Mr. Smith's "*folded membrane*," "*polype-skin*," &c. are in my opinion purely imaginary. If the tubular cavities disposed with so much regularity on the inner surface of the fossils to which I restricted the term Ventriculites were not cells inhabited by polypes, then I affirm that we have, at present, no evidence that any of these zoophytes were polypiferous; and I readily admit that this may still be regarded as an open question. The only unequivocal instance I have seen of the soft parts of a polype from the chalk strata, is one in flint discovered by the Rev. J. B. Reade, and figured in the 6th edit. of my 'Wonders of Geology,' p. 304: but there is no proof that this polype belonged to a Ventriculite.

How far it may be deemed expedient to admit of the application of the term "*cephalic membrane*" to the margin of a cup-shaped zoophyte, or to group together under the name of *Ventriculidæ* the incongruous assemblage of fossil zoophytes thus classed by Mr. Smith, I leave for competent naturalists to determine.

To those geologists who like me aspire only to a general knowledge of the organic remains found in the respective strata, I believe that the accurate and simple exposition of the form and structure of the *Ventriculites*, given in my works, long before Mr. Smith commenced his arduous labours, will be found alike true to nature and perfectly intelligible: the sublime transcendentalisms in the communications to which the above remarks refer, are far beyond the comprehension of such humble observers as,

Gentlemen, your very faithful servant,

Gideon Algernon Mantell.

Chester Square, Pimlico, May 5, 1848.

XLVI.—*Reports on the Progress of Physiological Botany.* No. 4.

By Arthur Henfrey, F.L.S. &c.

On the Multiplication of Vegetable Cells by Division.

On the 22nd of November 1847, Prof. Mitscherlich read before the Royal Academy of Berlin, a portion of an essay on the Development and Composition of the Confervæ. This has been published in the monthly report of the Academy*, and is so instructive that it deserves a somewhat detailed report here.

Prof. Mitscherlich selected the Confervæ on account of the simplicity of their structure and the rapidity of their development, and *C. glomerata* is the species which he found best adapted for the observations, as the cells are very distinct from each other, and develope well beneath the microscope. Moreover

* Monatsbericht der Königl. Preuss. Acad. Nov. 1847.

it is the plant on which Mohl's observations on cell-division* were made, which observations however were made on distinct individuals in different stages of development.

The author placed the plant on a slip of glass, covered it with thin glass, and laid a loose filament of cotton round the latter, the end of the filament being made to dip in a glass of water close to the stage, so that as often as the evolution of gas from the plant elevated the thin glass, the water soaked up by the filament ran in and kept the plant constantly surrounded with water. By this means he was enabled to continue the observations on one plant for several weeks.

In the first place Prof. Mitscherlich gives an account of the structure of the plant and the action of various reagents upon the tissues. The entire plant, with all its branches, is surrounded by a common, connected membrane; this may often be clearly distinguished in perfect cells from the membrane of the individual cells; it withstands the action of acids longer, although much thinner, so that when sulphuric acid is applied to the Conferva under the microscope, the membrane of the cells is dissolved, and when after some time openings occur in the outer enveloping membrane, the contents escape, and the envelope remains as a tube with very thin walls. It is clear that the envelope is yet undecomposed, and that what is seen is not the mere remnant of an enveloping membrane, from the fact, that when the upper part of the tube is properly focused, it requires a quarter of a revolution of the adjusting screw to bring the lower part into focus. The envelope is finally dissolved by the sulphuric acid, without acquiring a brown colour or leaving a brown residuum; therefore it is distinct from the substance of the long cells of wood, or of the cells of the stones of fruits; it is not coloured blue by iodine and sulphuric acid, therefore it is not cellulose; it was not possible to obtain enough of it for analysis; it agrees best in its peculiarities with the cell-membrane of Yeast. No special structure could be made evident by any mechanical or chemical means.

The cell-membrane which forms the wall of every individual cell consists of vegetable fibre-substance (*Faserstoff*), the so-called cellulose. It is coloured brown by iodine, and when sulphuric acid is applied to the wall thus coloured, every part acquires an intense blue tint and then it dissolves, the blue colour disappearing without leaving a trace of brown behind†. From all researches at present known to us, the blue colour which iodine pro-

* Vermisch. Schrift. p. 363, 1845.

† The author recommends a saturated solution of iodine in iodide of potassium or sodium, to avoid the inconveniences attending the separation of the iodine which occurs when the alcoholic tincture is used.

duces can only indicate a compound of iodine with starch. Iodine in a divided condition, whether dissolved or in powder, is always brown; but that the blue compound which fibre-substance (cellulose), iodine and sulphuric acid produce, when washed away with water leaves a residuum which gives no blue colour unless sulphuric acid is again applied, implies that the starch which has been found has been converted into dextrine by the addition of water and the presence of concentrated sulphuric acid.

When the Conferva is heated with hydrochloric acid of the usual strength, the cell-wall swells up and splits into separate fibres, the diameter of these being less than $\frac{5}{10000}$ths of a millimetre. They often appear as long as the cell, and lie side by side in the direction of the length of the cell; no spiral arrangement or crossing of these fibres could be observed. The walls of many cells, which consist of cellulose, become split up into such fibres by boiling in hydrochloric acid; this may be seen very plainly in the bass-fibres of flax, and a splitting-up of this kind occurs in mechanical operations upon them, as in the manufacture of paper. The cuticle does not pass in between the contiguous cells, so that the walls of the two cells are in immediate contact.

The contents of the cell consist at first of a gelatinous mass, coloured green by chlorophylle; the green colouring matter, which forms but an insignificant proportion of the whole, is dissolved on the addition of hydrochloric acid, and the gelatinous mass contracts. Iodine colours the mass brown, and then denser masses (nuclei), which lie irregularly scattered through it, become more evident. It withstands the action of sulphuric acid longer than the cellulose; heated with nitric acid and then saturated with ammonia, it gives the xanthoproteate of ammonia, and therefore consists at least in part of proteine compounds.

At a certain epoch of the development the nuclei of the gelatinous mass become opake and increase in diameter; then starch can be distinctly detected in their interior by means of iodine; in other Confervæ, for instance in *Spirogyra*, these points, in which starch is sometimes formed, may be perceived more distinctly. Sometimes the green gelatinous mass lies closely applied to the cell-wall in *C. glomerata*, and the whole cell is densely filled with it; sometimes, and particularly in rapidly developing cells, a clear fluid lies between the gelatinous mass and the wall, and in this fluid sometimes occur particles in molecular motion; spaces filled with clear fluid also occur in the interior of the mass, and are traversed by reticulated processes of the gelatinous matter.

The author observed and determined the growth and multiplication of *C. glomerata* in cooperation with his assistant M. Lasch,

in a great number of specimens; it will be sufficient to describe the complete course of the changes.

On the 19th of September a lateral branch consisted of two cells; on the 21st of three; on the 23rd of four; on the 24th of six; on the 26th of seven cells; in another branch from a cell at some distance, the same multiplication and enlargement occurred. No formation of cells within cells was observed, solely multiplication by division. This usually commenced when the length of the cell was about $\frac{4}{10}$ths of a millimetre.

The gelatinous mass usually separates a little from the cell-wall, and then a small ring is formed upon the latter; thus in the fourth cell of a side branch nothing was perceptible in the morning, then the foundation of a ring was formed; some two hours later the diameter of the ring was already more than half the diameter of the internal cavity of the cell; the gelatinous mass was retracted. About a quarter to one o'clock the mass parted so as to leave a cavity; a few moments after the mass divided on one side, and about half-past two the division was complete. The formation of a septum is generally effected in from four to five hours; the wall is a new structure and by no means a constriction *; it is at first a very thin membrane which extends across from one wall to the other; fresh cellulose is deposited upon this membrane, and when the cell elongates and enlarges every cell exhibits its own proper wall, which, where the walls of the parent-cell and new cell are in contact, stands apart from the former. Sometimes it happens that a cell-wall is only half-developed, very often only on one side; deposits are then subsequently found on these structures; and unless the development of the membrane is continuously traced under the microscope, these structures may easily be taken for the commencement of infolding or constriction.

If the Conferva is boiled in solution of soda of 1·35 sp. gr., which does not dissolve but loosens the texture of cellulose, the deposited mass frequently separates from the septum by which the division is first of all produced, and thus it may be distinctly observed; acetic acid has the same effect. The division takes place most frequently in the terminal cell, but also very often in the others, even in the old cells of the primary filament.

From the manner in which the gelatinous mass is divided by the new membrane, it is very clearly seen that the mass is not surrounded by a membrane; projecting pieces also and separate portions of the gelatinous mass are generally seen, which are not

* The author appears to misunderstand the way in which the constriction is said to take place. No one now supposes that the cell-wall is constricted, only the contents; and the septum is certainly a new structure, a double layer of membrane formed in the fold.—A. H.

inclosed in a membrane. When solutions which act through endosmose are applied to the cells, these abstract water from the gelatinous mass, and the outermost layer, which thus becomes the densest, may easily be mistaken for a membrane. The side branches are formed by the bulging-out of a cell, and this always occurs at the same end in all cells; thus if we call the end of a cell where such a protrusion has occurred, the upper end, it will be found at the upper end of all the cells. This bulging portion elongates into a cell, and the membrane which produces the division is usually formed close to the parent-cell. Sometimes it happens that if the parent-cell dies, or the contents have run out by a wound, the cell of the lateral branch elongates into the parent-cell.

The formation of the lateral branches by protrusion is of especial interest for the explanation of the multiplication of the top-Yeast (*ober-hefe*); no formation of cells within cells takes place in this. The author has repeatedly observed the whole course of the formation of a cell, in Yeast, beneath the microscope, and no little cell could ever be seen in the little nodule which first of all originates by the bulging-out of the parent-cell; a small granule of the contents of the parent-cell sometimes lay in front of the place where the bulging took place, but this never entered the young cell. In the bulging of the *C. glomerata* an opening exists which is almost as wide as the new cell; in the Yeast the opening is very small. The cell-membrane itself grows forth as in the *Conferva glomerata,* and the gelatinous contents increase within; some of this matter can be detected, by means of iodine, in the nodule at the very commencement of the protrusion.

The cells of Yeast are composed of a cell-wall and gelatinous contents which become granular, and the granules again consist of cell-wall and gelatinous contents, therefore of cells; the cell-wall is probably identical with the cuticula of the Confervæ; the cellulose layer is wanting in the Yeast, and in the Confervæ the primordial utricle which H. von Mohl has pointed out in other cells does not occur.

The deposition of starch takes place in the Confervæ, as in other plants, when the usual process of development in the cell is not so active or is hindered, and it ceases when this process begins again*.

The remainder of the paper relates to the chemical analyses of the different portions of the Conferva; but it will be more interesting to consider here the relations of the observations brought

* Starch is not usually formed abundantly in cells until they have ceased to grow. Indeed the formation of starch and the process of growth may be regarded as directly opposed phænomena, one being the accumulation of nutrient matter, the other the consumption of it.—A. H.

forward in the preceding pages to the investigations of other inquirers.

In the first place, with regard to the action of sulphuric acid and iodine upon the various membranes, H. von Mohl* has shown that this depends more upon the age of the structure than anything else. He finds that these reagents produce the blue colour in young cell-membrane, and that the older structures which are usually coloured brown, are brought into a condition to acquire the blue tint with iodine by boiling in nitric acid or solution of potash; and this without destroying the membrane, at all events without converting it into starch, since it remains insoluble in boiling water. He finds solution of potash produce the effect best in epidermal structures; nitric acid in the ligneous tissues. It is uncertain whether this altered condition of old tissues depends on spontaneous alteration or the penetration of the tissue by new substances. Unger† also states that these structures which are usually coloured brown by iodine may be made to acquire the blue colour by boiling in concentrated sulphuric acid. These observations show that mere chemical reaction is not sufficient to determine the physiological nature of the tissue. The outer layer, which Prof. Mitscherlich calls the *cuticula,* is apparently the wall of the original cell; the new cell-walls do not form part of it, being deposited on its interior in successive layers, with which the new septa are continuous.

With regard to the process of division many modifications of opinion exist; almost all recent observers however agree in attributing the principal influence to the substance which Prof. Mitscherlich calls the *gelatinous mass.* This is the *Schleim* of most German authors, translated by many English authors as *mucus,* and by myself always as *mucilage* or *mucilaginous matter*; a bad term, and one which it would be desirable to replace universally by the one proposed by H. von Mohl, *Protoplasm,* which involves no theory of its chemical nature, but certainly is correct in the view it assumes of the function of this matter. Some German authors apply the general term of *Inhalt* or *cell-contents* to it: it is the *cytoblastema* of Schleiden and the *endochrome* of other authors.

Kützing‡ holds that this protoplasm is enveloped in a special membrane, which he calls the *amylid-zelle.* H. von Mohl§ de-

* Ueber das Wachsthum der Zellmembran. Bot. Zeitung, vol. iv. p. 337, 1846.—Translated in Annals of Nat. Hist. Ser. 1. vol. xviii. p. 145, 1846. Untersuchung der Frage: Bildet die Cellulose die Grundlage sammtlicher vegetabilischen Membran? Bot. Zeitung, vol. v. pp. 497, 521, 545, 1847.

† Die Intercellularsubstanz und ihr Verhältniss zur Zellmembran bei Pflanzen. Botanische Zeitung, vol. v. p. 289, 1847.

‡ Linnæa, 1841, p. 546.

§ Beiträge zur Entwickelungsgeschichte der Pflanzen. Botanische Zeitung, vol. i. 1843.—Translated in Taylor's Scientific Memoirs, vol. iv. p. 91.

scribes such a structure under the name of the *primordial-schlauch*, which I have translated and adopted in my own researches under the name of *primordial utricle*. Unger* also takes the same view. Nägeli maintains that there is no special membrane inclosing the cell-contents, and like Prof. Mitscherlich he believes that the appearances which the protoplasm presents when coagulated on the surface have deceived the above observers. My own observations† have led me to agree with H. von Mohl, and the independent membranous nature of the primordial utricle is also asserted by K. Müller‡.

The action of the protoplasm in the production of the septum in cell-division is therefore either immediate, as asserted by Nägeli §, who declares that it secretes the new membrane or thickening layers, as the case may be, or it is the investing membrane of the protoplasm, the primordial utricle, on the surface of which the new deposits are formed and moulded.

Nägeli says, that the protoplasm divides into two complete portions, at once, and deposits the septum, perfect, though as yet very thin. Unger also describes the division of the primordial utricle as being effected at once, and the formation of the whole septum as simultaneous.

It has just been seen that Prof. Mitscherlich holds the formation of the septum to be progressive ||, and H. von Mohl¶ describes and figures the whole series of stages which he saw, and which convinced him that the process of formation proceeds from the periphery to the centre; that the primordial utricle gradually folds in, and secretes the cell-membrane as it advances. My own observations** agree with this view, and it is principally supported by what I saw in common with H. von Mohl, namely the continuation of the cell-contents through the imperfect septum. However Nägeli states that this appearance is produced by the adherence of the contents to the centre of the septum. On the other hand, I believe with Von Mohl that the conclusion that the contents are divided into two parts at once may be founded on an error caused by the action of reagents, which when they cause the protoplasm and primordial utricle to contract violently, also frequently produce a rupture across the isthmus which connects the contents of the two parts of the dividing cell.

* *L. c. supra.*

† Ann. of Nat. Hist. Ser. 1. vol. xviii. p. 364, 1846.

‡ Zur Entwickelungsgeschichte der Charen. Botanische Zeitung, vol. iii. 1845.—Translated in the Ann. of Nat. Hist. Ser. 1. vol. xvii. 1846.

§ Zellenkerne, Zellenbildung, &c. Zeitschrift für Wiss. Bot., Heft 1 & 3. The former paper is translated in the Ray Society's publications, 1845.

|| Prof. Mitscherlich does not attribute any function to the cell-contents.

¶ Vermisch. Schrift. p. 363, 1845.

** Ann. of Nat. Hist. *l. c.*

I may add to the above, in conclusion, that the opinions of observers are becoming more and more in favour of the view, that multiplication by cell-division is the regular mode of increase in *vegetating* or *growing* parts. Nägeli* asserts it in his most recent publications, and Unger † considers that it is the mode of increase in the cambium layer or *growing region* of wood. On the other hand, Mohl, Müller, Nägeli and many other authors, agree that spores, pollen and embryos are produced by free cell-formation from nuclei.

XLVII.—*Descriptions of* Aphides. By Francis Walker, F.L.S.

[Continued from p. 345.]

Eighth Group.

The following species is one of the most beautiful of the British Aphides, and is distinguished from all other kinds by its peculiar structure.

17. *Aphis Juglandis*, Frisch.

Aphis Juglandis, Frisch, Ins. xi. pl. 16. f. 1, 5.
Lachnus Juglandis, Kalt. Mon. Pflan. i. 150. 3.

The viviparous winged female. It feeds from July to October on the leaves of the walnut, *Juglans regia*, and is stationed in clusters along the middle vein of the upper side of the leaf. The body is pale orange: the head is darker, and rather short and broad: the front forms an angle where it retreats on each side, and is slightly concave in the middle: the feelers are filiform, and a little more than one-fourth, or sometimes full one-third, of the length of the body; the fourth joint is much less than half the length of the third; the fifth is a little shorter than the fourth; the sixth is less than half the length of the fifth; the seventh is much shorter and more slender than the sixth; the tips of these joints are black: the eyes are red: the mouth reaches to the middle hips; its tip is black: the discs of the chest and of the breast are black: the sides of the fore-chest are notched: the abdomen is rather large, and sometimes it contains upwards of thirty young ones which are all of the same size: the nectaries are extremely short, and less than one-twentieth of the length of the body: in the pupa there are four rows of brown spots along the back of the abdomen; the middle rows, which are confluent in the winged insect, have a short and slender transverse brown line on each interval between the spots: the fore-legs are much shorter than

* Zeitschrift für Wiss. Botanik, Heft 3, 1847. † *L. cit.*