *Campylodiscus* figured by Brightwell, in 'Jour. Mic. Soc.,' as *C. striatus* (Ehrenberg), is abundant, but bears but little resemblance to Ehrenberg's description or original figure. I propose to call it *C. Brightwellii.*

Synedra undulata, Greg. (= *Toxarium undulans*, Bail.), is abundant, also, at Quincy, Mass.; so is *S. Hennedyana*, Grey. The two specimens have an expansion in the middle, but one is straight, the other undulated; now, we have likewise two forms, rather rare, one straight, the other undulating, but without the expansion: are all four one species? *Naviculæ* of the type of *N. didyma* are plentiful; some appear identical with described species, but they are so variable that they recall Dr. Gregory's query, whether they should not all be considered one species. The same observations apply to *Naviculæ* of the type of *N. lyra*.

There are two forms of Ehrenberg's genus *Actinocyclus*, called by most authorities *Eupodiscus;* one resembles *E. sparsus*, Greg. *E. tenellus*, Bréb., and the *Actinocyclus* of Ehrenberg ('Mic. Geol.' Taf. xix, fig. 5, c. 10). Also *Coscinodiscus lunæ* (Tab. 35A, group xxi, fig. 7); *Cos. gemmifer* (Tab. 35A, group xxii, fig. 3). This form is distinguished by rays composed of lines of contiguous dots, with other dots irregularly scattered between the rays. The number of rays is very variable, from six upwards; sometimes the rays are so crowded, that the intermediate dots *almost* form continuous rays, only distinguishable by their irregular distance from each other; colour, usually some shade of brown.

The other form of *Actinocyclus* has very fine lines for rays, not always continuous; and the whole surface of the disc is covered with a very fine network of, probably, hexagonal markings, too fine to be well made out with my instrument. This form is represented by *Eupodiscus fulvus*, W. Sm., and possibly by *E. subtilis*, Ralfs; by a great many of Ehrenberg's species, 'Mic. Geol.,' Tab. xviii, fig. 8, c. 18, Richmond,
„ „ xxviii, gr. 22, fig. 7,
„ „ xxxv, A, gr. 17, fig. 1, and 2, guano,
„ „ „ gr. 18, fig. 1, 2, and 3, guano, Saldanha Bay;

also Strafford Cliffs and Rappahanock Cliffs, var. colour, usually blue or purple, sometimes brown, and sometimes colourless. Both of these forms have generally, but not always, a nodule or process near the margin, resembling the "feet" of *Eupodiscus* and *Aulacodiscus*; which is probably the reason of their having been taken for *Eupodisci*, though the structure of the valve appears entirely different from the true species of that genus. Ehrenberg does not figure or describe the nodule, but on examining the *Actinocycli* of Saldanha Bay, in the Bailey collection, received, I believe, by Bailey from Ehrenberg, I find the nodule is present in them.

Ehrenberg's figures are sufficient to indicate the genus, but not the species, except by the number of the rays, which is not a good specific character, neither is colour. But I am well satisfied that many of the so-called *Eupodisci* are Ehrenberg's *Actinocyclus;* in fact, it is almost admitted by Smith.

These two forms of *Actinocyclus* should probably be placed in two genera. They have quite a different structure; that of the first-mentioned is not cellular, but the dots are projecting papillæ or tubercles, as may be easily seen in oblique examples. The whole group of *Actinocycli* and *Eupodisci* requires revision, and I believe that Mr. Edwards intends to undertake the task.

We have quite abundant and variable *Stauroptera aspera,* Ehr. = *Stauroneis pulchella,* W. S. Ehrenberg made a sub-genus of those *Stauroneis* that were striated or marked; but improved instruments having shown that all the *Stauroneis* are marked, and none smooth, the sub-genus should be cancelled, but the original specific names should stand.

There are a great many species of other genera, some of which will undoubtedly prove to be new; but these are not worked up as yet, or I have not received Mr. Edwards's results. There are also several new forms, whose position in classification is as yet quite doubtful.

The Sandwich Island slides in this parcel represent very well the character of all the others examined, except perhaps in the genera Nitzschia, Amphora, and Campylodiscus, which have been found much more abundant in number and species than here, some of the species of which will probably prove to be new; spicules of sponges are very abundant.

On the Zanzibar slides I have seen two specimens of an *Auliscus,* probably new; and several of an *Isthmia,* certainly so.

MICROSCOPICAL SOCIETY.

ANNUAL MEETING.

February 13*th*, 1861.

Dr. Lankester in the chair.

Report of Council.

According to annual custom, the Council have to make the following report on the state and progress of the Society during the past year.

The Society at present consists of—

Compounders - - -	41
Annual Subscribers - -	259
Honorary and absent -	5

giving a total of - - - 305 for the number of members this day on the books; of these 35 have been elected during the past year, and are included in the above number. The Council have to regret the loss by death of 5 members—P. W. Fry, Esq., Geo. Jackson, Esq., Rev. David Laing, Charles May, Esq., and Dr. James Forbes Young. Three of these, viz., Mr. Fry, Mr. Jackson, and Dr. Young, were among the original members who founded the Society. The Council have also received seven resignations. During the past year the Library has received an accession of 73 books; of these 25 consist of various complete works, many of which are of great value: among these may be particularly noticed the works of Leuwenhoek, 2 vols. 4to., and Swammerdam's 'Historia Insectorum,' 3 vols. fol., presented with other works by Dr. Millar, and the valuable contributions of the Hackney Microscopical Society, presented through Mr. Roper; four works also have been purchased with the Library Fund; and the remaining works consist of serial publications, presented by the various editors, with the exception of one, the 'Annals of Natural History,' which is purchased, as it appears, for the use of the Society.

The cabinet of objects has received an accession of 66 slides, including 27 from the Boston (U. S.) Natural History Society, 14 from Dr. Carpenter, being specimens of Polyozoa

AUDITORS' REPORT.

From February 8, 1860, to February 13, 1861.

Receipts.

	£	s.	d.
Balance of last year	25	16	10
Entrance fees of members	38	17	0
Compositions invested	52	10	0
Subscriptions	274	7	0
Sale of 'Transactions'	0	12	9
,, Soirée tickets	3	18	0
	£396	1	7

Payments.

	£	s.	d.
By Salary of Assistant Secretary	21	0	0
,, Curator	8	0	0
Delivery of Journals	9	7	7
Editors of ditto	128	12	0
Ray Society	1	1	0
Commission on £365 9*s*.	18	5	6
Soirée expenses	26	6	11
Library fund	1	10	0
Petty expenses (oil, stationery, postage, &c.)	22	8	4
Tea and Coffee	19	4	0
Printing	10	6	0
Purchase of £59 13*s*. 6*d*. Consols	54	15	0
Balance in Treasurer's hands	75	5	3
	£396	1	7

8th February, 1861.

We, the undersigned, have examined the Treasurer's accounts, with the documents and vouchers, and found them to be correct, and also to state that there is a year's interest due on £485 15*s*. 3*d*.

HENRY DEANE,
F. H. WENHAM, } *Auditors.*

and illustrations of the development of Comatula, and some micro-photographs by the late Mr. Jackson.

At the first meeting of the present session an elaborate report was made by a committee, consisting of Mr. Farrants, Mr. Lobb, and Mr. Legg, appointed to examine, arrange, and report upon the objects in the cabinet. This task has been performed by these gentlemen in a most satisfactory manner, as may be seen by the report; and the result of their investigation is, that at the date of the report, October 3, 1860, the cabinet contained 832 objects, which for facility of reference they had arranged under 13 heads or classes, distinguished by the capital letters from A to M. They at the same time made a suggestion as to an arrangement by which the objects might be allowed to be taken out by the members under certain regulations, to which arrangement the Council have given their assent.

The Journal has continued to be published regularly, and circulated as usual.

The President then delivered the following address:

The President's Address *for the year* 1861.

By Professor John Quekett, F.R.S.

Gentlemen,—Before proceeding to the general business which usually occupies the attention of the members of the Microscopical Society on this, the evening of the anniversary, I have much to say to you in the way of apology for my seeming neglect in never having occupied the chair, to which, unknown to me, I had been elected by the Council. Feeling that the state of my health did not allow me to perform the duties of the office in such a manner as I could wish, I did all in my power to prevent the appointment when it was hinted to me as likely to be made. Not having been consulted in the matter, nor officially informed of the intention of the Council, but hearing through a private source that I had been proposed to fill the office of President, I wrote a letter to the Council, telling them that, had my health permitted, I should have felt much honoured by the appointment; but that, as things stood, I must necessarily decline it. In February last, however, and but a few evenings before the Anniversary, I was, for the first time, officially informed that my letter, declining the position of

President, had come to hand too late; and that the election must stand good. I regret to say that my apprehensions with regard to the state of my health have been more than realised; for, without a single exception, from the time of the *soirée*, which was held in this room in April of the past year, I have been prevented, by illness, from attending any of the meetings.

Knowing, as you all do, the part taken by me in assisting to establish this Society in the outset, and that I have performed the duties of Secretary for a period of nineteen years, during many of which I was unassisted, my declining so honorable a post as that of President must, at first sight, have given rise to the idea that either my views as to the usefulness of the Society had changed, or that my occupations, being numerous, would not allow me time for microscopical investigation, nor for the transaction of any business connected with the Society; but when I state the truth, viz., that I have been physically incapable of performing these duties, I feel sure that no further apology will be needed, more especially as I endeavoured in every way to prevent my appointment, having, on more than one occasion, previously refused it on the same grounds. I can only add, that should it please the Almighty Disposer of events that my health should be restored, I shall hope to be able, at some future time, to show you that a long period of unavoidable absence has in no way diminished my love for this Society, nor the zeal and energy with which I once assisted in carrying on its affairs.

Since the Anniversary, which was held on the 8th of February in the past year, there have been nine meetings of the Society; and, in addition to the subjects which have been brought forward orally, no less than thirteen papers have been read; and of these, four relate to the Diatomaceæ, a subject which, perhaps, more than any other, has, from the earliest days of the invention of the Achromatic Microscope, occupied the time and attention of the most persevering and painstaking portion of our Microscopic community; a certain number occupying themselves with the nature of the markings on the surfaces of the valves, whilst others are engaged in classifying and arranging the numerous species which are daily being procured from all parts of the habitable globe. We are indebted to Dr. Greville, Dr. Wallich, Mr. Norman of Hull, and Mr. Tuffen West, for these papers, all of which have been published in full in the 'Transactions' of the Society, and many of them have been delineated by the accurate pencil of the last-named gentleman.

The paper by Dr. Greville is a very elaborate one: it is entitled a "Monograph of the Genus *Asterolampra,* including *Asteromphalus* and *Spatangidium.*" The material employed for investigation was obtained from three very different sources; the first consisted of soundings from the Indian Ocean; the second, of a deposit from the United States, prepared for examination by Mr. E. W. Dallas; and the third, of a substance known as the Monterey Stone, prepared by Professor Walker-Arnott. One great object of this paper is to point out how far the genus *Spatangidium* of De Brébisson should have been adopted in his former paper; the species formerly described as belonging to this genus being considered as strictly referable to *Asterolampra* or *Asteromphalus.*

The paper by Mr. Tuffen West is entitled "Remarks on some Diatomaceæ, new or imperfectly described, and on a new Desmid." The sources from which the algæ upon which Mr. West's observations have been made were various, some of them being from the British coasts, others from the Mauritius and from the so-called Barbadoes earth. The genus *Triceratium* is the one principally mentioned; and of this no less than seven species are described, and figures of each given, with the usual accuracy of this accomplished artist.

Five other genera are then alluded to, and one or more species of each described of these genera; that of *Attheya* is new, and its species *A. decora* was found by Mr. Atthey plentifully on Cresswell Sands, in June, 1859, and in May, 1860, in Druridge Bay. At first sight this species is considered to resemble *Striatella unipunctata* in miniature; but the presence of spinous processes at the angles, and the entire absence of stripes or attachment of any kind render the establishment of a new genus perfectly necessary.

The paper of Mr. Norman, read in June, is a continuation of that brought before the Society in January, 1860. It is a list of the various forms of Diatomaceæ in the neighbourhood of Hull. The genera *Pinnularia, Stauroneis, Pleurosigma, Synedra, Gomphonema, Meridion,* and upwards of thirty others, are represented each by one or more species, tending to show not only the richness of the locality, but also the zeal, activity, and powers of discernment of the microscopists of that town in this particular department of scientific inquiry.

Volvox globator, which within the last few years has occupied so much of the attention of microscopical observers, has points in its history still remaining to be cleared up. Dr. Hicks has done much to make the matter clearer, and has pointed out a stage, viz., the amœboid, in which this Protean form agrees with that of three other members of the vegetable kingdom.

At the same meeting, Dr. Wallich, in a paper, entered into a discussion on the structure of the diatom valve; believing, from his observations, that the growth of the valve ceases either at or shortly after its liberation from the parent. That, subsequently, no change in shape occurs in the *siliceous* valve except at its margins. That the markings are circular, and arranged determinately according to species; the figure being dependent upon forces occurring during its connection with the parent frustule; the size and relative fineness of markings depending upon the condition of the frustule while in the stage of generation. As to the gelatinous envelope, its growth may probably go on indefinitely.

The next paper relates to the zoophyte division of the animal kingdom.

Professor Allman described, in a paper read 14th March, 1860, a new genus of Lucernariidæ, *Carduella*, identical with the species *L. cyathiformis* of Sars, but differing from the true Lucernariidæ in the margin of the circular disc not being produced into the rays, the tentacles not springing from the edge of the cup, and in these being situated in a single circle.

From a careful description of its anatomy, he believes it to represent a true hydrozoan type, notwithstanding a resemblance to the actinozoan, in the presence of the vertical lamellæ connecting the stomach with the outer wall of the animal.

The papers relating to the improvement in the microscope itself, and in the apparatus connected with it, have been, during the last year, more numerous than in any preceding one. Thus, there have been two on the Binocular form, by Mr. Wenham; one on a Portable Field or Clinical Microscope, by Dr. Lionel Beale; and another on a Dissecting Instrument, by Mr. James Smith. All these are fully described and illustrated in the 'Transactions,' and are worthy of the greatest attention from their being the contrivances of men qualified in every possible way to show to the uninitiated what is truly good and useful. Mr. Wenham's invention, however, is one which requires more than a passing notice, as it is likely to prove of greater use to the observer than any other form of instrument which has yet been brought before the notice of the members of this Society; and glad should I be if the limits of this address would allow me to enter fully into some of its advantages.

The next duty I have to perform is a painful one, viz., to remind you that although our little community scarcely numbers three hundred strong, yet within the last year no less than five of our members have been taken from us by the unsparing hand of death. These are James Forbes Young, Charles May, David Laing, P. W. Fry, and George Jackson; and of all the losses the Society has met with since its formation, no greater one has happened than that of so valuable a member as Mr. Jackson, for there is hardly one amongst us who has used the microscope as a scientific instrument, but has been more or less indebted to Mr. Jackson's skill for the instrument employed in taking accurate measurements of minute objects.

Mr. George Jackson was the eldest son of a farmer at Higher Yellington, in South Devon, and was born in 1792. At an early age he exhibited a strong mechanical genius; his first attempts in that direction being to manufacture a mouse-trap, his grandmother having promised him a guinea for the first that was caught, under the impression that such a thing was impossible; a mouse, however, was soon trapped, and the promised guinea as quickly reduced to a half-crown. Then sixpence a head was the price affixed; but still, even at this reduced rate, the money earned from the efficiency of the trap was considered too much for so young an artist, and payments consequently ceased altogether. He was educated at the Ashburton Grammar School, whither his innate tendencies, also followed him; and if ever young Jackson was missing, he was sure to be found in the workshop of Mr. Ireland, the carpenter. Numerous lasting memorials of his skill, in the form of writing-desks, work-boxes, &c., still remain to evidence this early predilection.

Mr. Jackson was articled to Mr. Gervis, a surgeon and medical practitioner at Ashburton, whose sons had been his schoolfellows, and whose second daughter he afterwards married. He attended the lectures at the United Hospitals of St. Thomas and Guy, and took the diploma of Member of the Royal College of Surgeons of London in 1813.

At an early period of his life he was an excellent manipulator with the table blowpipe, and supplied himself and many of his relatives and friends with most excellent thermometers, hydrometers, and barometers. He also constructed a transit instrument, which was erected, when in use, on a stone cantilever firmly embedded into the wall behind his house. In 1826, he was rewarded by the Society of Arts for an ingenious and useful instantaneous light-apparatus, being a modification of the hydrogen and spongy platinum lamp.

Mr. Jackson was an early lover of the microscope, and many years before the existence of our Society constructed a very efficient instrument for using the doublet lenses introduced by the late Dr. Wollaston; the two lower pairs of these he framed and figured for himself. This was followed by the production of a large-sized instrument, capable of effecting all that the best microscopes of that period were able to do. At the turning-lathe and planing-machine he was a thorough workman, and these instruments he had constructed on his own plans, and much of them by his own hands. He was the first to show the great importance of employing the latter for perfecting the instrument and economising labour.

Mr. Jackson was one of the original members of our Society at its formation in 1840, and most of his various suggestions for the improvement of his favorite instrument have been laid before the members.

The first of these was a paper "On Microscopic Measurement," read September 23d, 1840, and printed in the 'Microscopic Journal,' vol. i, p. 11—a subject with which his name has become so intimately connected.

In April, 1841, he described a portable candle-lamp for illumination by reflection, some observations on which will be found in the 'Microscopic Journal,' vol. ii, p. 77. This was followed in November, 1847, by his paper on "The Eyepiece Micrometer," published in the 'Transactions of the Society,' vol. ii, p. 134.

The small but elegant little ruling-machine, which he constructed for the division of these micrometers, is a most efficient arrangement, and although, I believe, never figured or described, yet he had no hesitation in exhibiting it to any person who was interested in such matters.

It was about this period that he also constructed a very complete and serviceable cutting-machine for producing thin sections of woods, &c.

In 1852 Mr. Jackson was elected President of this Society, and I am sure that the members will all bear witness with me in stating that he was at all times most active in advancing the true interests of the Society.

In conjunction with Dr. Carpenter, Dr. Lankester, and your President, he was appointed by the Council of the Society of Arts a member of the committee, to assist in awarding their premium for the best and cheapest microscopes.

In May, 1857, he exhibited and described a new form of travelling microscope, four of which he has constructed as presents to various relatives.

Soon after the process of photography on collodion had become practised, Mr. Jackson turned his attention, with his accustomed clear-headed assiduity, to this engaging branch of art, constructed for himself a camera box, travelling arrangements for micro-photographs, and with a good achromatic lens, manufactured by Ross, set to work with his usual perseverance and industry to take the portraits of all his relatives and friends, scientific or not, the liberal distribution of which among his large circle of acquaintances afforded him unalloyed pleasure. The Society's museum is enriched by his liberality with micro-photographs of some sixteen of its members.

Several other short notices from our deceased member have also appeared in the pages of the 'Quarterly Journal of Microscopical Science,' as "On thin glass Covers" (vol. i, p. 141), "On Micrometers and Micrometry" (vol. iv, p. 241), "On Microscopical Photographic Portraits" (vol. vii, p. 122). He also undertook to oblige his friend, the late Dr. Pereira, with the measurement of the starch granules of various amylaceous substances for the last edition of his 'Elements of Materia Medica' then in preparation, twenty-five of which have been published in that work.

One of the greatest improvements in the microscope as a working instrument was that carried out by Mr. Jackson in the construction of the continuous bar, supporting the body of the instrument above the stage, and carrying a small secondary body below, the whole bar being planed from end to end on one level, and with rack; this secondary body carrying the achromatic or other condenser, polarising prism, dark well, &c. In this way the axis of the instrument is perfectly continuous, and no centering or adjustment is required.

Three sets of castings were made from the patterns which he had constructed, two of which were given to his friends, Mr. Alfred White and the late Mr. Greening; and the patterns were then transferred to Messrs. Smith and Beck, and exist in the present form of their No. 1 instrument.

In 1858 Mr. Jackson was elected one of the managers of the London Institution.

In his own profession in mechanical surgery he exhibited considerable tact and skill; and although such requirements were seldom brought into action, yet it was a source of great delight to him if he could by some simple contrivance alleviate the sufferings of his patients, and thus facilitate their cure. One of the last undertakings of his life was the production of a very simple and most efficient contrivance for reducing dislocations of the shoulder-joint—an operation at times, in very muscular subjects, very difficult to perform.

His quiet and unassuming manners, his clear and upright mind, rendered him generally beloved; and the readiness with which he was ever willing to communicate to others whatever knowledge he might have acquired made his acquaintance and society both profitable and engaging to all who had the privilege of his friendship.

The other gentlemen whose loss we regret were more distinguished for their love of science than for their practical investigations.

The several reports which have been read to you will show that the Society is in a flourishing condition; its members, its list of books, and its museum are being daily increased; and though your President has been unable to perform the duties of his office, yet owing to the kindness of friends his place has been most ably filled, and in the hope that in years to come more and more will join our ranks, he begs to resign the chair to one who is in every way calculated to do it honour.

Descriptions *of* New *and* Rare Diatoms. Series I.

By R. K. Greville, LL.D., F.R.S.E., &c.

(Read March 12th.)

Stictodiscus, n. gen., *Grev.*

Frustules simple, discoid, divided by radiating lines into numerous plicate compartments. Lines not reaching the centre. Compartments furnished with conspicuous transparent, pore-like puncta. (In the four typical species, large scattered puncta also occupy the blank central portion of the disc.)

This genus is founded primarily upon *Discoplea? Rota* and *D.? Rotula* of Ehrenberg, and two most beautiful diatoms which occur in a deposit found in the Island of Trinidad. While engaged in preparing a description of the two latter, my friend, Mr. Ralfs, directed my attention to the idea thrown out by Ehrenberg, that *Actinoptychus dives,* and *Cyclotella Rota,* and *C. Rotula* might be generically associated; and that they would come very conveniently into the new genus I was proposing to establish. The words of Ehrenberg are (under his definition of *Discoplea? Rota*)— "Proxime ad *Actinoptychum divitem* in Græciâ fossilem accedens forma, et cum ea forsan, et cum sequente (*Discoplea? Rotula*) in peculiari genere reponenda." ('Bericht. Berl. Akad.,' 1844, p. 202). I entirely concur in this view. Four of the species enumerated in this paper, namely, *Stictodiscus Buryanus, S. Johnsonianus, S. Rota,* and *S. Rotula,* may be considered typical, being distinguished not only by the pore-like puncta or papillæ, or whatever they may be called, which occupy a definite (?) arrangement within the compartments, but by large puncta remotely scattered over the convex and otherwise blank centre of the disc. The remaining species, which agree in general habit, and in the presence of definitely arranged puncta or cellules within the compartments, may be at least retained provisionally.

For the discovery of the deposit in Trinidad, new, I believe, to the microscopic world, we are indebted to Dr. John Davy, well known for his researches in various departments of natural history. He kindly informs me that, from his observations made in Trinidad, he is disposed to consider the formation in which the deposit occurs as connected with the New Red Sandstone; adjoining to which is the sandstone, probably of the same description, in which the Pitch Lake is situated. The extent of the deposit is not known; but, like that in Barbadoes, it is probably large both in surface and depth. It does not contain a great variety of diatomaceous forms; but various new and interesting species have already been observed in it.

Stictodiscus Buryanus, n. sp., Grev.—Pore-like puncta at the marginal extremity of each compartment, forming a pyramidal group; rays 30; diameter ·0040″ (Pl. IV, fig. 1).

Hab. Deposit at South Naparima, Trinidad; Mrs. Bury.

The disc of this superlatively beautiful diatom is transparent and gently convex, remotely dotted over with large, clear, pore-like puncta, exhibiting also the shadows of puncta belonging to the lower valve. The marginal groups consist of six or seven. The radiating lines (septa?) are free for more than half their length, and then, after anastomosing, become faint and inconspicuous before reaching the centre. When these lines are accurately focussed, the plicate character of the disc is not visible, but by changing the focus it becomes conspicuous (fig. 2). A single specimen only has hitherto been observed, for which my cabinet is indebted to the generous kindness of its discoverer.

Stictodiscus Rota (Ehr.), Grev.—"Disco amplo superficie inæqualiter papillosa, papillis centralibus majoribus, margine radiis 52 æqualibus centrum non attingentibus intervallorum papillis sparsis."

Discoplea? Rota, Ehr., 'Bericht. Berl. Akad.,' 1844, p. 202; 'Microgeol.,' pl. xxxv, A. 22, fig. 6.

Cyclotella Rota, Kütz., 'Sp. Alg.,' p. 19; Ralfs in Pritch. 'Infus.,' 4th edit., p. 812.

Hab. Southern Ocean.

The figure given of this diatom, by Ehrenberg, indicates very clearly that it is a genuine *Stictodiscus*. The valve is very large, the radiating lines much shorter than in the other species; the puncta within the compartments disposed, apparently, in an irregular double series, and extend as far as the termination of the lines. The whole central space is covered with numerous large puncta, as in the preceding species.

Stictodiscus Rotula (Ehr.), Grev.—Puncta equal, remotely scattered over the blank centre of the disc, those within the compartments irregularly (?) disposed; rays 20.

Discoplea? Rotula, Ehr., 'Microgeol.,' pl. xxxv, A. 22, fig. 7.

Cyclotella Rotula, Kütz., 'Sp. Alg.,' p. 19; Ralfs in Pritch. 'Infus.,' 4th edit., p. 840.

Hab. Southern Ocean.

A very small species compared with the preceding, but evidently closely allied to it, the prominent character of the scattered central puncta being distinctly exhibited in Ehrenberg's rude figure. The small number of rays at once separates it from all the others.

Stictodiscus Johnsonianus, n. sp., Grev.—Pore-like puncta of each compartment equal, forming a short linear series; rays 50; diameter ·0034″. (Pl. IV, fig. 3.)

Hab. Deposit at South Naparima, Trinidad; Christopher Johnson, Esq.

Not less beautiful than *Stictodiscus Buryanus*, and well distinguished by the single series of puncta in each compartment, which extends from the margin to about a third of the distance between it and the centre. Other puncta are scattered over the surface of the disc, as in the two previous species. A single example only has been found, for the possession of which I have again to acknowledge the kindness of Mrs. Bury.

Stictodiscus insignis, n. sp., Grev.—Cellules large at the margin, forming a moniliform series in each compartment to near the centre; rays 46; diameter ·0021″. (Pl. IV, fig. 4.)

Hab. Barbadoes deposit; very rare.

A small but exquisite diatom, of which I have as yet only seen two individuals. It will be at once recognised by the puncta, or in this instance rather cellules, which, commencing at the margin, continue in a moniliform series, and decreasing gradually in size until they approach the centre, when they lose their radiating character and occupy the entire surface.

In this species we do not find the peculiar puncta scattered over the central portion of the disc, so characteristic of the three preceding species, while the centre itself is fully occupied with puncta or minute cellules similar to those of the compartments. The valve is also much less convex.

Stictodiscus dives (Ehr.), Grev.—Pore-like puncta in each compartment minute, equal, forming a single series; rays 52 (centre minutely punctate ?).

Discoplea? dives, Ehr.

Actinoptychus dives, Ehr. 'Microgeol,' Pl. xix, fig. 12; Ralfs in Pritch. 'Infus.' 4th ed., p. 840.

Cyclotella dives, Kütz., 'Sp. Alg.,' p. 20.

Hab. Egina.

The appearance of this disc, as far as we can judge from Ehrenberg's figure, is sufficiently striking to justify its provisional admission into the genus. No central punctation, however, is exhibited in the figure.

Coscinodiscus.

Coscinodiscus armatus, n. sp., Grev.—Cellules minute, equal, radiating, about 13 in ·001″; the disc furnished, towards the margin, with numerous, radiating, spine-like ridges. Diameter ·0025″ to ·0035″. (Pl. IV, fig. 5.)

Hab. Barbadoes deposit; very rare.

A curious species, resembling very closely, in the marginal ridge-like spines or processes, *Brightwellia Johnsoni* (Ralfs, MS.); one of the most beautiful of the many new diatoms which have been found in this deposit. When the disc is viewed in the position in which it usually presents itself, that is, vertically, these processes appear as short, thickened lines tapering towards the centre; but an oblique view brings out their real character.

Coscinodiscus tuberculatus, n. sp., Grev.—Disc with a deep pore-like umbilicus; cellules radiating, subequal, the longer series terminating in marginal tubercles; cellules 9 in ·001″; marginal striæ 25 in ·001″. Diameter ·0025″ to ·0035″, or more. (Fig. 6.)

Hab. Barbadoes deposit; frequent.

Cellules hexagonal; those immediately surrounding the umbilicus small; the rest nearly equal till near the margin, where they become again smaller. The longer rays of cellules appear to be in pairs, and it is the line of separation between them which terminates in the tubercle. The latter, on an oblique view, is seen to form an obtuse process. The margin is distinctly and rather broadly striated.

Coscinodiscus biradiatus, n. sp., Grev.—Granules distinct, filling up the centre irregularly, afterwards radiating, large, prominent, somewhat quadrangular, gradually diminishing in size to the margin; rays distant, the long ones alternating with a shorter series; margin with a row of minute puncta. Diameter ·0035″. (Fig. 7.)

Hab. Barbadoes deposit; rare.

An object of exceeding beauty and brilliancy. The disc is very convex; and in taking a vertical view, and in passing the focus down the side of the disc, the effect is very striking; the prominence of the granules being so great as to cause the rays, when so viewed in perspective, to resemble the ribs and tubercles of a *Cardium*. There is no umbilicus.

Coscinodiscus elegantulus, n. sp., Grev.—Granules minute, subequal, irregularly scattered over a central space equal to about a third of the diameter of the disc; they afterwards form a single series of distant, often somewhat curved, rays; margin with a row of very minute puncta. Diameter ·0017″. (Fig. 8.)

Hab. Barbadoes deposit; rare.

A very delicate, transparent little disc, easily overlooked, but well marked by its wide fringe-like rays.

Coscinodiscus Barbadensis, n. sp., Grev.—Disc divided into compartments by double lines of punctiform cellules, the intervals between the lines being so clearly defined as to present the appearance of rays; cellules within the compartments less conspicuously radiate, subequal, except at the margin; 15 in ·001″; diameter of disc ·0025″. (Fig. 9.)

Hab. Barbadoes deposit; very rare.

Disc convex, very delicate, and apt to be overlooked even by careful observers. Under a moderately magnifying power it would scarcely be taken for a *Coscinodiscus*, as it rather suggests the idea of an *Actinocyclus* (Ehrenberg, not Smith); but, under a higher power, the apparent rays are found to result from the space left between two lines of cellules, which radiate from the centre to the circumference. Further observations may determine the presence of an umbilical pore. One of my specimens is injured at that part; and the other shows, although obscurely, an approach to such a character.

TRICERATIUM.

Triceratium capitatum, n. sp., Ralfs.—Valve with the angles much produced and capitate, and separated from the centre by a transverse line; surface with indistinct, scattered puncta, and two spines. Distance between the angles about ·0019″. (Fig. 10.)

Hab. Barbadoes deposit; extremely rare.

"A small species, with very indistinct puncta. Valves, irrespective of the produced angles, straight or slightly convex." (Ralfs.) The frustule appears to be not unfrequently imperfect or mutilated. I had examined half a dozen examples before I perceived any trace of puncta at all. Mr. Rylands then kindly communicated a specimen, in which, in addition to the central puncta, a few larger and more definite puncta were scattered on the narrow portion of the produced angles, and the surface was also furnished with two conspicuous spines. I have subsequently found two frustules myself, exhibiting very distinctly these characters.

Triceratium Westianum, n. sp., Grev.—Sides of the valve deeply and sharply concave; angles forming segments of circles, separated from the centre by transverse lines; margin of the angles with very short radiating lines; surface strongly punctate; distance between the angles ·0018.″ (Fig. 11.)

Hab. Barbadoes deposit; extremely rare.

I have much pleasure in dedicating this remarkable and ornate species to my friend, Mr. Tuffen West, the unrivalled illustrator of the Diatomaceæ, and who is well acquainted with the nature of the objects themselves. It is allied to *Triceratium castellatum*, described by himself, from the same deposit, in the eighth volume of the 'Transactions of the Microscopical Society;' but is, in several important characters, perfectly distinct. Like most of the species of *Triceratia* discovered in this mine of novelties, it is excessively rare. I have only met with six specimens.

Triceratium Barbadense, n. sp., Grev.—Sides of the frustule gently concave; angles broadly rounded, separated from the centre by transverse lines; whole valve closely and minutely punctate. Distance between the angles ·0016″. (Fig. 12.)

Hab. Barbadoes deposit; excessively rare.

Allied to *T. castellatum*, but differs in the form; the sides of the valve not being nearly so deeply concave, and the angles, instead of swelling into segments of circles, being merely broadly rounded.

Triceratium nitidum, n. sp., Grev.—Sides of frustule rather deeply concave, angles ovate, separated from the centre by transverse lines; whole valve punctate; puncta of the central space radiating, and becoming conspicuous as they reach the margin. Distance between the angles, ·0014″. (Fig. 13.)

Hab. Barbadoes deposit; extremely rare.

I am not aware of any described species for which this can be mistaken. A good character exists in the puncta of the centre, which radiate in single lines, becoming gradually larger and the lines more distinct as they approach the margin.

Triceratium cellulosum, n. sp., Grev.—Sides of the valve straight; angles with pseudo-nodules, obtuse, separated from the centre by transverse lines; centre and angles coarsely and irregularly cellulose; cellules of the former more or less ovate or oval, and disposed in a radiating direction, though not in lines; those of the latter in rows parallel with the separating line. Distance between the angles ·0026″. (Fig. 14.)

Hab. Barbadoes deposit; exceedingly rare.

Large and robust, as compared with many of the Barbadoes species; and so peculiar in its characters as to be instantaneously recognised. The cellules of the angles are somewhat quadrate, and hence those parts of the valve have a sort of cancellated aspect. The lines which separate the angles from the central area appear as linear spaces left unoccupied by the cellules.

Murrayfield, Edinburgh; January 15th, 1861.

The following new species of *Triceratium* have also been discovered in the Barbadoes deposit, and will be figured and more fully described in a future number.

T. aculeatum, Grev.—Sides of valve gently and evenly concave; angles somewhat obtuse, with a decided pseudo-nodule; granules irregularly radiant; centre convex, with three spines. Distance between the angles ·0022″.

T. cornutum, Grev.—Valve (in my specimen four-angled) with straight sides, and sharp angles furnished with strong horn-like processes; surface minutely granulose in radiating lines; centre with three spines. Distance between the angles ·0015″.

T. productum, Grev.—Valve punctate; angles produced, capitate; centre divided into compartments by radiating, vein-like lines. Distance between the angles ·0027″.

T. inconspicuum, Grev.—Minute, sparsely punctate; valves (in my specimens four-angled) with the angles semicircular, separated from the centre by a transverse line; centre bordered with a row of puncta. Distance between the angles ·0005″.

T. delicatum, Grev.—Minute; valve with slightly concave sides and broadly rounded angles, filled up with transverse rows of fine puncta; centre containing a pale, obtusely triangular band, within which is a triangular spot bordered with puncta. Distance between the angles ·0012″.

T. ornatum, Grev.—Valve with rounded angles and convex sides; conspicuous pearly granules sparingly scattered in the semi-blank central space, and forming a broad marginal band of radiating lines, which are 7 in ·001″. Distance between the angles ·0024″.

T. labyrinthæum, Grev.—Valve with rounded angles and slightly convex sides; the centre occupied with a network of widely anastomosing, vein-like lines, from the boundary of which short lines are given off towards the margin; spaces enclosed by the anastomosing lines finely punctate. Distance between the angles ·0023″.

T. blanditum, Grev.— Sides of valve (in my specimen four-angled) deeply concave; angles sub-hemispherical; centre with a small blank space; granules conspicuous, sub-remote, equal, forming straight, equidistant, parallel lines, 11 in ·001″. Distance between the angles ·0020″.

TRANSACTIONS.

On the Metamorphoses *of a* Coccus *found upon* Oranges.* By Richard Beck.

(Read March 13th, 1861.)

If the external surface of almost any of the sweet oranges be only cursorily examined, it will be found more or less spotted with small scales, the shields of a coccus or scale insect; they are adherent to the rind of the orange, but can easily be detached; and, on turning one of the larger ones over, it will be found, on examination under a low power, to present, as the most striking feature, a large accumulation of eggs lying beneath a cottony secretion (Plate V, fig. 1, *b*); very frequently these eggs are in the process of hatching, and, under such circumstances, we have the insect in its larva state (fig. 3).

The body is white, oval, and very flat: there are two antennæ proceeding from underneath; they are about one fourth the length of the body, rather hairy, and of eight or nine joints, two very small light-pink ocelli, or simple eyes, occur one on each side, at the very edge of the body, and about where the long curves of the oval commence; considerably below the antennæ is a proboscis, a long and apparently horny tube, proceeding from a conical base. These, with the exception of a few isolated hairs, are the only external organs of the head that are apparent. The legs are six in number, each consisting of, I think, four members; the terminal ones being provided with a hook, and two or more very small suckers hardly to be distinguished from

* The author considers these observations as very incomplete; his object in laying them before the society in such a state was to afford any member an opportunity of investigating the subject whilst the oranges were in season, having since found that the same coccus is in great quantities on plants in this country, and that the eggs are now hatching; he would still call the attention of microscopists to the subject.

hairs. At the extremity of the body two exceedingly minute hairs trail behind for some considerable length; and besides these are numerous setæ and orifices, parts, I believe, of the organ for the secretion of the cottony substance and the hard shield.

The locomotive power of the larva—and this is the only time it makes use of it—is I believe very limited; frequently it settles close to the parent home, and I imagine that when once the proboscis is inserted in the orange it is never removed; the insect thus located, the skin on the back changes to a darker colour, thickens, and ultimately becomes a cast skin, the coccus having retreated between the secretions of the hard shield, as a protection above, and the cottony substance as a close attachment below, but to neither of them is it ever adherent; at this stage it also loses every trace of antennæ, legs, and eyes, whilst, on the contrary, the proboscis is more fully developed: this is evidently the pupa state, and thus far I have been unable to detect any difference between male and female.

The first indication that I have found of the male insect is the presence of two dark and rather diffused red spots in the head, and also a simultaneous disappearance of the proboscis (fig. 4). Then after a skin is cast, there is an entire disappearance of the organs for the secretions of the shield, which is completed of a long and narrow shape; one stage more in advance and the ocelli are black and distinct, and there can be traced two long antennæ and two wings at the side; six legs are also in process of development, the two in front being directed forward, which is a peculiarity of the pupa of this genus; and at the extremity of the body is a protuberance I imagine to be the male organ (fig. 5). Another skin is yet cast, and then there is a perfect male insect (fig. 6). The ocelli are four, two above and two below; the antennæ, eight or nine jointed, very delicate, hairy, and nearly the length of the whole body; the legs have four members, the terminal one of each being provided with a single hook and two or more delicate suckers; the wings project considerably beyond the body, they are transparent, but covered with very minute hairs, and strengthened by a simple ribbing of two corrugations which unite at the base. The two halterers or poisers are oval, and terminate with a hair bent like a hook at the extremity; and that which I presume to be the male organ is long, attenuated, and attached at its base to, and immediately above, a truncated projection which has an aperture at its apex.

We thus find in the male complete insect metamorphoses.

I am unable to say as much of the female, though I presume such must be the case, as only a perfect insect is capable of reproducing its species. I have not as yet paid as much attention to this sex, but so far as my investigations have gone, after it has changed into the pupa state all external organs entirely disappear, excepting those at the extremity of the body, and the proboscis, which becomes stronger and larger (fig. 8); the secretion of the shield is continued until nearly four or five times the size of the male, and the body of the insect bears about the same proportion; it then deposits its eggs, between one and two hundred in number, which are placed on end in great regularity, and the first ones will frequently be found hatching before the last are laid.

The external surface of the shield of the male (fig. 7) gives very marked indications of the three changes that have taken place: first, there is the cast skin of the larva; secondly, the shield for the pupa; and thirdly, a thin and short addition to the shield for the wings of the imago, which I believe is lifted up when the insect escapes.

There are also three similar indications on the external surface of the female shield, and these may also warrant the conclusion that its metamorphoses have been complete.

It is somewhat surprising that these cocci are to be found in a living state at all, after the change they must have experienced in the climate; it is, however, very evident that the larva and pupa states are much hardier than that of the imago; at least so far as the males are concerned, I have found it very difficult to obtain any alive after the external organs were fully developed. As it is, the circumstances under which they appear are very favorable to their examination; one single orange, if well selected, will supply every condition I have mentioned; and I imagine that from the fact of the shield being such a complete protection, the metamorphoses are more distinct in their development than under the more ordinary circumstances where the insect itself is exposed. I have invariably used Mr. Wenham's binocular arrangement with the microscope, and I can only say that for this class of investigations the results are perfectly marvellous.

On the Microscopic Characters *of the* Crystals *of* Arsenious Acid. By William A. Guy, M.B. Cantab., Professor of Forensic Medicine, King's College, London.

(Read May 8th, 1861.)

In submitting to your society this paper on the miscroscopic characters of the crystals of arsenious acid, I have two principal objects in view. I wish, in the first place, to illustrate, by a striking instance, the great value of the binocular microscope as a means of diagnosis; and, in the second place, to give a more exact account than any at present in existence of the crystalline forms assumed by a very important poison. That to render such an account is not a work of mere supererogation, a reference to the descriptions of the crystals given in works of authority would readily prove.

Most authors describe the crystals as regular octahedra, without recognising any other crystalline forms. Some writers, however, speak of the regular octahedron and its modifications, or of forms traceable to the octahedron; and acicular crystals, long prismatic needles, triangular and hexagonal plates, and even tetrahedra, are to be met with in the descriptions of authors.*

I may add that, in illustrated works, the octahedral crystals are usually figured in the form in which they are most readily identified; the less usual positions of the octahedra and the rarer forms and modifications of the crystal being omitted.

The imperfect and somewhat conflicting accounts thus given of the crystals of arsenious acid are, doubtless, to be explained, partly by the difficulty of examining them, whether by lens or microscope, when sublimed, as they were formerly, in thick reduction-tubes of narrow bore; partly to the great variety of lights and shadows presented by the crystals, especially when viewed by transmitted light; and partly to the imperfect relief given to the crystals when examined by the monocular microscope.

* Consult Pereira's 'Materia Medica,' 4th edition, p. 685, in which the tetrahedron is mentioned as one form of the crystal; Miller's 'Elements of Chemistry,' part ii, p. 961, in which mention is made of long prismatic needles, isomorphous with those of oxide of antimony; and Taylor, on 'Poisons,' 2d edition, p. 385, in which equilateral triangular plates are specified. Pereira cites a foreign authority (Wöhler) who found in a cobalt roasting-furnace arsenious acid crystallised in hexahedral plates derived from a right rhombic prism.

The substitution of the modern form of reduction-tube, in which the vapours of arsenious acid are made to pass through a narrow glass tube with thin sides, has made the examination by the microscope more easy; but the simple plan which I suggested about three years since, for obtaining the crystals on a flat surface, has offered still greater facilities, of which it is but natural that I should have largely availed myself. The knowledge of the subject thus obtained may be said to have been completed by the use of the binocular microscope.

The most superficial and cursory examination of the first specimens obtained upon a flat surface sufficed to convince me that very much remained to be done before our knowledge of the true crystalline characters of arsenious acid could be placed on a level with the practical importance of such knowledge. In the first place, it was quite clear that those descriptions which spoke only of the regular octahedron as the one proper form of the crystal were wholly inadequate; and that even those which recognised, not only the perfect crystal, but all the forms traceable to the octahedron were still insufficient. We ought to know what particular forms to look for. Again, it must be interesting, and might be practically important to know something more of the alleged acicular or prismatic crystals, of the triangular and hexagonal plates, and of the tetrahedra, described and figured in Pereira's work. The crystallographer, too, could scarcely abstain from speculating on the possible occurrence among these octahedra of those other members of the regular system, the cube and the rhombic dodecahedron. Some, if not all, of these questions I hope to be able to answer, without proving tedious to those who have not the special interest in this subject which I have myself. Reverting to my early examinations of the crystalline deposits of arsenious acid as obtained on a flat surface, I may state that I encountered many forms and appearances which I was not able to explain to my own satisfaction. When viewed by transmitted light, a large proportion of the crystals wore the appearance of dark squares, a smaller number of dark oblong figures, a still smaller number of long, thick, black lines. These latter, the long lines, I took to be the acicular or prismatic crystals described in books. The dark squares and oblongs were not so readily explained. Then, again, I encountered among the crystals transmitting or reflecting light, in addition to forms which might be merely different attitudes or postures of the regular octahedron, or of the truncated octahedron, or of the lengthened octahedron, well-formed triangular prisms, terminated at either end by triangular facettes, also twin-crystals or *mâcles,* also equilateral triangles resting on half the adjoining triangle as a base. I will not take up your time further by specifying all the forms which at first puzzled and perplexed me. Suffice it to say that, in the full consciousness that I did not understand the things I saw, I determined to turn for awhile from nature on the small scale to art on the large. I procured octahedra of wood, and not being satisfied with them, prevailed on Messrs. Powell, of Whitefriars, to make me the crystals of glass now before you. By studying these large models, placing them in all sorts of positions, and viewing them from different points and in different lights, I was prepared to understand most of the appearances under the microscope. The broader shadows of the transparent glass crystals were reproduced in the small crystals of arsenious acid, and the several postures which I caused the large crystals to assume were recognisable under the microscope. I found that the sublimed crystals adhered to the flat surface of glass by their solid angles, by their edges, and by their faces, as well as in positions less easily described. I also inferred that the dark squares were crystals (octahedra) adhering to the glass by their solid angles, in which position, as my glass model taught me, the play of lights and shadows was such as to occasion confusion and possible darkness. This suspicion, which was strengthened somewhat when I examined the sublimates by reflected light, became certainty under the binocular microscope. Under that admirable instrument, with reflected light, there are no dark masses, and no obscure forms. The meaning of the dark oblong forms and of the dark lines which I at first identified with the acicular or prismatic crystals of authors did not occur to me till later in my inquiries.

I have mentioned the frequent occurrence of the three-sided prism with bevelled extremities. I do not mean the figure sometimes described as a lengthened octahedron, but a figure having the deceptive appearance of a triangular prism. Was this a distinct crystalline form, or might it not be some aspect of the octahedron? It obviously could not be brought about by any attitude of the whole crystal; but my wooden model, supplied by Professor Tennant, is cut in half by a plane parallel to, and equidistant from, two of its faces, and these two equal halves of the-crystal are made to rotate on each other, so as to show the twin-crystal, or *mâcle.* Here, then, without supposing any new form of crystal, there was new material for speculation. I had seen the twin-crystal, or *mâcle;* in almost every specimen I examined. Hence, it was clear that half-crystals were among the possibilities of arsenious acid sublimed. Well, this half-crystal which I was soon encouraged to have made in glass, when placed in a certain position, gave me the precise figure which had perplexed me; it gave also the equilateral triangle with the half adjoining triangle for its base (one of the commonest crystalline forms); also, the half-triangle itself; also the hexagon, and the hexagon tipped with three small, dark, triangular facettes.

Now this appearance of a triangular prism, terminated at each end with an equilateral triangle, is given by the tilting forward of the half-crystal; and just as the whole crystal adhering by a solid angle becomes by transmitted light a dark square, so this half-crystal appears as a dark oblong.

But the long dark lines which I had taken for needles or prisms, what were they? Possibly not distinct and separate crystals, but only deceptive appearances like the dark squares and oblongs. Could they be the forward edges of large deep plates, owing their dark appearance to the same depth of crystalline mass? It was reserved for the binocular microscope to demonstrate this. On examining with this instrument a vast number of specimens, and passing under review thousands and thousands of crystals, I find many large hexagonal plates with their edges thrown forward, but very few prismatic crystals. I also find triangular plates of various thickness, square plates also of varying substance, and a few rhombic and rhomboidal plates. But my catalogue is not yet exhausted. Before I made use of the binocular microscope, I thought that I had encountered one or two cubes; but as the assertion that I had met with cubes was received somewhat incredulously, I looked for them in the field of the binocular with great interest. I found several figures which approached very closely to the cube, and in one instance encountered a perfect cubical crystal. I say this without any sort of hesitation. I have also more frequently met with the rhombic dodecahedron, and its *mâcle*, or twin-crystal. I have not yet seen a tetrahedron; though in one specimen obtained from Scheele's green, and abounding in triangles less symmetrically formed than usual, I thought that I discerned the marks of the tetrahedron. Be this as it may, I am quite sure that this form of crystal should be set down among mere possibilities: I have not seen it in any one of many hundreds of specimens of crystalline deposit obtained from arsenious acid itself, or from the metal arsenic. It is probable that the deep triangular plates, which abound in some specimens, have been taken for tetrahedra.

I have now briefly sketched the course of experiments, observations, and inferences by which I was gradually possessed of my existing knowledge of these interesting crystalline forms. Something I learnt from actual examination; such, for instance, as the common appearances of the perfect octahedron, and the fact of the existence of plates of various forms, as well as of crystals other than the octahedron. Something more I learnt by inferences drawn from the close examination of models of the crystal and half-crystal, opaque and transparent. I understood at once the twin-crystal, or *mâcle*. I inferred that the equilateral triangle mounted on a half-triangle as its base, the hexagon with three-shaded points, and the triangular prism were merely phases of the half-crystal; and I thought it likely that some of the detached equilateral triangles and some of the hexagons might be explained in the same manner. But I remained quite satisfied with the belief that a considerable number of the long narrow crystals were prisms. I was not quite satisfied of the existence of triangular plates or of hexagonal plates. I spoke doubtfully about cubes, and had not been able to make out the rhombic dodecahedron; and I felt that my views concerning the large part played by the half-crystal, though highly probable, were still only probable. But under the binocular microscope all my doubts were dissipated, all my errors corrected, some surmises confirmed, and most of my inferences justified. That which had been a work partly of observation, and partly of reasoning, became a simple matter of sensation. If there is any one who doubts the value of this form of the microscope, or is disposed to treat it simply as a philosophical toy, I will ask him to examine these crystals with the monocular microscope by transmitted light, and with the binocular microscope by reflected light; and I would especially commend to his attention the crystalline and globular sublimate (crystals of arsenious acid, and globules of metallic arsenic) shown in the capillary reduction-tube. The fine relief and perfect roundness of the tube and its contents is, at one and the same time, a proof of the utility and of the faithfulness of the binocular microscope.

With a view to give completeness to this paper, I will first briefly describe and illustrate by appropriate engravings, corresponding with the large diagrams and models shown at the meeting, the various attitudes and appearances of the entire octahedron and of the half-crystal, as deduced from the study of models of wood and glass,* and then exhibit some

* Since the paper was read, I have added studies of the rhombic dodecahedron, similar to those of the octahedron which were shown in the diagrams exhibited at the meeting. This addition goes far towards exhausting the crystalline forms of sublimed arsenious acid.

of the leading forms as seen under the monocular microscope by transmitted light, and under the binocular microscope by reflected light. I also append, at the desire of the editors of the Journal, a short account of the best mode of obtaining the crystals of arsenious acid for microscopic examination.

1. *The entire crystal.*

a. The crystal adhering by one of its edges, and displaying two sides (fig. 1).

1


b. The crystal adhering by one of its faces, and displaying three sides (fig. 2).

2


c. The crystal adhering by one of its faces, and so seen as to display four sides (fig. 3).

3


d. The crystal adhering by a solid angle, so as to show four equal faces (fig. 4). In this position the crystals appear by transmitted light as black squares.

4

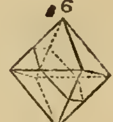

e. The crystal adhering by one of its faces, and showing the lights and shadows of the transparent model (fig. 5).

5

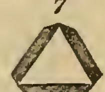

2. *The half-crystal.*

The regular octahedron may be divided into two symmetrical bodies—

1. By a plane parallel to two faces of the crystal (fig. 6).

6


The sections thus formed are bounded by a hexagon and by an equilateral triangle, and they have the appearance shown in fig. 7.

7


2. By a plane passing through four edges of the crystal, each section being a four-side pyramid on a square base (fig. 8).

8


3. By a plane cutting the equilateral triangular faces of the crystal into two equal right-angled triangles, each section presenting a rhombic face (fig. 9).

9


The first section supplies the following forms:

a. The equilateral triangle (fig. 10).

b. The equilateral triangle resting on half the adjoining triangle as a base (fig. 11).

10

11

This is a very common aspect of the half-crystal.

c. The hexagon. (fig. 12.)

d. The hexagon with the three small triangular facettes in shadow (fig. 13).

12

13

This also is a very common aspect of the half-crystal.

e. The half-triangle (fig. 14.)

f. The edge of the half-crystal tilted forward, so as to give the appearance of a triangular prism (fig. 15).

14

15

This again is a very common aspect of the half-crystal.

16

17

g. The *mâcle* or twin-crystal, formed by the partial rotation of two half-crystals on each other (fig. 16).

h. The same, with the triangular face of one half-crystal visible (fig. 17).

The second and third sections are of rare occurrence, and do not assume appearances requiring more minute description.

3. *The rhombic dodecahedron.*

18

a. Three sides visible, so as to resemble the perspective of a cube (fig. 18).

19

b. Four sides visible, and a solid angle projected forward (fig. 19).

20

c. Five sides visible (fig. 20).

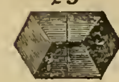
21

d. Five sides visible; another aspect of the crystal (fig. 21).

22

e. Six sides visible (fig. 22).

23



f. The *mâcle* or twin-crystal of the rhombic dodecahedron (fig. 23).

24.

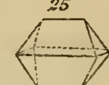
g. The *mâcle* or twin-crystal; another view (fig. 24).

Having now figured some of the leading appearances which the models of the octahedron and rhombic dodecahedron, with their half-crystals, may be made to assume by changes of position, I proceed to give a brief summary of the crystalline forms which I have been able to distinctly recognise in the course of my examinations of the sublimates of arsenious acid.

1. The crystalline sublimates of arsenious acid consist of regular octahedra, rhombic dodecahedra, cubes, plates, and prisms.

2. The regular octahedra may be entire and homogeneous, or they may be variously truncated and notched, mottled and figured; and they may assume any of the forms depicted in figures 1, 2, 3, 4, and 5.

25

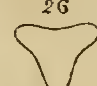


3. The entire regular octahedron may also be modified as in the annexed engraving (fig. 25).

4. The octahedron may present itself as a half-crystal in any of the forms depicted in figures 7 to 15, inclusive.

5. The half-crystals may be combined to form *mâcles,* or twin-crystals, as in figures 16 and 17.

26



6. The entire crystal and the half-crystal may have their edges notched, so as to yield figures resembling the trefoil, or *fleur-de-lis,* as in the annexed figure (fig. 26).

7. The rhombic dodecahedron may present itself entire in any of the forms depicted in figures 18 to 22.

8. The rhombic dodecahedron may present itself as a half-crystal; and two half-crystals may be united to produce the *mâcles,* or twin-crystals depicted in figures 23 and 24.

9. The cube is a very rare form among the crystals of arsenious acid.

10. The plates present themselves as hexagons, equilateral triangles, squares, rhombs, and rhomboids; and they may be of any thickness, from that of thin iridescent films, to the

third or the half of the diameters of the faces of the plates. They may also greatly exceed in size the largest crystals of the groups in which they are found. The principal forms are shown in the annexed figure (fig. 27).

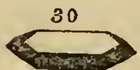
27

28

11. Sometimes compound plates of large size and symmetrical form are found united at angles corresponding with those of the faces of the octahedron, as in fig. 28. At other times they are grouped with great irregularity. In other instances plates, such as the equilateral triangle, are found built up by a hexagonal plate symmetrically joined to three equilateral triangles, as in fig. 29.

29

30



12. The prisms are either four-sided prisms of small size, or they are large four-sided rectangular prisms terminated by four-sided pyramids (fig. 30).

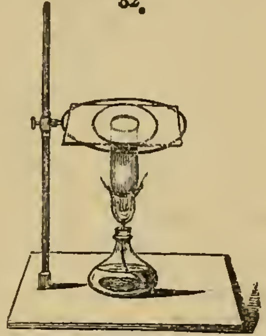
31

13. Sometimes the prisms are shorter, and present the form depicted in the subjoined figure (fig. 31).

To this detailed description it is only necessary to add that there is great variety to be found in groups of crystals of arsenious acid produced at the same time and in the same way. In some groups the crystals are perfect, free from spot or blemish, transparent, and brilliant; in others, notched or truncated, mottled and figured, and translucent; in some the regular octahedron is the prevailing form, other forms being exceptional; in others, plates predominte, and are nearly as numerous as the crystals themselves; occasionally equilateral triangular plates occupy the whole field, to the exclusion of almost all other forms. The lithographic plate (Pl. VI) appended to the paper, and showing the sublimates as they appear by the monocular and binocular microscope, by transmitted and reflected light, will give some idea of the variety of forms which the crystals assume.

The best mode of obtaining the crystals of arsenious acid may be described in a few words. The apparatus required consists of a spirit-lamp with small flame, specimen tubes of small diameter and not exceeding an inch in length, and slides or discs of crown glass. A few grains of arsenious acid are placed in a clean and dry specimen tube, and this in a convenient holder, consisting of a slip of copper or brass punched or drilled to receive it. The tube is to be held over the flame of the lamp till the acid collects as crystals, or as a white powder, round the orifice of the tube. The slides or discs are then to be heated in the flame of the lamp, so as to drive off the moisture, and raise considerably the temperature, of the glass. The slide or disc, thus heated, is to be placed over the mouth of the tube, and kept there till bright spots appear on its under surface. The spirit-lamp is then to be removed, and the glass allowed to cool. The process may be conducted with the two hands over the lamp, or the holder may be supported on a retort-stand, as is shown in figure 32, and the spirit-lamp removed for a time after each operation. Good results can only be obtained when the slide or disc is heated; but if too much heat is used, the crystals are dissipated as soon as formed. When the operation is quite successful, we obtain one of the most beautiful of microscopic objects, and one of the very best illustrations of the value of the binocular microscope as a means of identification and diagnosis.*

32.



On a New Hemispherical Condenser *for the* Microscope, *and its use in illustrating an important principle in Microscopic Illumination.* By the Rev. J. B. Reade, F.R.S.

(Read May 8th, 1861.)

The condenser which I am now using has been so favorably received by several of my friends, that I am induced, at their request, to offer a description of it to the members of our society. I need scarcely say, that an unpretending single lens cannot be proposed as a rival to the almost perfect combinations in use among us; but it may, perhaps, take its place as an efficient adjunct to the microscopes of those observers who are disinclined, from one consideration or another, to procure more expensive apparatus.

The condenser consists of a hemisphere of glass, about one and three-quarter inches in diameter, with an arrangement of stops by which difficult test objects are well defined under half-inch object-glasses of 90° aperture. It is set in a thin brass ring, and screws upon a cylinder adapted, like other fittings, to the opening of the sub-stage of the microscope.

* For a more detailed description of the mode of obtaining crystals of arsenious acid, consult a paper in 'Beale's Archives,' No. III, 1858, and the second edition of my 'Principles of Forensic Medicine,' in which several of the forms depicted here will be found figured.

The hemisphere in question has been many years in my possession, though I did not apply it to the table microscope until February, 1860. It happened to be one of the lenses which Mr. Chamberlain, the optician, called "a sporting lot;" and I may say, that on more than one occasion I have successfully used it in following optical game. In the year 1837 it did me good service when connected with the condensing lens of a solar microscope, inasmuch as it gave me great light with little or no heat, and thereby prevented all risk in the use of *achromatic object-glasses* and objects mounted in balsam.

The arrangement for this purpose is as follows:—A beam of solar light, containing both colorific and calorific rays, was transmitted through the condensing lens of the instrument; and, owing to the different refrangibility of these components of the beam, we have a cone of light-giving rays formed within a cone of heat-giving rays, and the principal focus of heat is further from the lens than the principal focus of light. But when these rays cross the axis, the cone of heat-giving rays lies within the cone of light-giving rays; and, if the hemispherical lens be placed in these second cones, at the distance of its own focal length from the principal focus of heat, it will be at a greater distance than its focal length from the principal focus of light; and, consequently, the rays of heat will be rendered parallel, while the rays of light will converge to a second focus, exhibiting great intensity of illumination, but without any sensible heat.

I have approximately measured the heating power of the calorific rays in the second cone, when rendered parallel by the hemispherical lens; and I found, in the month of December, that the mercury in a sensitive thermometer, when placed in the second focus, did not reach 90° Fah., while, at the same time, the heat in the focus of the first cone was sufficient to discharge gunpowder.

The admirable drawing, by Lens Aldous, of the magnified head of a flea mounted in balsam, from which his well-known lithograph was made, is a good illustration of the practical value of this application of the lens; and it is probable that a cemented achromatic object-glass was then, for the first time, used with safety in the solar microscope.

I also used the hemisphere, with a central disc of tinfoil upon its plain surface, as a means of obtaining a black-ground illumination in the solar microscope; and nothing can exceed the beauty of the brilliant tint of the *Volvox globator* and *Hydra viridis* under this arrangement. I found it impossible, however, to take a photograph of these objects under this illumination, though with direct solar light I had no difficulty whatever.

It is probable that a similar application of the hemispherical lens and central stop to the oxyhydrogen microscope, which our variable climate almost compels us to use, would in like manner throw into the pictures on the screen the additional charm of natural colours, and thereby greatly enhance the interest of the exhibition.

Notwithstanding my use of the condenser in the experiments just described, it did not occur to me to extend the application of it, until I was, as it were, driven by necessity. My old parishioners and other kind friends presented me with a valuable microscope at the commencement of last year; and not having, in the first instance, any of the well-known condensers at hand, I used the light of two lamps placed at right angles to each other, and by means of suitable lenses I threw sufficient light on the rectangular markings of the *P. acuminatum* and other similar tests. I was much pleased with the effect of this simple method of illumination; and I am glad to find that Mr. Tomkins has also used it, but with considerable improvement, by employing two achromatic prisms, which give brilliant illumination, while the "marking shadows" are in deep relief.

In order to obtain any proper definition of the markings, I found it necessary so to turn the valve of the diatom, that a line of markings might lie at right angles to a line of light. In fact, in any other position the markings are scarcely visible; and the conclusion seemed forced upon me, that the ordinary spot lens contains in its circle of light a large portion of unnecessary, if not injurious, illumination. With this impression on my mind, it suddenly occurred to me, that my old friend, "the kettle-drum," as Mr. Gravatt calls my condenser, might play an important part, if its plain surface were covered with tinfoil suitably pierced at the circumference for the tranmission of two pencils of light at right angles to each other. I made the experiment, and happily I can fall back upon the testimony of well-qualified observers as to the success which attended it. The direct illumination of only one lamp was now sufficient, and, instead of rotating the object—always a difficult process in the absence of suitable adjustments—it was easier to rotate the secondary stage which held the condenser, and so gain the proper position of the two points of light. It may be well to state, that by taking out the eye-piece, and looking at the points of light down the body of the tube, we may at once, by the rotation of the sub-stage, place them in the right position for illuminating any rectangularly marked valve whose position on the stage of the microscope is known. One point of light must lie over the end of the valve for bringing out the horizontal lines; the other will be opposite the side of the valve, and will act on the longitudinal lines; and resolution into dots or squares will be immediately effected by adjusting the distance of the condenser.

For oblique or diagonal markings, the apertures at the circumference of the diaphragm must no longer be placed at 90° apart, but at such an angle as is indicated by the markings themselves. In the case of the *P. angulatum*, where there are three lines of markings, there must be three apertures, since with two apertures only, we should exhibit, according to their position, any two, and but two, of these three lines, in turn, and, at the same time, give a sort of unnatural elongation to the peculiar markings on the valve. The size of the apertures is 24° at the circumference and opposite side, and $\frac{4}{10}$ths of an inch in the direction of the radius. The latter dimension must be less in diaphragms for smaller hemispheres, and must never exceed half the radius of the condenser.

In order to secure the best effect, the distance between the apertures must be adjusted with considerable accuracy. For this purpose I use a diaphragm of thin brass, or of strong tinfoil, having one aperture only, and by its rotation under a given valve of the *P. angulatum*, for instance, I bring into view the three lines of markings in succession, first the horizontal lines, and then the oblique lines, by rotating the diaphragm to the right and left, and thus the three points at which the apertures are to be made can be determined with the utmost precision. If the aperture for the horizontal lines be made at the distance of 180° from the place thus obtained, these lines will be illuminated on their opposite sides, and the three apertures will be 120° apart, as in the diaphragm first cut out for me by Mr. Waterhouse, who happened to be working with me at the time. But in practice I find it not only better, but indispensable, to illuminate all the markings on the same side, as by the first method, and preserve thereby that uniform direction of the shadows which is the key to accurate definition. A set of diaphragms thus obtained, and a diaphragm with a minute circular aperture in the centre only, for the central adjustment of the lens, complete the furniture of the condenser; and a brass ring sliding outside the top of the cylinder on which the condenser is screwed conveniently holds the diaphragms in their place, and admits of their being readily changed.

In the application of this condenser to the resolution of lined test objects, it will be seen that the principle sought to be carried out is to throw the axis of the pencil of illuminating rays in a direction at right angles to the line to be resolved. In all cases where the precise position of such lines is known, a supplementary diaphragm may be cut with the apertures in their correct mutual positions; but as these position angles greatly vary in different diatoms on the same slide, my friend, Mr. Waterhouse, ingeniously suggests the use of a pair of similar diaphragms overlying each other, and capable of revolution round a common centre. For this purpose the diaphragm next the condenser must be fixed in position, and moveable with the lens, by means of the pinion motion of the sub-stage, while the other is attached to a deep hoop fitted upon the brass tube carrying the lens, so as to be conveniently rotated by the finger and thumb, applied to a narrow milled ring, but sufficiently small to pass through the opening of the second stage, when the condenser is required to be removed for other purposes. To carry out this suggestion, place two diaphragms together, and mark out on their circumference the positions of six adjacent apertures; cut out one aperture, pass over two, and cut out the remaining three; then turn them face to face, so that the small stops between the apertures may coincide, and, by the rotation of one diaphragm upon the other, the stop between two apertures, or little prisms, as they virtually are, may be made to vary from about 30° to 120°. This will be ample scope for all bilinear, oblique, and rectangular markings. This method of arrangement also admits of the introduction of a third aperture for the *P. angulatum*, &c., and the whole diaphragm system is thus brought within the least possible compass.

The lens in its present form is simple, cheap, and easy of adjustment, though of course not free from chromatic aberration; but the proper adjustment of the apertures to the object examined seems to prevent this error from being very apparent, and a pierced diaphragm beneath as well as upon the condenser has advantages in this direction, as well as occasionally in others. The central pencil of about $\frac{1}{20}$th of an inch in diameter, which gains intensity from the construction, is itself virtually achromatic, and is also very effective for direct central illumination where obliquity is not required, or would be injurious.

The angle of aperture of the lens is necessarily small; and therefore I cannot help thinking, with Mr. Tomkins, that if it were possible by the application of rotating pierced diaphragms to stop out the light *in the right place* of a Gillet's, or perhaps still better, from its greater angle of aperture, a Powell's condenser, we should approach perfection in resolving difficult markings under the deepest powers.

My old black-ground illumination, which led to the formation of valuable condensers by Messrs. Shadbolt and Ross, may be produced with very good effect by the hemisphere and a single aperture; and I feel sure that the members of our society will be much pleased with the brilliant definition and detail of a scale of Podura under this illumination and the half-inch object-glass. I have in my possession the same scale which my old and valued friend, Andrew Ross, saw with his first achromatic $\frac{1}{8}$th, in his little workshop at St. John's, Clerkenwell, and I shall never forget the expression of his astonishment. But the present half-inch is superior in all respects to that $\frac{1}{8}$th.

It is now generally known that I offer the hemispherical condenser as the special adjunct of the new half-inch object-glass of 90° aperture. Mr. Thomas Ross sent me his first object-glass of this new construction, for examination and report; and I believe, like many others, he hesitated to give implicit credence to my account of its working. As he was ignorant of the power of the "kettle-drum condenser," he thought that the asserted resolution of that old microscopic nebula, the *P. angulatum*, under so low a power as a half-inch, even of large aperture, indicated the partiality of friendship rather than the severity of honest criticism. Accordingly I was summoned before a microscopic jury, consisting of Messrs. Leonard, Millar, Lobb, and Roper; and after sufficient and careful examination, Mr. Leonard, as the judge, decided that I might "take a rule *nisi*."

As the half-inch and the condenser had not only not flinched from any fair work, but had even trespassed on the domain of the $\frac{1}{4}$th and the $\frac{1}{8}$th, I thought that I would show at last what they could not do; and therefore, without the slightest expectation of taking anything for my pains, I placed on the stage of the microscope a slide of the Amician test, the *Navicula rhomboides*, which was kindly presented to me by Mr. Powell, whose fine $\frac{1}{16}$th, with its unequalled achromatic condenser, reveals the exquisite skill which is bestowed on this almost invisible work of the great Creator. It does one good, both mentally and morally, to review such a work as this; and, to my astonishment and delight, I witnessed its resolution under my new arrangement. It is necessary, in this instance, to use a deep eye-piece for attaining the requisite amplification; and as eye-pieces are instruments for measuring the imperfections of object-glasses, this result led to a definite opinion as to the quality of the power employed.

I will only add, that when combined with the hemispherical condenser and the whole series of eye-pieces, the new half-inch is a battery of microscopic powers, and will be a good substitute, in case of slender purses, for the $\frac{4}{10}$th, $\frac{6}{10}$th, $\frac{1}{8}$th, and other fractions. I may therefore be permitted to congratulate our society on the valuable results consequent upon the attainment of almost unlimited aperture, combined with perfect flatness of field, in powers as low as the $\frac{1}{2}$ and $\frac{4}{10}$th; and let it not be forgotten, that English opticians still take the lead in these improvements, which should yield honour as well as profit to themselves.

On the SEED *of* DICTYOLOMA PERUVIANA, D.C., &c.

By HY. B. BRADY, F.L.S.

(Read June 12th, 1861.)

THERE are few points of greater interest to the microscopist, or that better repay his attention, than the external character of the seeds of plants. Many, from their mere superficial beauty, have become popular show-objects; but a deeper interest is awakened, and an almost boundless field of investigation is suggested, by such phenomena as those presented by the peculiar spiral cells of the testa of Collomia, Ruellia, or Salvia; the curious hairs from the seeds of Cobæa or Acanthodium; the beautiful surface markings on those of Papaver, Lychnis, or Silene; the coma of Hoya and other Asclepiads; or the membranous wings so common amongst the Bignoniaceæ. That there are many new and valuable facts to be gathered from a systematic study of these structures, no one who has given much attention to them can doubt, and I only regret that my own observations, though extending over a considerable time, have as yet been too desultory and disconnected to be of much practical value. Recently, however, a specimen was placed in my hands so peculiar in some of its characters that I have thought it might properly form the subject of a short notice.

The seed of *Eccremocarpus scaber,* a half-hardy climbing plant, common in our gardens, is familiar to most as a microscopic object; but as an acquaintance with this will render the rest of my paper more intelligible, I may be allowed to advert to it in a few words.

When mature, it is a roundish or kidney-shaped seed, about a quarter of an inch in diameter, thickest at the centre, and gradually thinner towards the outer edge, which we find expanded into a thin, membranous wing (Pl. VII, fig. 5). Careful examination shows that the cells on the outer layer of the testa, which appear on the body of the seed in the form of irregular projections, are, towards the circumference, excessively developed, especially in length, and it is in this way that the expansion alluded to is formed. The *side* walls of these elongated cells become much thickened in the process of growth, thus affording to the wing the necessary strength and firmness, whilst the *front* and *back* walls retain their original transparency, being marked only by a very delicate subspiral deposit. A glance at the accompanying sketch (fig. 6) will supply any deficiencies of this verbal description.

This introduction will, I trust, render intelligible the more complicated structure which is observable in *Dictyoloma Peruviana*. A general idea of this beautiful seed may be gathered from fig. 1. Endlicher's description of it, which is very defective and partially incorrect, runs thus:—"*Semina late reniformia, compressa, dorso in alas duas parallelas radiatim reticulatas, fibra marginali connexas expansa, sinu ventrali umbilicata.*" As we may infer from the above, it is broad, kidney-shaped, and flattened. Besides possessing a wing formed in a similar manner to that of Eccremocarpus, by the expansion of the testa round the edge, there are several succesively smaller, lateral wings in the same plane, the margins of which form a series of concentric rings over either surface of the seed. These smaller wings lie close to the surface, and appear almost like a continuous coat of connected cells; indeed, those nearest the centre seem to be more or less connected through their entire length to the seed itself, the outer extremities only being raised above the general surface, thus keeping up the appearance of concentric rings above alluded to. The alæ, as they approach the circumference, become successively larger, and to a greater extent free. The sectional sketch, fig. 2, represents, as nearly as I can make out from the small materials at my command, the arrangement of the wings.

But perhaps the structure of the alæ themselves is the most remarkable feature in the case. Each wing appears to consist of a series of radiating fibres connected at their outer margin, the spaces between them being left quite open.

Fig. 3 represents a portion of the outer sets of wings under a higher magnifying power, and this sketch will also serve to show their position with regard to each other. I was some time before I could satisfactorily account for this singular character, and it is only after a number of observations on other winged seeds bearing more or less on my specimen that I am enabled to speak with confidence about it. The separate wings seem to be formed in the manner I have just described in reference to Eccremocarpus. The cells of the outer layer of the testa are developed to a great length, and the *side walls* are thickened in the same way; but the *front* and *back* walls, not being supported by deposit of any sort, are ruptured at a very early stage, and gradually disappear, leaving the *side walls only* as a sort of framework or skeleton. The frequent raggedness of the sides of the fibres is best accounted for in this way, and the appearance of one of the inner wings carefully removed from the seed (fig. 4) fully confirms this view, as it still retains portions of the delicate cell-wall only partially disintegrated. I had hoped that an examination of the ovules in a very early stage would have shown the *outer* wings entire, but in the only flower which I have had an opportunity of dissecting the ovary was too immature to throw any light on the subject. Altogether, the specimen I have described reminds one strongly of the leaf of *Ouvirandra fenestralis*, and though botanically the phenomena are not identical, it loses nothing in interest by such association.

In conclusion, I must acknowledge my thanks to my friend, Professor Oliver, for the specimen from which this notice is written, and Mr. Tuffen West for memoranda from seeds in his own collection bearing somewhat on the present case.

DESCRIPTIONS *of* NEW *and* RARE DIATOMS. SERIES II.

By R. K. GREVILLE, LL.D., F.R.S.E., &c.

(Read June 12th, 1861.)

RYLANDSIA, n. gen., *Grev.* and *Ralfs.*

FRUSTULE simple, disciform, cellulose; disc with smooth rays, dilated at their base, and not reaching the centre. (No umbilical lines nor hyaline area.)

This remarkable genus appears to belong to the group represented by *Asterolampra,* but differs essentially in the absence of umbilical lines and of the hyaline area, so conspicuous in all the discs referred to that genus. In the only known species of the genus now proposed, the valve is cellulose, very much in the manner of *Coscinodiscus radiatus;* and the rays, two in number, have their dilated bases separated by a considerable interval, and have no connection whatever with each other. This singular diatom is worthily dedicated to my friend Thomas George Rylands, Esq., of Heath House, Warrington, a very acute observer, who communicated it to me soon after its discovery by Mr. Ralfs.

Rylandsia biradiata, n. sp., Grev. (Pl. VIII, fig. 1).

Hab. Barbadoes deposit, very rare; John Ralfs, Esq., T. G. Rylands, Esq., Dr. Greville.

A considerable number of specimens of this curious disc have now been seen, and it is satisfactory to know that it is quite constant to its characters. The cellules in the centre of the valve between the bases of the rays are large; they then suddenly become smaller, and decrease gradually in size as they radiate to the circumference. The rays are broadly cuneate at the base, and linear as they reach the margin; they appear to be tubular, as in *Asterolampra,* and a faint shadow indicates the continuance of this structure through the middle of the dilated bases. In a single instance the two valves occurred *in situ,* the rays of the lower crossing those of the upper valve.

Coscinodiscus.

Coscinodicus symmetricus, n. sp., Grev.—Granules radiating, distinct, all equal and equidistant; seven of the radiating lines extending from the centrical granule to the circumference; margin striated. Granules 10 in ·100″; marginal striæ 15 in ·001″. Diameter ·0031″. (Pl. VIII, fig. 2.)

Hab. Barbadoes deposit; excessively rare.

One of the most beautiful of the granuliferous group of *Coscinodisci,* and well characterised by the equal distribution of the granules. It is also distinguished by the manner in which the radiating lines are arranged. From the central granule proceed seven long lines, and within the compartments so formed the next two longest are disposed, one on each side, so as to form two equal sides of the triangle, and so on until the whole space is filled up.

Cresswellia.

Creswellia superba, n. sp., Grev.—Valves hemispherical, depressed, with a broadly expanded hyaline margin; areolation large; connecting processes robust, spine-like, situated nearer to the margin than the apex. Diameter ·0024″ to ·0054″. (Pl. VIII, figs. 3, 4, 5.)

Hab. Barbadoes deposit; frequent.

A splendid species, with very large areolation. Average specimens possess from six to eight connecting processes, but examples occur with from four or five, up to the giant represented at fig. 5, with nineteen. I have never seen Ehrenberg's *Stephanopyxis diadema;* but if Kutzing's definition be correct, "disci medii depressi annulo dense denticulato"—my present diatom must be distinct. Kutzing, besides, gives the number of teeth in the crown as thirty, whereas it is a very rare circumstance indeed to see so many in *Cresswellia superba* as appear in fig. 5.

EUODIA.

Euodia Barbadensis, n. sp., Grev.—Frustules semilunate, ends slightly produced, lower margin straight; surface cellulose, with a small, irregular, central blank space. Distance between the angles ·0015″ to ·0020″. (Figs 6, 7.)

Hab. Barbadoes deposit; extremely rare.

Valve yellowish; short, vein-like lines are given off from the margin, sufficiently conspicuous in the larger specimens, but less so in small ones. The upper margin is conical-convex, so as to give the frustule very much the outline of a cocked hat. Cellulation rather large, but under a low power appearing as granules.

TRICERATIUM.

Triceratium cornutum, n. sp., Grev.—Valve (4-angled?) with straight sides and sharp angles furnished with strong, horn-like processes; surface minutely granulose, in lines radiating from the centre, on which are three spines; granules at the margin 15 in ·001″. Distance between the angles ·0015″. (Fig. 8.)

Hab. Barbadoes deposit; excessively rare.

The only frustule, a very perfect one, which has come under my notice, has four angles with exceedingly strong, horn-like processes, which, as they cast a dark shadow, render the frustule conspicuous. The granules are very minute in the centre, but increase in size as they radiate to the margin. It is quite distinct from the few species already described, having spinous lateral surfaces.

Triceratium productum, n. sp., Grev.—Valve punctate;

angles produced, capitate; centre divided into compartments by radiating, vein-like veins. Distance between the angles ·0027″. (Fig. 9.)

Hab. Barbadoes deposit; excessively rare.

This beautiful species is evidently related to *T. truncatum* and *T. venosum;* to the former very closely, while, at the same time, it is abundantly distinct; the truly capitate, produced angles taking the place of the broad, truncate angles of that diatom.

Triceratium inconspicuum, n. sp., Grev.—Minute, sparsely punctate; angles of the valve semicircular, subtruncate, separated from the centre by a transverse line; centre bordered with a row of puncta. Distance between the angles ·0005″. (Fig. 10.)

Hab. Barbadoes deposit; excessively rare.

Of this exceedingly minute species I have seen half a dozen specimens, all of which have four angles. In its characters it comes very near to some varieties of *T. brachiatum*, but is separated by its size alone, which scarcely exceeds that of *T. exiguum.*

Triceratium delicatum, n. sp., Grev.—Minute; valve with slightly concave sides and broadly rounded angles filled up with transverse rows of fine puncta; centre containing a pale, obtusely triangular band, within which is a triangular spot, bordered with puncta. Distance between the angles ·0012″. (Fig. 11.)

Hab. Barbadoes deposit; excessively rare.

A minute species, difficult to define in few words. The eye is first impressed with the pale (blank), triangular band, which exactly fills up the centre of the valve by the angles reaching to the concave margin, and, consequently, separating the angles of the valve from the parts within. In the central spot, which is edged with a row of distinct puncta, I have been unable to trace any particular structure. A peculiar feature in this little diatom is a considerable space between the sides of the pale band and the transverse rows of puncta which occupy the angles. These puncta also gradually decrease in size as they approach the apex.

Triceratium labyrinthæum, n. sp., Grev. — Valve with rounded angles and somewhat convex sides, the centre having a network of flexuose, widely anastomosing, vein-like lines, the inclosed spaces being finely punctate. Distance between the angles ·0023″. (Fig. 12.)

Hab. Barbadoes deposit; excessively rare.

Of all the curious *Triceratia* which have been discovered in this inexhaustible deposit the present species is one of the most remarkable. About half a dozen examples have been observed. The interval between the margin and the central labyrinth of lines is blank, with the exception of a few short, vein-like lines given off from the central network, some of which nearly reach the margin. In this, as in many other instances, a figure will convey a better idea of the object than the most elaborate description.

Triceratium areolatum, n. sp., Grev.—Valve with slightly concave sides and acute angles; surface covered with rather large, circular areolæ, while very short, vein-like lines project from the sides of the valve. Distance between the angles ·0026″. (Fig. 13.)

Hab. Barbadoes deposit; extremely rare.

I do not know any member of the genus with which this diatom can be compared, unless it be *T. acutum*, Ehr., with which it agrees in the rather peculiar areolation. From that species, however, it differs in the sides of the valve being decidedly, although slightly, concave, and in the angles not being in the smallest degree elongated. The short, vein-like lines present, in addition, a conspicuous differential character. Nevertheless, I am not certain of its being distinct.

Triceratium tessellatum, n. sp., Grev.—Valve with straight sides and rounded angles, somewhat convex in the centre; surface filled with subquadrate, large, more or less concentric granules, becoming smaller at the angles; margin with a row of minute granules, 11 in ·001″. Distance between the angles ·0025″. (Fig. 14.)

Hab. Deposit on the banks of Pertuxent River, near Nottingham, Maryland, United States.

Distinguished by the large size and more or less square form of the granules, especially those of the convex centre. Smaller granules completely fill up the angles. In some examples the convexity of the centre is scarcely at all apparent.

Triceratium robustum, n. sp., Grev.—Valve with straight or very slightly concave sides and rounded angles with pseudo-nodules; surface filled with irregularly shaped, coarse granules, those in the circumference of the convex centre and at the angles small, the rest large. Distance between the angles ·0030″ to ·0040″. (Fig. 15.)

Hab. Cove, Calvert County, Maryland, United States.

A strong, coarse-looking species, with a large, clear, pseudo-nodular space at the angles. The granules are very irregular, small ones being often mixed with the large ones. Sometimes a concentric arrangement is conspicuous, but in other cases it is very partial, being most distinct between the convex centre and the angles, where also the largest granules occur. This diatom is subject to occasional distortion, several examples having occurred to me in which the sides were of very unequal lengths.

Triceratium Browneanum, n. sp., Grev.—Small; valve with straight sides and rounded angles with obscure pseudo-nodules; surface filled up with small, round, equal, irregularly disposed granules. Distance between the angles about ·0020″. (Fig. 16.)

Hab. In mud, Savannah, Georgia, U.S.

Probably not a rare species, as it occurs tolerably abundantly in a slide kindly communicated to me by my friend, Mr. George Mansfield Browne, of Liverpool. It is well marked by the equal size throughout the entire valve of the round granules, which, although not crowded, are rather closely situated. The angles are thickened, but can scarcely be said to possess a pseudo-nodule.

Triceratium ? blanditum, n. sp., Grev.—Sides of valve deeply concave; angles broadly rounded; centre with a small, blank space; granules conspicuous, subremote, equal, forming straight, equidistant, parallel lines. Distance between the angles in the four-angled frustule ·0020″. (Fig. 17.)

Hab. Barbadoes deposit; excessively rare.

A very striking object, which I introduce with some hesitation as a *Triceratium*. *Amphitetras*, however, is now admitted to be separated from that genus by a very slender line. I have seen only two frustules, both of which are four-angled, and very conspicuous for the equal size of the granules, their equidistance, and the perfectly straight, parallel lines in which they are arranged. The small, circular, blank space is only defined by the absence of granules. There is also a small, vacant space opposite to each concavity of the valve. This species may have some affinity with *Amphitetras parallela* of Ehrenberg, found in a fossil state in Greece.

COCCONEIS.

Cocconeis Grantiana, n. sp., Grev.—Very minute; valve elliptic, smooth, with a slender median line and nodule, the margin furnished with a moniliform row of large, oblong granules. Length ·0011″. (Fig. 18).

Hab. On marine shells, Macduff; John Grant, Esq.

A beautiful little object, the smooth disc rendering the marginal row of brilliant, bead-like granules more conspicuous. Mr. Grant, to whom I am indebted for a specimen, aptly compares the entire frustule to a jeweller's ornament set with gems.

Cocconeis granulifera, n. sp., Grev.—Minute, elliptic-oblong, with a median line and rather large nodule; disc with remote radiating lines of large, oval granules (three in each line), reaching from the median line to the margin. Radiating lines 5 in ·001″. Length ·0015″. (Pl. VIII, fig. 19.)

Hab. On Pectens, Carrickfergus; John Grant, Esq.

The characteristic features of this little species are the very large granules, the small size of the valve being considered (three only being found in each line), and the distance between the radiating lines themselves, there being only about thirteen on each side. Both this and the preceding appear to be clearly distinct from all described species.

DESCRIPTIONS *of* NEW *and* RARE DIATOMS. SERIES III.

By R. K. GREVILLE, LL.D., F.R.S.E., &c.

(Read June 12th, 1861.)

BRIGHTWELLIA, *Ralfs*.

Brightwellia elaborata, n. sp., Grev.—Cellules of coronal circle roundish; border composed of uniform, radiating lines, connected by numerous transverse lines. Diameter ·0034″. (Pl. IX, fig. 1.)

Hab. Barbadoes deposit; excessively rare.

This exquisite diatom bears a considerable general resemblance to *Brightwellia Johnsoni* of Ralfs, MS., being of the same size and having a very similar coronal circle of large cells. But an essential difference is found in the structure of the border. In *B. Johnsoni* it is composed of radiating lines of round cellules, which decrease in size from the corona to the margin, where they are quite minute; while at irregular intervals dark, strong, radiating lines occur, which appear to project like a spinous ridge, as in my *Coscinodiscus armatus*. In the present species, on the contrary, the border is formed by a close series of straight, uniform, radiating lines, connected by transverse (or concentric) lines or bars, which thus produce rows of quadrate cellules, increasing in size from the coronal circle to the margin. Two of the radiating lines, with their connecting bars, might not unaptly be compared to a microscopic ladder.

This beautiful genus appears to be a very natural one; its characteristic feature being the coronal circle of large cellules, and the curved or spiral arrangement of the cellules within the circle. The typical species, *B. coronata,* has never, I believe, been found entire, the greater portion of the border being always absent. On two occasions only have I obtained a fragment in which, along with part of the corona, was a portion of perfect margin. Do the coronal cells in this species invariably retain their oblong character? Examples have certainly come under my notice in which they were more round than oblong, but I unfortunately omitted to mark them. It is, however, by no means improbable that the valves referred to may belong to an undescribed species.

Triceratium.

Triceratium notabilis, n. sp., Grev.—Large. Valve punctate, with straight sides; angles broad, much produced, dilated, oblong or somewhat rhomboidal, with a conspicuous pseudo-nodule; centre convex, with radiating puncta and several spines. Distance between the angles ·0025″ to ·0040″. (Figs. 2, 3.)

Hab. Barbadoes deposit; rare.

Of this fine diatom above a dozen examples, including broken specimens, have come under my observation. It is evidently related to *T. coniferum,* but is a much larger species, and conspicuous for the very produced angles, which are equal in length to the straight sides of the valve. The prevailing form of the angle is rhomboidal, but it is occasionally oblong, as in fig. 3. The centre of the valve is convex, and the puncta radiating as in *T. coniferum,* a character omitted to be brought out in the figure of that species in the 'Microscopical Journal.' The centre is also furnished with spines, no fewer than seven being present in fig. 3, while in the specimen represented at fig. 2, two are situated at the base of each angle. The Barbadoes deposit has yielded me several other frustules, which form a highly characteristic little group, of which *T. coniferum* may be regarded as the type, but whether some of them ought to be considered species or mere varieties is extremely difficult to say. They all agree in the radiating punctation, convex centre, spines, and pseudo-nodules, but differ considerably in form and relative proportions. Of these diatoms figures will be given on a future occasion.

Triceratium microcephalum, n. sp., Grev.—Valve with convex sides and slender, produced, subcapitate angles, furnished with pseudo-nodules; entire surface, except a small, central, circular space, minutely punctate. Distance between the angles ·0026″. (Fig. 4.)

Hab. Barbadoes deposit; excessively rare.

In general outline this species bears a close resemblance to *T. productum* of my Series II, but differs essentially in the absence of all vein-like lines. From *T. capitatum* of Ralfs it is removed by the much larger size, shorter angles, the absence of spines, and by the minute and close punctation of the whole surface.

Triceratium insignis, n. sp., Grev.—Large. Valve with concave sides, and broadly rounded angles, furnished with minutely punctate pseudo-nodules; surface filled with radiating lines of minute, distinct granules, except a small, central, blank space; margin with short, broad striæ, 9 in ·001″. Distance between the angles ·0034. (Fig. 5.)

Hab. Barbadoes deposit; excessively rare.

A remarkably fine and ornate species, possessing most distinctive characters. At first sight the angles have the appearance of being separated from the centre by a transverse line, but this is not the case. The effect is produced by the radiating lines of granules curving up the prominent angles, and being viewed, as it were, in prospective, the extremities of the lines form a transverse row of dark points. A very conspicuous feature in the valve is the termination of what are doubtless strong, broad striæ in the front view, and which are curved over the edge of the valve in the side view. The radiating lines of granules which closely cover the surface do not quite reach the margin, but leave a narrow, blank space.

Triceratium rotundatum, n. sp., Grev.—Small. Valve with deeply concave sides and broadly rounded angles, the ends of which are filled with minute puncta, bordered with a few larger ones; centre blank, surrounded by an irregular, triangular band of still larger granules, between which and the granules of the angles is a transverse, blank space; concave margins, with a few distant, large granules. Distance between the angles ·0020″. (Fig. 6.)

Hab. Barbadoes deposit; extremely rare.

About the size of *T. castellatum* and *T. Westianum*; but the angles do not form segments of circles as in those species, being merely broadly rounded. About six granules compose the marginal row in the concavities of the valve.

Triceratium amœnum, n. sp., Grev.—Small. Valve with straight sides and rounded, incrassated angles; centre somewhat convex, with subremote radiating puncta, which gradually increase in size from the centre to the circumference. Distance between the angles about ·0024″. (Fig. 7.)

Hab. Nottingham deposit, Maryland, U.S.

Not rare, yet I cannot refer it to any described species: It is a neat and brilliant little diatom. The puncta or minute granules are rather distant, the largest being those immediately external to the raised centre; in the angles they again become smaller. The angles themselves are frequently, though not invariably, slightly dilated, as in fig. 7, and are thickened in substance, but no distinct pseudo-nodule is perceptible.

Triceratium obscurum, n. sp., Grev.—Small. Valve thin and delicate, with nearly straight sides and rounded angles; puncta equal, very minute, radiating in straight lines. Distance between the angles ·0024″. (Fig. 8.)

Hab. South Naparima deposit, Trinidad.

Contour exactly resembling that of *T. condecorum*, but the radiating lines of puncta are perfectly straight. The puncta are also somewhat more minute.

Triceratium Harrisonianum, n. sp., Norman and Grev.—Large. Valve with convex sides and slightly produced, rounded angles; pearly granules forming a marginal band of radiating rows, and thinly scattered over the ample central space, in which is a conspicuous network of large, elongated, radiating cellules, sending down lines between the rows of granules to the margin; rows 4 in ·001″. Distance between the angles ·0070″. (Fig. 9.)

Hab. Barbadoes deposit (Springfield Estate); exceedingly rare; George Norman, Esq.

A truly splendid diatom, belonging to a small, very natural group, and, as is frequent in such cases, extremely difficult to define satisfactorily. It may be, indeed, that most of them constitute but one species; and if so, it becomes all the more necessary that they should be carefully figured and described. This I hope to be able to do in a future series. *T. margaritaceum*, described by Ralfs in the last edition of 'Pritchard's Infusoria,' is the only one hitherto published, and, as the first known, may stand as the type. It is comparatively a small species, the distance between the angles being only about ·0030″, often less. All the members of the group, however, possess the same structural arrangement, the central portion of the valve being composed of large, radiating, elongated cellules, which towards the margin become smaller and quadrangular, each of the quadrangular cellules containing a round, pearly granule. In none of the species are these characters seen so conspicuously as in our new *T. Harrisonianum*. The outline of the valve in these species varies considerably. According to Ralfs, the sides of the valve in *T. margaritaceum* are straight or slightly convex, and the angles rounded. In all the specimens I have seen they are straight or very nearly so, but other valves in my possession have the sides decidedly convex, along with a generally distinct aspect at once appreciable by the eye, but difficult to convey in words. Among other characters, the value of which I do not at present venture to estimate, is the slightly produced angle in combination with the more or less convexity of the side, as seen in the present and following species. This feature has not been observed in *T. margaritaceum*, and may eventually be found to facilitate the diagnosis of these most perplexing diatoms.

We have much pleasure in dedicating this fine species to Mr. Harrison, of Hull, who has devoted much attention to the microscopical investigation of the *Diatomaceæ*.

Triceratium giganteum, n. sp., Grev.—Large. Valve with slightly convex sides, and rounded, somewhat produced, angles; pearly granules, forming a marginal band of radiating lines; central space filled with minute, scattered spines. Distance between the angles ·0066″. (Fig. 10.)

Hab. Barbadoes deposit; exceedingly rare; Christopher Johnson, Esq., George Norman, Esq.

Scarcely less splendid than the preceding, and more remarkable on account of the singular spinulose, central surface. It is a robust species, with large, round, somewhat flattened, granules, and a very strong margin. For the specimen in my cabinet, from which my drawing was made, I am indebted to the kindness of my friend, Mrs. Bury. The only other frustule hitherto discovered, so far as I know, is in Mr. George Norman's collection.

AMPHITETRAS.

Amphitetras minuta, n. sp., Grev.—Minute. Valve with deeply concave sides and rounded angles; lines of very minute puncta, radiating from the centre to every part of the circumference. Distance between the angles ·0014″. (Fig. 11.)

Hab. Nottingham deposit, Maryland, United States.

I have seen several frustules of this inconspicuous little diatom, which is extremely liable to be overlooked. All are four-angled, and I venture to place it provisionally in the present genus.

TRANSACTIONS.

Descriptions *of* New *and* Rare Diatoms. Series IV.
By R. K. Greville, LL.D., F.R.S.E., &c.

(Read June 12th, 1861.)

Stictodiscus.

Stictodiscus Californicus, n. sp., Grev.—Puncta equal, large, in rows of a single series; rays obscure, terminating in conspicuous, linear-oblong bases within the broad margin; central puncta somewhat remotely scattered. Diameter ·0038″. (Pl. X, fig. 1.)

Hab. Monterey stone.

A genuine *Stictodiscus*, distinguished from *S. Johnsonianus* (which it resembles in the puncta, being arranged in single rows) by the obscure and much shorter rays, by the broad margin, and linear-oblong bases of the rays. Although the latter are decidedly obscure compared with the same parts in the other species, a careful adjustment shows their presence, as well as the anastomosing lines towards the centre, which exist in *S. Buryanus* and *S. Johnsonianus*. When the surface of the disc is exactly in focus, the puncta appear simple; but by slightly lowering the focus a pore becomes visible in the middle of each punctum; and on viewing the valve from within, the pores are very conspicuous, and placed on the summits of little circular convex cavities (plane on the outer surface, convex on the inner surface, of the valve), strongly resembling the discs in the woody fibre of the Coniferæ, which are themselves little, plano-convex boxes, with an orifice. The border of the disc is bounded by a row of minute puncta. The number of rays is upwards of forty.

Stictodiscus Kittonianus, n. sp., Grev.—Disc umbonate, with a central nucleus; rays numerous; puncta minute, equal, forming a double series in each compartment, and closely covering the central space. Diameter about ·0020″. (Figs. 2, 3.)

Hab. Nottingham deposit, Maryland, U.S.; Richmond, Virginia, F. Kitton, Esq.

A small but beautiful species, with very numerous puncta of equal size throughout, and especially distinguished by the umbonate surface and central nucleus of the disc. The rays terminate simply at the margin, which is unmarked by puncta or striæ of any kind. My best thanks are due to Mr. Kitton for a specimen exhibiting the front view, which forms a very interesting object. It shows the frustule to be composed of two unequally umbonate valves, each of them furnished with a broad, folded-down edge, as in the lid of a pill-box, which edge is divided into large, square cellules, corresponding in number with the rays and compartments as seen in the side view. These cellules are the more conspicuous from being destitute of any kind of sculpture. Mr. Kitton informs me that, in addition to the localities above recorded, he has observed this diatom in the Pescataway, Rappahannock, and Monterey deposits.

COSCINODISCUS.

Coscinodiscus patellæformis, n. sp., Grev.—Central granules minute, round, numerous, from which proceed a number of rays, terminating about half way between the centre and the margin in an irregular circle of minute, dark, spine-like tubercles, beyond which are radiating lines of sub-contiguous granules increasing in size to the circumference; margin with a row of minute puncta. Diameter about ·0034″. (Fig. 4.)

Hab. Barbadoes deposit; very rare.

This curious diatom has much the appearance, under a low magnifying power, of *Coscinodiscus biradiatus*, with some adventitious matter adhering to the disc. Indeed, I passed over several specimens under this impression; but I was at length induced to examine them more carefully, and perceived that several important characters indicated a distinct species. The radiating lines which occupy the outer half of the disc are composed of coarse granules almost touching one another, and increasing in size as they approach the margin. But a more remarkable feature is found in another series of radiating lines, occupying not exactly the centre, but what may be termed the crown of the disc, and terminating about half way down. These have all the appearance of a separate structure, closely united to the original one, the whole bearing a strong resemblance to some of the *Patellæ*. The last-mentioned series, or, as they may be called, the coronal rays, are somewhat irregular in length, and consequently do not form an exact circle. They terminate in one or occasionally in two spinous processes, which are evidently analogous to those with which some of the rays in *C. armatus* and other diatoms are furnished.

TRICERATIUM.

The first seven of the following species constitute a very interesting and exceedingly natural little group, and present an excellent illustration of the difficulty of distinguishing between closely allied forms. Without attempting to dogmatise upon the *questio vexata* of "What is a species?" we may safely venture to figure and describe, with benefit to science, such organisms as we have reason to believe exhibit characters by which they may at any time be identified. Such characters are necessarily sometimes minute, but are not thereby of less value. In a systematic work the species about to be described would arrange themselves at once into two sections—the first containing those which have simple (not striated) margins and the central triangular space filled up with radiating lines; the second those which have striated margins and the central triangular space blank. There is another peculiarity, also, which separates the two sections. In the first the angles of the central triangle are lengthened out until they reach the pseudo-nodule; in the second the angles are not lengthened out, but each is kept with a short strong line which never reaches the pseudo-nodule, but terminates in a fork more or less connected with other vein-like lines. I have not satisfied myself about the nature of the short line referred to. In *T. pulcherrimum* (fig. 6) it takes the form of a small spine, distinctly seen within the pseudo-nodule. In *T. marginatum* it may also be seen, but with some difficulty, through the intervening lower pseudo-nodule. These little spines must be regarded as analogous to the short lines holding a similar relative position to the angles of the inner triangle in the species of the second section. In some instances, especially in *T. variegatum*, I have observed the short line to be slightly raised, suggesting the idea, which is confirmed by the position of the spine in the species of the first section, that this organ belongs properly to the framework of the inner triangle, and that the lines which appear to emanate from it belong to the system of costæ or vein-like lines which divide the border of the valve into compartments.

Triceratium marginatum, Br.—Valve with slightly convex sides, rounded angles, double pseudo-nodules, and simple margin; centre a triangular space, filled with radiating moniliform lines; border divided by transverse lines into punctated compartments. Distance between the angles, about ·0026″. (Fig. 5.)

Triceratium marginatum, Brightw., 'Mic. Journ.,' vol. iv, p. 275, pl. xvi, fig. 13. Ralfs, in 'Pritch. Infus.,' 1861, p. 854.

Hab. Barbadoes deposit, chiefly from Cambridge Estate; extremely rare; T. Brightwell, Esq., F. Kitton, Esq., Dr. Greville.

Although this fine species has been, in all essential points, correctly figured in Mr. Brightwell's paper quoted above, I have a twofold purpose in introducing another illustration in this place. It is very desirable that the student should be able at once to compare with it the new and allied species I am about to describe, most of which I have received under the same name. I wish, besides, to represent a structural arrangement which does not appear in Mr. Brightwell's figure. This consists of a circular, blank space surrounding the apex of the angle of the inner triangle and the inferior pseudo-nodule. It contains no puncta; and several faint, short lines, and two dark and longer ones, radiate from it. It is probable that this character may be more or less obscure in some individuals, as it is by no means conspicuous in Mr. Kitton's specimen, which he has kindly permitted me to examine. It would appear that no dependence can be placed on the number of lateral costæ. In Mr. Kitton's example there are two on each of two sides, and three on the other. In my own the number on two sides is similar, but there is only one on the third side. Mr. Brightwell's figure shows four on each of two sides and three on the other. With regard to the radiating lines of the inner triangle, I am inclined to consider them as modified costæ. Much depends upon the angle at which they are viewed. In my own specimen they have all the appearance of lines of puncta, but in Mr. Kitton's valve the costate character comes clearly out, with the addition of being nodulose, especially as the costæ approach the margin of the inner triangle.

Triceratium pulcherrimum, n. sp., Grev.—Valve with slightly convex sides, rounded angles, and simple margin; centre a triangular space, filled with radiating costæ; border divided by transverse lines into punctated compartments, which are continued round the large, oblong pseudo-nodules. Distance between the angles ·0045″. (Fig. 6.)

Hab. Barbadoes deposit, C. Johnson, Esq.; exceedingly rare.

One of the most beautiful diatoms known, and closely allied to the preceding. In this case the radiating lines of the centre are genuine costæ, each of which, as it terminates at the margin of the inner triangle, becomes capitate, producing an exquisitely ornamental effect. The pseudo-nodules are large, flat, and oblong; and an approach is made to the double pseudo-nodule of the preceding species, by their being traversed by two fine oblique lines, which, meet at the apices of the angles of the inner triangle; and what brings the approach still closer, is the fact that it is the division next the angle of the valve only which is punctate. A remarkable peculiarity consists in the pseudo-nodules not being situated in the extreme angle, as in the other species of the group, but leaving space for the lateral costæ to be visibly continued round them. These costæ are widely separated throughout the greater length of the border, but increase rapidly in number as they turn round the angle, so that there are about twenty on each side. The angles of the inner triangle are lengthened out until they enter the punctate portion of the pseudo-nodule, and terminate in a short spine. In this and the preceding species the puncta in the lateral compartments are rather widely scattered.

Triceratium Abercrombieanum, n. sp., Grev.—Valve with nearly straight sides, obtuse angles, and striated margin; centre a blank triangular space; border divided by transverse costæ into punctated compartments; a short line from each angle of the central triangle terminating in a wide fork with incurved apices, a faint, undulating line passing along the middle of each border. Distance between the angles, about ·0023″. (Figs. 7—9.)

Hab. Barbadoes deposit, C. Johnson, Esq., Dr. Greville; extremely rare.

At a hasty glance this might readily pass for a variety of the preceding species; but the presence of a striated margin, and the totally different centre, immediately dispel the impression. The pseudo-nodule, besides, is single; and although in one instance (fig. 9) the fork of the apex of the short line terminating the angles of the central triangle forms an enclosed, roundish space, instead of remaining open, it is unconnected with the pseudo-nodule, and contains puncta. A remarkable character in this species is a faint undulating line which passes along the middle of the border, commencing at the outer angle of the fork above mentioned, and ending at the corresponding point in the opposite angle of the valve. This line, which, although faint, may be traced without any difficulty, I have found uniformly present in the four specimens which I have had an opportunity of examining. By a reference to the plate it will be perceived that some variation is liable to occur in the lines at the angles, as well as in the number of the lateral costæ. The puncta are considerably more numerous than in *T. marginatum.* I have much pleasure in dedicating this diatom to my acute correspondent, Dr. Abercrombie, of Cheltenham.

Triceratium inopinatum, n. sp., Grev.—Valve with nearly straight sides, rounded angles, and striated margin; centre a blank triangular space; border divided by transverse costæ into minutely punctated compartments; a short line from each angle of the central triangle terminating in a small, roundish compartment, joined to the pseudo-nodule; no undulating line along the border. Distance between the angles ·0020″. (Fig. 10.)

Hab. Barbadoes deposit; extremely rare.

The only question which can arise relative to the validity of the present species is whether it be not a variety of the preceding. Had the separation been proposed on account of the apparently double pseudo-nodule alone, I should have felt some hesitation. It might have been said that in one of the varieties of *T. Abercrombieanum* the short lines proceeding from the angles of the central triangle terminate in enclosed spaces, owing to the incurved apices of the fork becoming united; and that if these enclosed spaces had been pushed forward to a junction with the pseudo-nodule, we should just have the appearance exhibited by the diatom now under consideration. It may be remarked, however, that the enclosed spaces above mentioned preserve their relative distance from the pseudo-nodule, as distinctly as if the apices of the fork had remained open. In the present species there is, at first sight, the appearance of an actual double pseudo-nodule; but it is an appearance only, the second one being merely the fork of the short line meeting at the base of the pseudo-nodule, and thereby indicating a different relative position of the parts from what occurs in the preceding species. In addition to what has been said, the total absence of the undulating line so remarkable in the border of that diatom seems to confirm the view I have taken of the propriety of regarding *T. inopinatum* as distinct.

Triceratium approximatum, n. sp., Grev.—Valve with straight sides, obtuse angles, and striated margin; centre a blank, triangular space; border divided by transverse costæ into punctated compartments; a short line from each angle of the central triangle terminating in a wide, shallow fork; pseudo-nodule single, sending out two spurs from the base;

no undulating line in the border. Distance between the angles ·0029″. (Fig. 11.)

Hab. Barbadoes deposit; excessively rare.

A fine species, coming nearest to *T. Abercrombieanum,* but wanting the undulating border line. The fork referred to in the specific characters here assumes a *Patera*-like form. Whether any dependence can be placed on the two little spurs at the base of the pseudo-nodule, a character I have not observed in any other species of the group, it is impossible at present to say. The puncta are numerous.

Triceratium gratiosum, n. sp., Grev.—Valve with slightly convex sides, obtuse angles, and striated margin; centre a triangular, blank space; border divided by transverse costæ into closely punctated compartments; a short line from each angle of the inner triangle terminating in a fork, from the centre of which spring two other lines, curving outwards to the margin. Distance between the angles, ·0029″ to ·0035″. (Figs. 12, 13.)

Hab. Barbadoes deposit; extremely rare; George Norman, Esq., Dr. Greville.

A very elegant species, closely and conspicuously punctate. The arrangement of the vein-like lines at the angles is peculiar, and serves at once to distinguish it from all its allies. Two lines spring from a point within the fork already mentioned, near its base, and curve gracefully outward until they reach the margin. In the examples which I have examined, the lateral costæ alternate more or less regularly with imperfect ones, extending about half-way across the border.

Triceratium variegatum, n. sp., Grev.—Valve with straight sides, obtuse angles, and striated margin; centre a blank, triangular spaee; border divided by transverse costæ into very minutely punctated compartments; a short line from each angle of the central triangle terminating in a deep, campanulate fork, the lines of which reach the margin. Distance between the angles, ·0027″. (Fig. 14.)

Hab. Barbadoes deposit; excessively rare; George Norman, Esq.

Of this beautiful diatom I have seen only a single specimen; but it differs so materially from all the preceding, that no doubt whatever can exist regarding its claim to being ranked as a distinct species. It will be recognised at once by the graceful campanulate or vase-like compartment at each angle of the valve, which is very minutely, yet more distinctly punctate than the border. A very minute, deflexed line may also be seen given off externally on each side from near the base of this compartment.

Triceratium nebulosum, n. sp., Grev.—Valve with concave sides and broadly rounded angles, the ends of which are filled with a cloud of minute puncta; centre occupied with an indefinite cluster of small puncta, while larger ones are remotely scattered over the rest of the space. Distance between the angles ·0032″. (Fig. 15.)

Hab. Barbadoes deposit; exceedingly rare; George Norman, Esq.

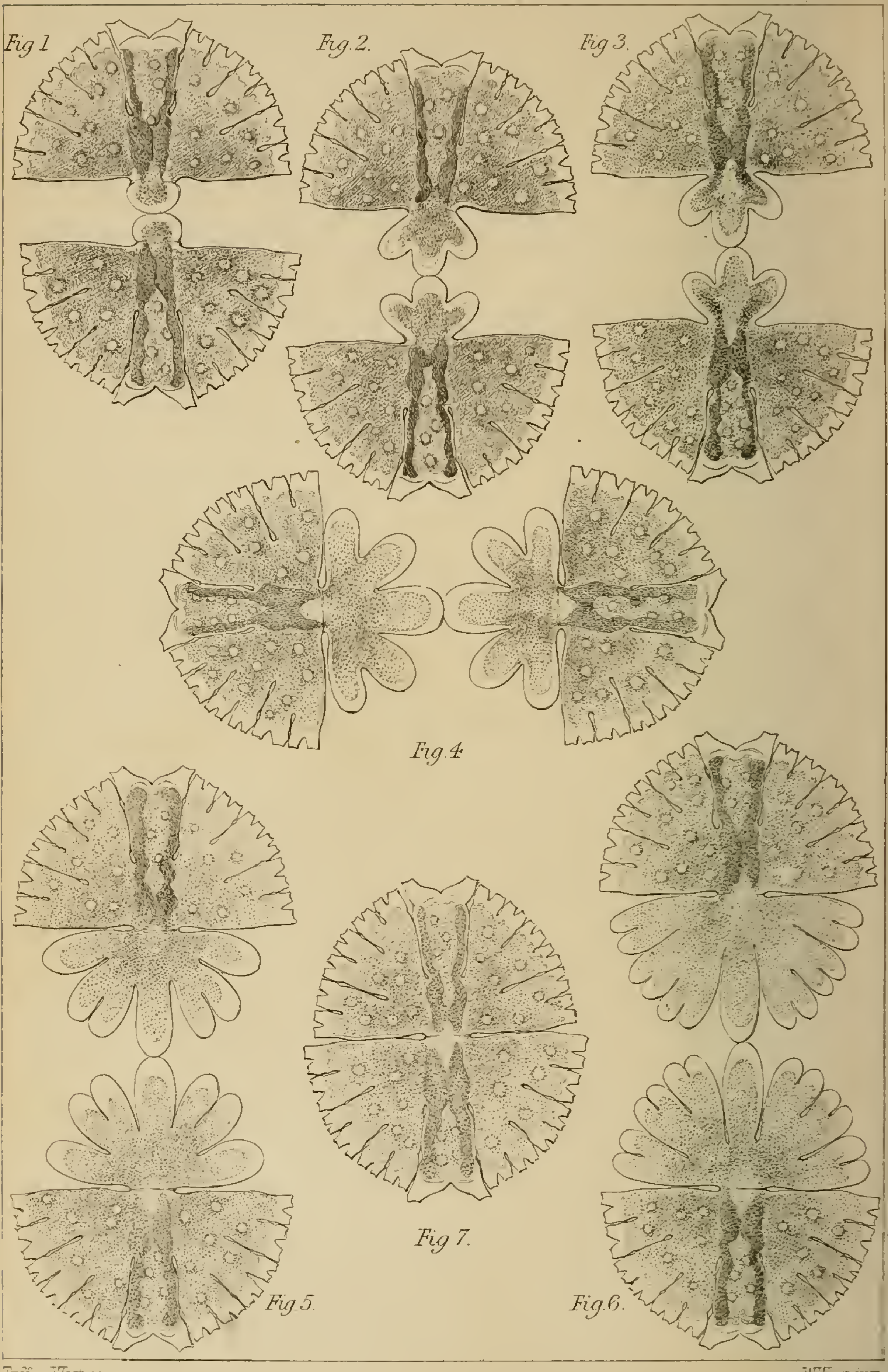
This species bears some resemblance in general outline to *T. trisulcum* of Bailey, figured in Pritchard's 'Infusoria,' 4th edit., pl. viii., fig. 27; but there are no transverse lines separating the angles from the centre. It is otherwise nearly allied to the same diatom, in the angles being crowded with minute puncta and in those of the centre being remotely scattered. These latter, however, are more numerous than in Professor Bailey's species, and there is, besides, a marginal line of irregularly disposed and more closely approximated puncta in the concave sides of the valve. It is also allied to my *T. rotundatum*, a much smaller species, from which it differs in the sides being much less deeply concave, in the absence of the single lateral row of large granules, and in the arrangement of the central granules generally.

AMPHIPRORA.

Amphiprora conspicua, n. sp., Grev.—Front view broadly winged, much constricted, truncated at the ends; a row of linear nodules at some distance within the margin; striæ conspicuous, about 18 in ·001″. Length ·0046″. (Fig. 16.)

Hab. Sierra Leone, F. Kitton, Esq.

The finest species, perhaps, of the whole genus; allied to *A. alata*, but quite distinct. In the first place, the frustule is far from being equally hyaline; and instead of the striæ being perceived with some difficulty, they are rather coarse and very conspicuous. Then, in *A. alata* the number of striæ (which I have been unable to ascertain satisfactorily for myself) is given by Smith as 42 in ·001″, which is adopted by Ralfs in the last edition of Pritchard's 'Infusoria;' but in our new species they may be set down at 18 in ·001″. I have found them vary a little, but I assume this number as the average. Again, a certain number of the striæ swell into a sort of linear nodule at some distance within the margin, and the line thus formed, following the marginal curve, constitutes a most peculiar and striking character. There seems to be no fixed rule as to the proportion of striæ which exhibit this feature. Sometimes it is every fourth, at others every third striæ. In addition to these differences there is yet another, in which the diatom under consideration agrees with *A. pulchra* of Bailey ('Mic. Obs. in South Carolina, &c.,' p. 38, pl. ii, figs. 16—18), the striæ near the margin being punctate. The surface of the valve is undulate, so that a portion only is in focus at one time, and the striæ consequently appear to decussate obliquely in waving lines. I may add that, although I have seen a number of specimens, I have never observed one in the twisted state so common in *A. alata*.



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TRANSACTIONS OF MICROSCOPICAL SOCIETY.

DESCRIPTION OF PLATE I,

Illustrating Mr. Lobb's paper on the Self-division of *Micrasterias denticulata.*

Fig.
1.—*Micrasterias denticulata* in the first stage of self-division.
2.— " " in the second stage of self-division.
3.— " " in the second stage of self-division, the endochrome coming in differently to what it does in figure 2.
4.— " " in the third stage of self-division.
5.— " " in the fourth stage of self-division.
6.— " " in the fifth stage of self-division.
7.— " " self-division completed.

DESCRIPTION OF PLATE II,

Illustrating Mr. G. Norman's paper on some Undescribed Species of Diatomaceæ.

Fig.

1.—*Asterolampra Stella.*

2.—*Surirella Baldjikii.*

3.—*Coscinodiscus fuscus.*

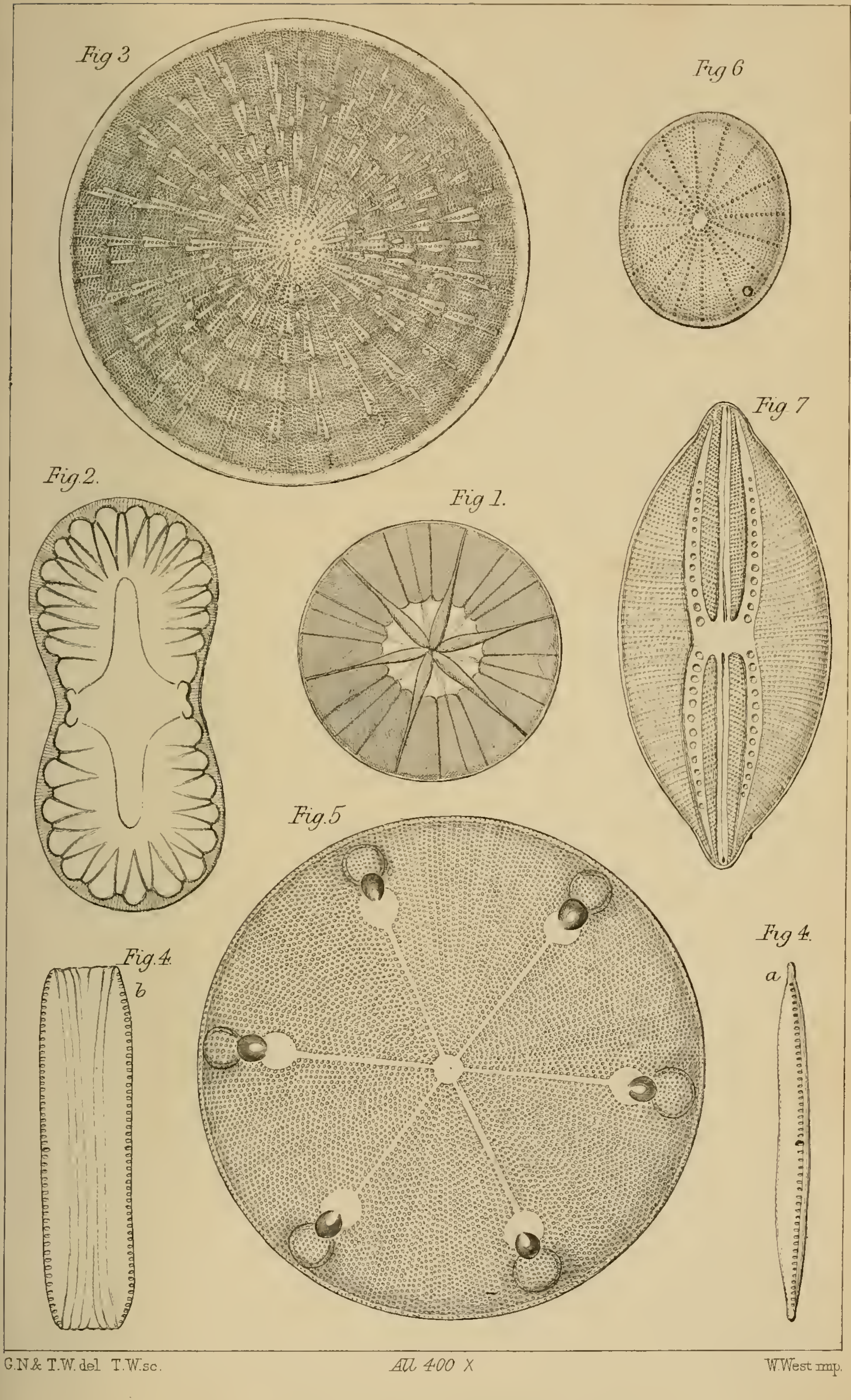
4.—*Nitzschia vitrea.*

5.—*Aulacodiscus Sollittianus.*

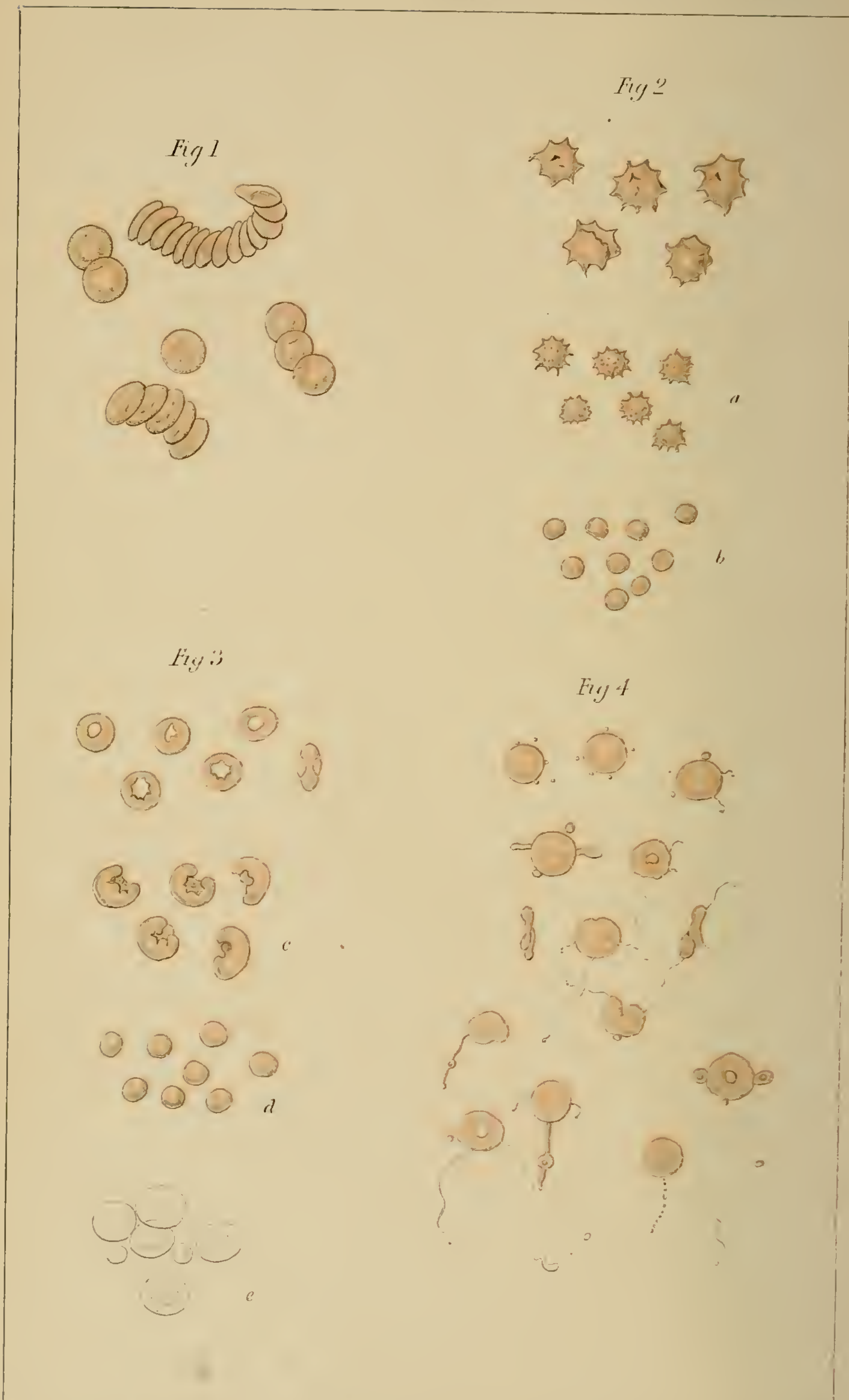
6.—*Eupodiscus ovalis.*

7.—*Navicula bullata.*

All magnified 400 diameters.



G.N & T.W. del T.W. sc. All 400 X W. West imp.



W.A. del. Tuffen West sc. T. West imp.

TRANSACTIONS OF MICROSCOPICAL SOCIETY.

DESCRIPTION OF PLATE III,

Illustrating Mr. Addison's paper on Changes of Form in the Red Corpuscles of Human Blood.

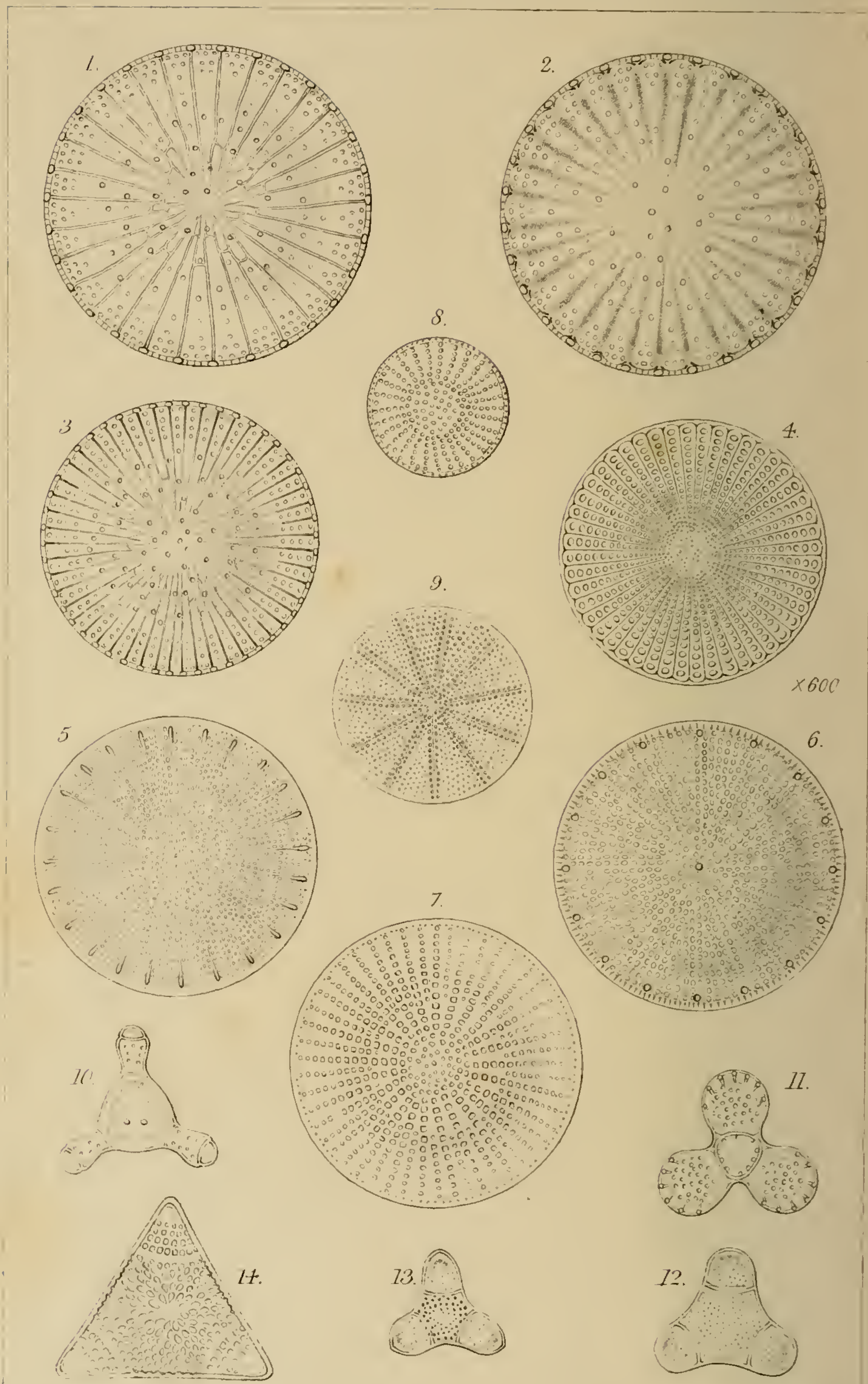
Fig.

1.—*Natural forms* of the red corpuscles of human blood.

2.—*Alkaline forms*, produced by saline and alkaline liquids.

3.—*Acid forms*, produced by the action of weak acid liquids.

4.—*Tailed forms*, produced by Sherry wine, &c.



R. K. Greville del. T. West sc.

W. West imp.

DESCRIPTION OF PLATE IV,

Illustrating Dr. Greville's paper on New Diatoms, Series I.

Fig.

1.—*Stictodiscus Buryanus,* focused for the radiating lines.

2.—The same, focused to show the plicate character of the disc.

3.—*S. Johnsonianus.*

4.—*S. insignis,* × 600.

5.—*Coscinodiscus armatus.*

6.—*C. tuberculatus.*

7.—*C. biradiatus.*

8.—*C. elegantulus.*

9.—*C. Barbadensis.*

10.—*Triceratium capitatum.*

11.—*T. Westianum.*

12.—*T. Barbadense.*

13.—*T. nitidum.*

14.—*T. cellulosum.*

All the figures are × 400, except fig. 4, which is × 600 diameters.

The Barbadoes species are described from a fine series of slides supplied by Mr. J. T. Norman.

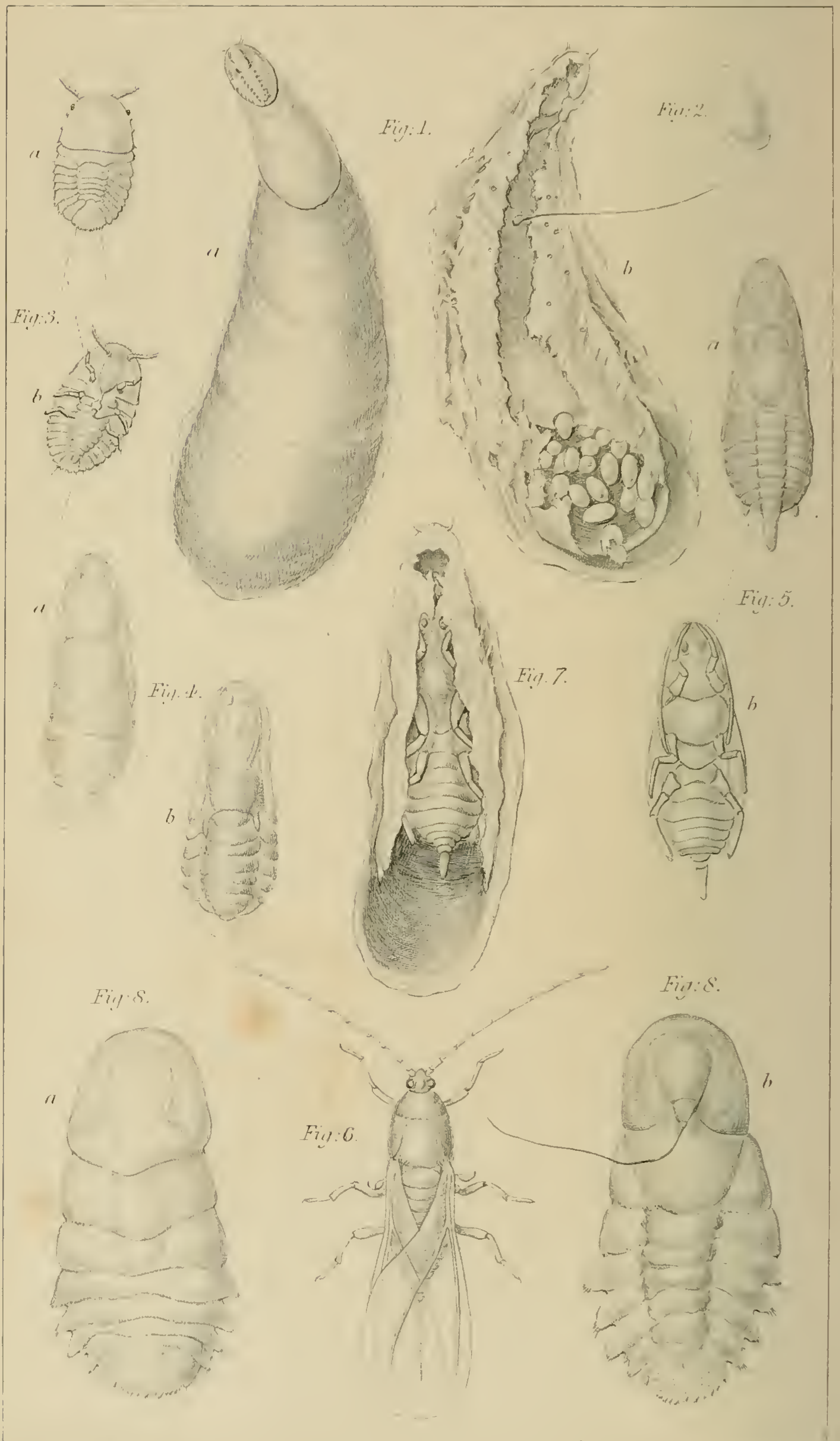


Fig: 1.
a
Fig: 2.
b
a
Fig: 3.
a
b
Fig. 4.
a
b
Fig: 5.
b
Fig. 7.
Fig: 8.
a
Fig: 6.
Fig: 8.
b

DESCRIPTION OF PLATE V,

Illustrating Richard Beck's paper on the Metamorphosis of a Coccus found upon Oranges.

Fig.

1.—Female.

2.—Egg taken from one of the above.

3.—Young Coccus shortly after breaking from the egg.

4.—Male insect at the earliest period at which any traces of sexual characters can be distinguished.

5.—A male insect further advanced.

6.— „ „ mature.

7.—Shell of a male Coccus, with indications of its formation at three distinct periods,—the larval covering, the pupal covering, with a subsequent addition for the protection of the wings of the imago.

8.—Mature female removed from the shell.

In all the figures where letters are employed, *a* represents the upper, *b* the lower surface.

TRANSACTIONS OF MICROSCOPICAL SOCIETY.

PLATE VI,

Illustrating Dr. Guy's paper on the Crystals of Arsenious Acid, showing the sublimates as they appear by the monocular and binocular microscope by transmitted and reflected light.

Fig. 1

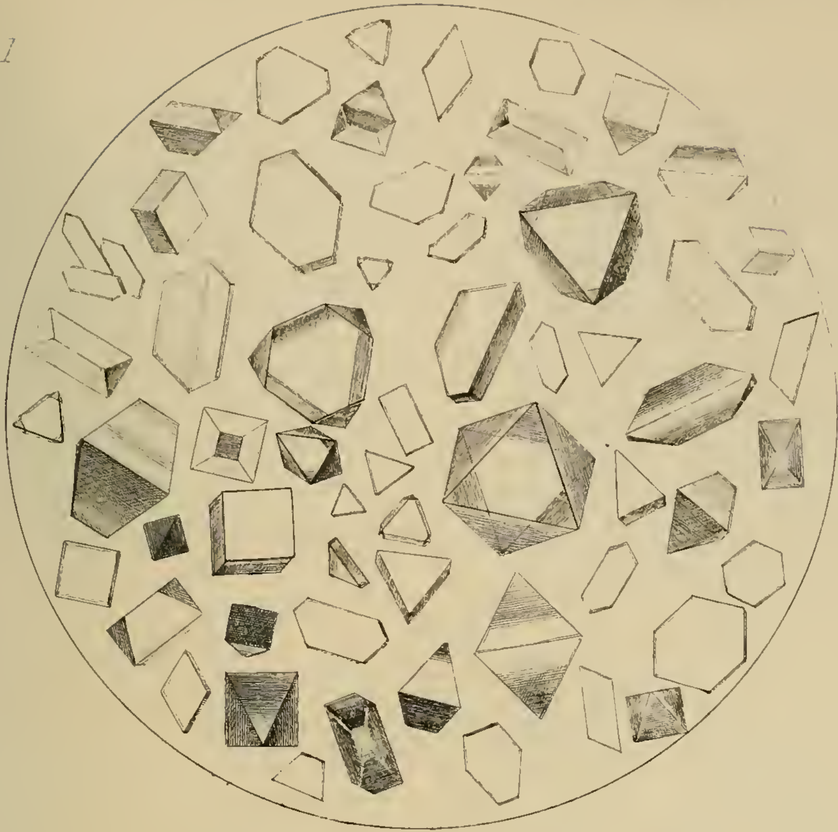
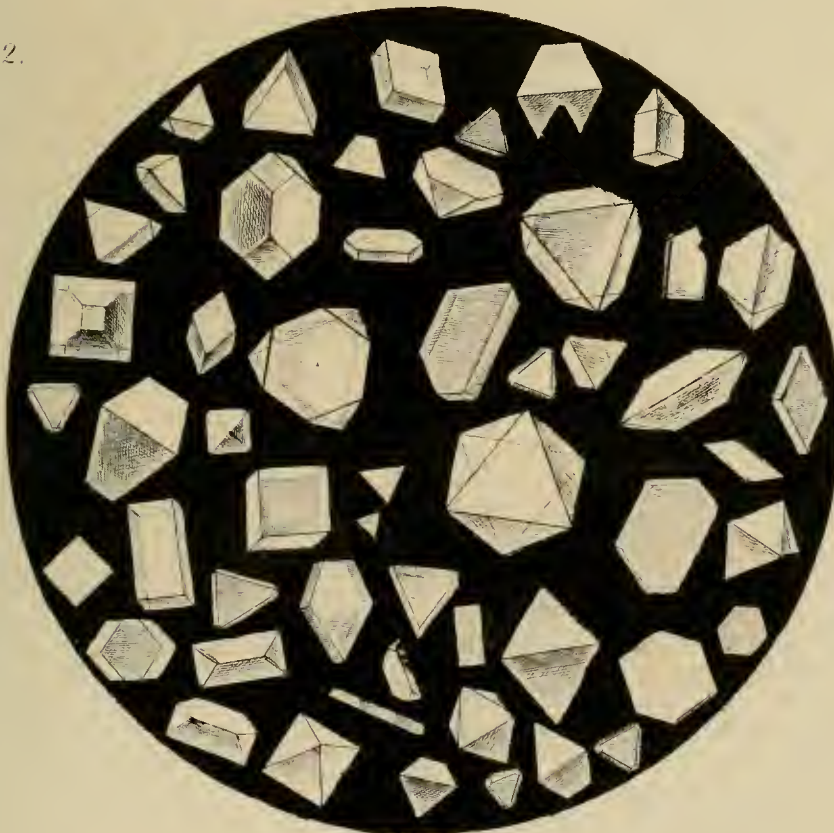


Fig. 2.



Tuffen West ad nat.

W. West imp.

× 12

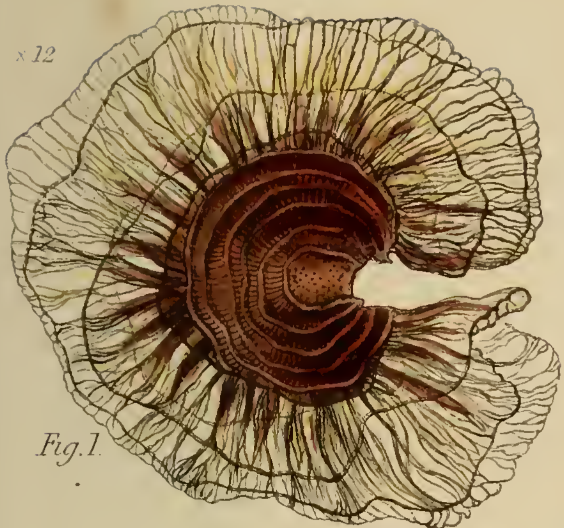


Fig. 1.

× 12

Fig 5

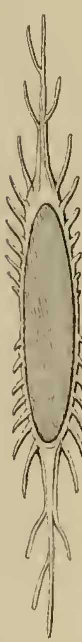


Fig 2

× 100

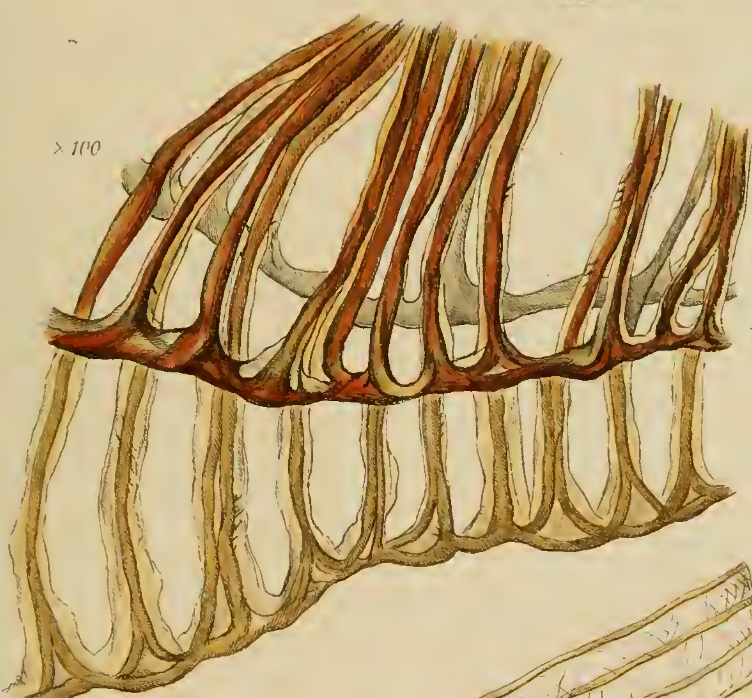


Fig 3.

× 100

Fig. 4

× 100

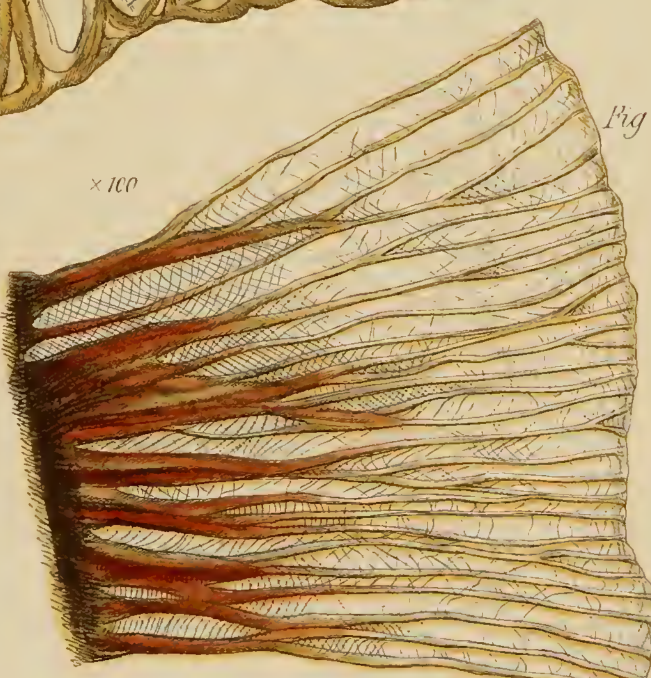
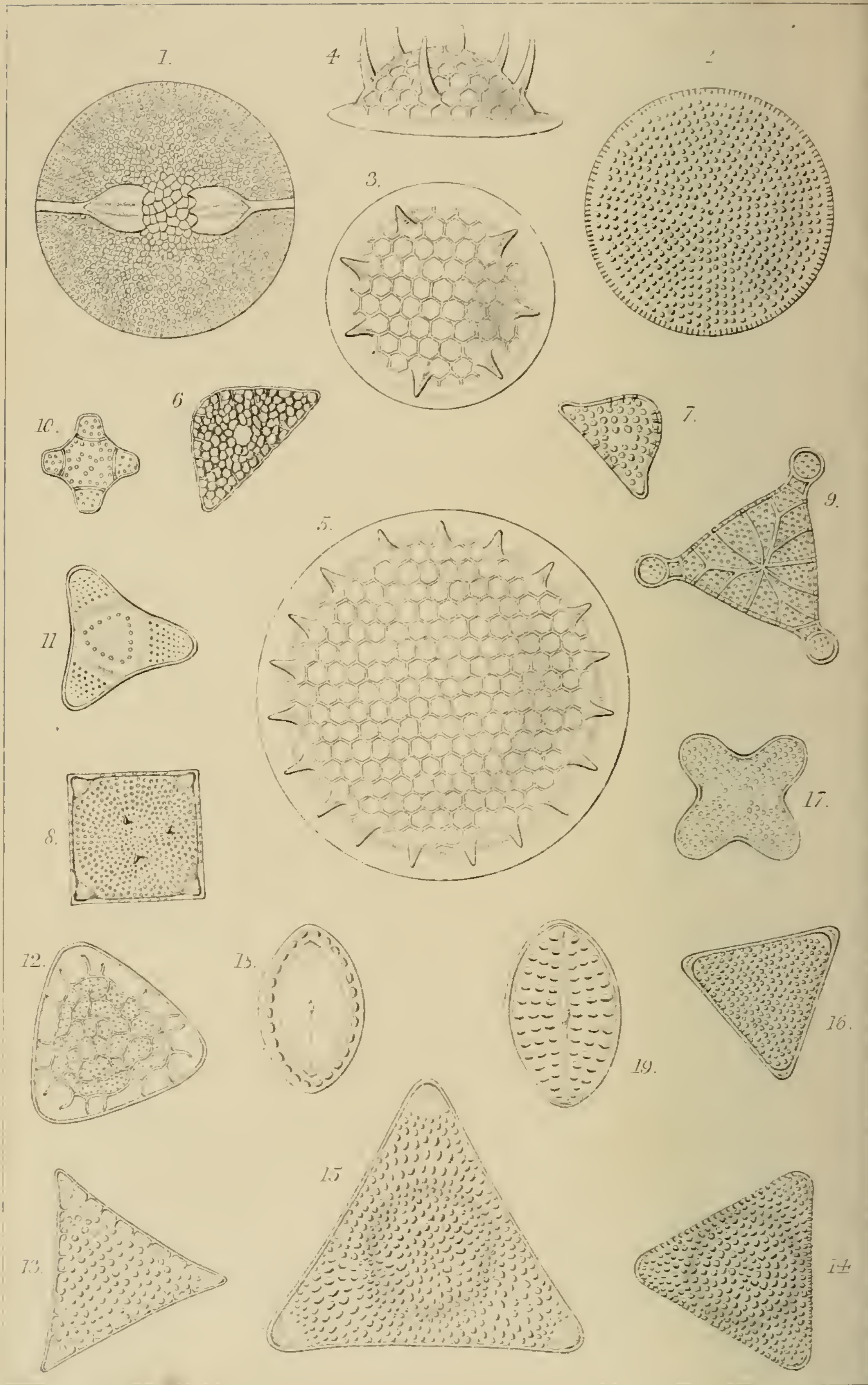


Fig 6

H.B.B. ad nat. del. Tuffen West sc. W. West imp. chr.



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DESCRIPTION OF PLATE VIII,

Illustrating Dr. Greville's paper on New Diatoms, Series II.

Fig.

1.—*Rylandsia biradiata*, × 600.

2.—*Coscinodiscus symmetricus.*

3—5.—*Creswellia superba.*

6, 7.—*Euodia Barbadensis.*

8.—*Triceratium cornutum.*

9.—*T. productum.*

10.—*T. inconspicuum*, × 800.

11.—*T. delicatum*, × 600

12.—*T. labyrinthæum.*

13.—*T. areolatum.*

14.—*T. tessellatum.*

15.—*T. robustum.*

16.—*T. Browneanum.*

17.—*T.* (?) *blanditum.*

18.—*Cocconeis Grantiana*, × 800.

19.—*C. granulifera*, × 600.

All the figures are × 400 except where the contrary is mentioned.

DESCRIPTION OF PLATE IX,

Illustrating Dr. Greville's paper on New Diatoms, Series III.

Fig.

1.—*Brightwellia elaborata.*

2, 3.—*Triceratium notabilis.*

4.—*T. microcephalum.*

5.—*T. insignis.*

6.—*T. rotundatum.*

7.—*T. amœnum.*

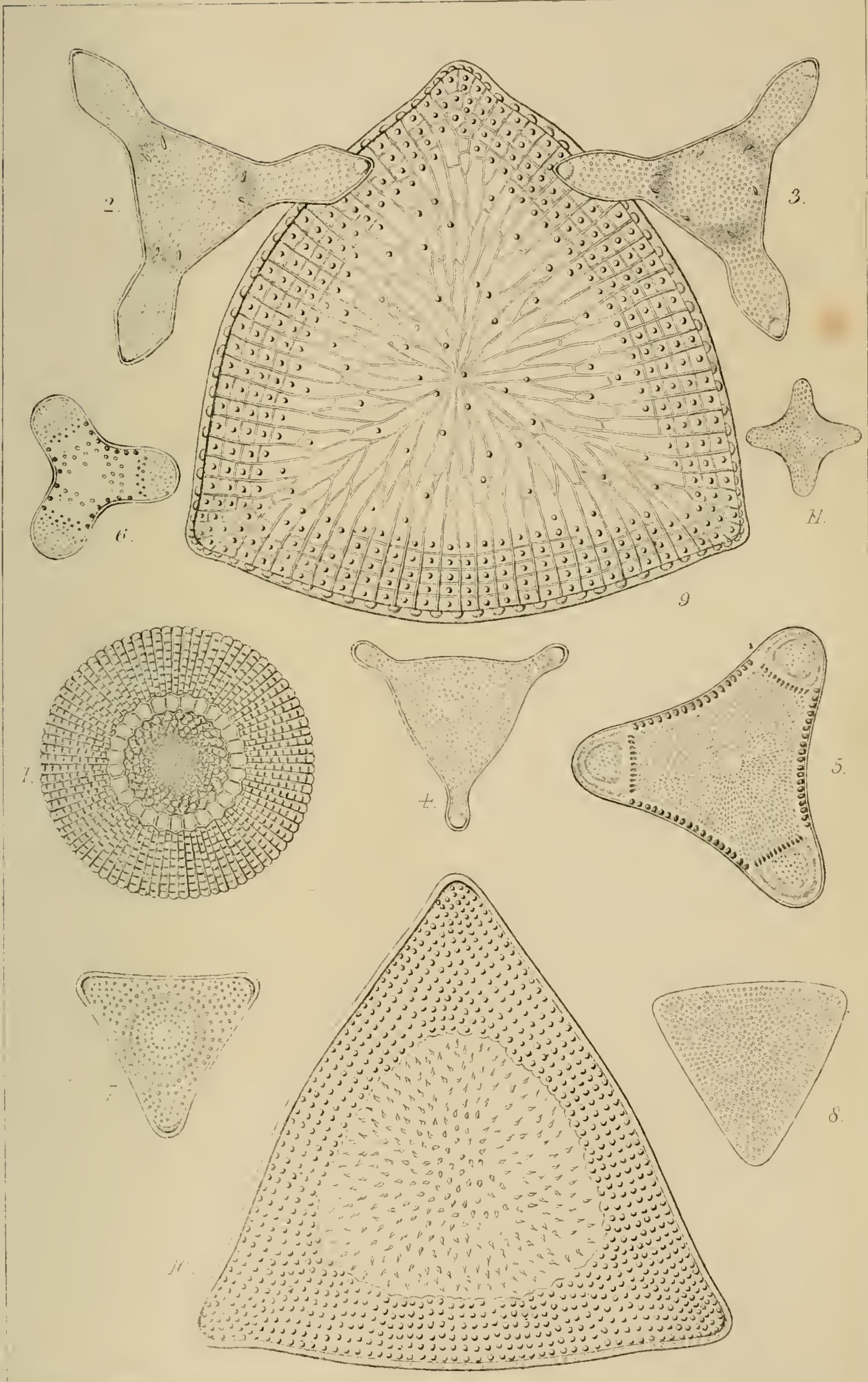
8.—*T. obscurum.*

9.—*T. Harrisonianum.*

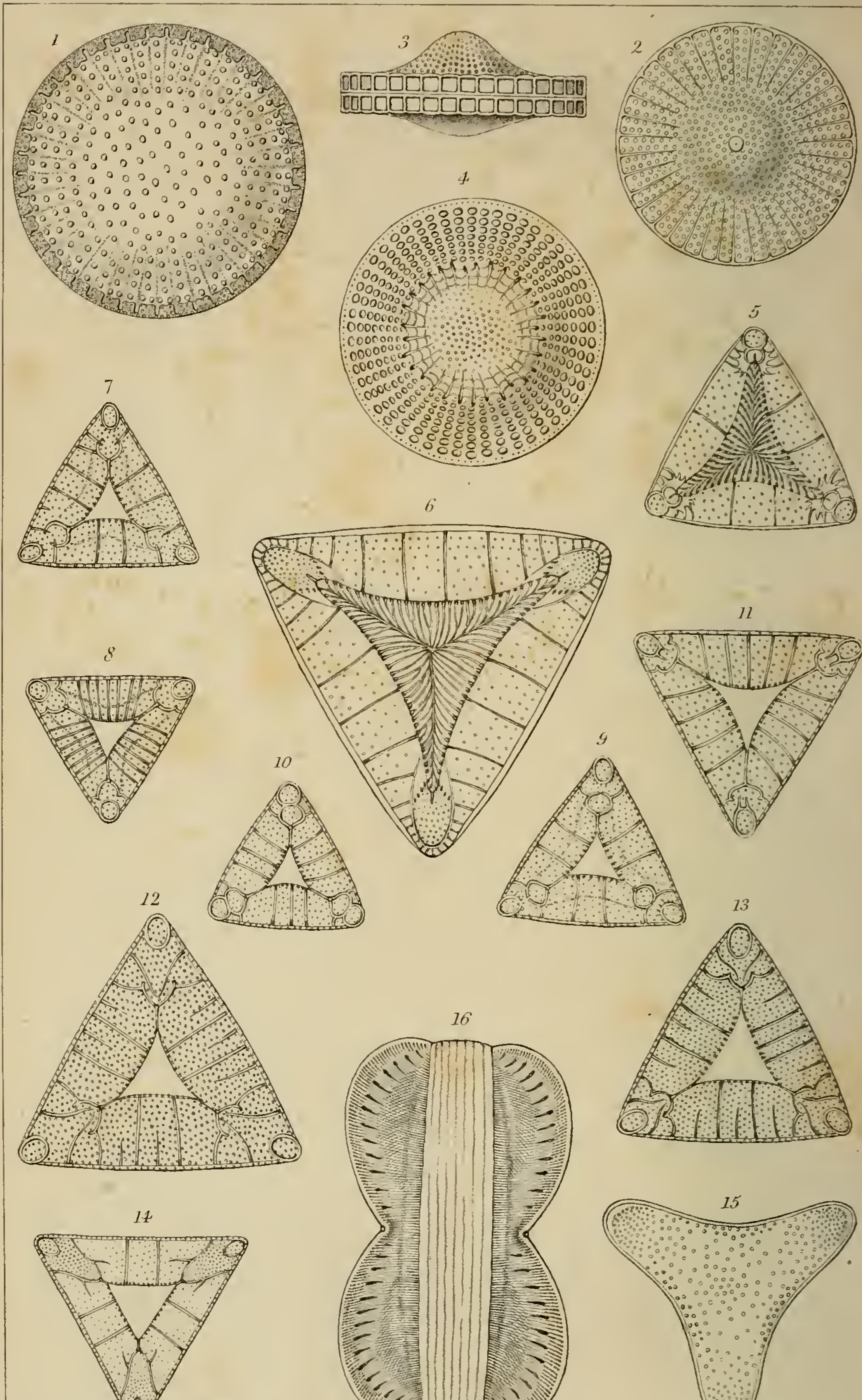
10.—*T. giganteum.*

11.—*Amphitetras minuta.*

All the figures are × 400 diameters.



W West imp.



R. K. G. del. Tuffen West sc. W. West imp.

DESCRIPTION OF PLATE X,

Illustrating Dr. Greville's paper on New Diatoms, Series IV.

Fig.

1.—*Stictodiscus Californicus.*

2, 3.—*S. Kittonianus*, × 600.

4.—*Coscinodiscus patellæformis.*

5.—*Triceratium marginatum.*

6.—*T. pulcherrimum.*

7—9.—*T. Abercrombieanum.*

10.—*T. inopinatum.*

11.—*T. approximatum.*

12, 13.—*T. gratiosum.*

14.—*T. variegatum.*

15.—*T. nebulosum.*

16.—*Amphiprora conspicua.*

All the figures except 2 and 3 are × 400.

Errata in Series III.—For *Triceratium notabilis* and *T. insignis*, read *T. notabile* and *T. insigne.*

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