3. The rhachis occurring in the vitellogene of certain Nematoidea is never an apparent one in Meissner's sense, but always an actual one.

4. Meissner's micropyle in the eggs of *Ascaris mystax* does not exist. Bischoff and Thompson have disputed its existence with perfect justice.

5. Whether the fecundation of the eggs is, or is not, effected by the penetration of the seminal corpuscles, remains undecided. At any rate, the observations published by Nelson and Meissner upon this point are insufficient to establish the penetration.

6. Meissner's theory of the conversion of the seminal corpuscles into fat is destitute of any solid foundation, and can by no means be sustained.

7. The formation of fat-drops takes place in great proportion in the unfecundated eggs.

8. Schneider's statement as to phænomena of movement in the seminal corpuscles of certain Nematoidea is founded upon very accurate observations, which are confirmed not only by our own, but also by those of G. Wagener and N. Lieberkühn.

XX.—*On the Investigation of Vegetable Tissue by the aid of Polarized Light.* By H. von Mohl*.

Polarized light offering a most sensitive means of discovering very slight differences, such as cannot be detected in any other way, between bodies which in every other respect behave exactly alike, the idea readily suggested itself of applying it in combination with the microscope to the examination of the structure of organic bodies. In addition to the isolated observations of Biot, Brewster, and others, we possess more comprehensive treatises on the investigation of vegetable tissue by means of the polarizing microscope, by K. von Erlach, Ehrenberg, and Schacht †. Of these, Erlach occupied himself more with the physical explanation of the phænomena which doubly-refracting substances exhibit on the polarizing microscope, than with extended researches upon vegetable structures.

The most general conclusion which Erlach drew from his researches was, that every organic substance of a certain thickness,

* Botanische Zeitung, January 1, 1858.

† Dr. Karl v. Erlach, Müller's Archiv f. Anat. u. Phys. 1847, p. 313. Ehrenberg, Bericht Berlin, Akad. 1849, p. 55. Schacht, Pflanzenzelle, 1852, p. 429; Lehrbuch d. Anat. u. Phys. d. Gewächse, 1855, i. p. 428. Whether the works of Boeck should be enumerated here, I know not, since I have not access to the originals, and the extract given by Hannover (Müller's Archiv, 1844) is too imperfect.

in its natural condition, has the power of diverting transmitted polarized light in determinate directions. As a special investigation, he devoted his attention especially to the examination of the cells of the coats of bulbs, in which he observed that the horizontal section of their wall is invisible on the dark field when the walls are placed parallel with the plane of polarization of the transmitted rays, while they are seen with more or less bright illumination when they are placed obliquely towards this plane, and appear in the brightest light when they are inclined at an angle of 45° to this plane. He subjected the phænomena exhibited by starch-granules to elaborate investigation, and explained the analogy between them and cell-walls. He overlooked the distinction which exists between these two classes of structures in their action upon polarized light. In nuclei, and in the other granular structures occurring in cells, he likewise detected traces of an influence exerted upon polarized light.

Ehrenberg's treatise differs essentially in character from that of Erlach. While the latter worked more as a physicist, and endeavoured to deduce by the aid of calculation, from a small number of accurate observations, the laws according to which vegetable matter acts upon polarized light,—Ehrenberg's essay is infinitely richer in observations in all the kingdoms of nature, but on the other hand, his theoretical reflections are less satisfactory. In opposition to Erlach, Ehrenberg totally denies that all organic tissues possess the power of doubly-refracting light; in particular he disputes the existence of this property, among the class of objects now under consideration, in the nucleus of the vegetable cell, chlorophyll-granules, yeast, inulin, the tissue of fleshy and filamentous Fungi, and in the scales upon the leaves of *Olea, Rhododendron,* and *Myrica.* He gives special illustrations of the scales of certain plants and of starch-granules. From the circumstance that the scales of *Tillandsia usneoides* and other plants, similar in structure to those of the plants above named, act very strongly upon polarized light, while the others do not exert this influence, he drew the conclusion that the cause of the action of those scales did not lie in the organic structure alone, and in the arrangement of the membranous cells, but in some doubly-refracting substance that was spread over the external or internal surface of the membrane of those cells; this substance, though it agreed with starch in the character that it could be removed by acids, was not starch, because it could not be converted into dextrine by heating. In reference to starch, Ehrenberg remarks, that besides the ordinary roundish and longish granules in which a rectangular or oblique cross is visible under the polarizing microscope, there exists a third form (in *Alpinia Galanga* and allied plants), where the granules are extended lengthwise, and in which black longitudinal striæ are visible in polarized light. He was inclined to attribute the doubly-refracting property of starch-granules and the substance contained in the scales of plants, not to conditions of tension, but to a minute crystalline condition, somewhat comparable to the concentric arrangement of the needles of carbonate of lime in pearls and pisolites.

Schacht's essay is an extremely small affair. It acquaints us with one single correctly observed fact not mentioned by his predecessors, namely the appearance of a black cross in the vicinity of the pits of fir-wood, of the endosperm-cells of *Phytelephas*, &c. All the rest of his statements (omitting the long-known and unmistakeable fact that starch-granules and transverse sections of thick-walled cells of plants exhibit a black cross) are false. The whole work is consequently not merely valueless in itself, but positively injurious, since it is only calculated to lead inexperienced readers into error. According to Schacht, unstratified membranes (cambium-cells, the parenchyma of young organs) do not possess the power of doubly-refracting light. This is totally false: equally devoid of truth is the statement that the polarizing microscope may be employed to detect whether vegetable cell-membrane has formed broad layers of thickening. Not less false is the further assertion, that the chemical character of vegetable matter is not concerned in its effects upon polarized light: the very reverse is the case. In the same way, the assertion is incorrect that vegetable membranes do not act upon polarized light when it passes through in a direction perpendicular to their surface.

If my investigations have led to the discovery of phænomena that escaped my predecessors, the reason lies not in the application of new apparatus, but chiefly in the circumstance that I took great pains to give the polarizing microscope the most advantageous arrangement, and especially to improve the illumination. It would lead me too far to enter into a description of the contrivances that suggested themselves to me; I shall take another opportunity of doing this.

In passing to the account of the phænomena which the vegetable tissues exhibit in the polarizing microscope, I shall confine myself to the detail of the facts, and only intersperse theoretical considerations so far as they may appear necessary for the comprehension of the phænomena, by those who are not acquainted with the properties of polarized light and of doubly-refracting substances, which come into play here.

I commence with the consideration of the *cellulose membranes*. The action which these exert upon polarized light, is perhaps shown most clearly in the examination of a thin transverse section of regular circular structures, it being of little consequence here whether we select the section of a colourless or only slightly tinged * cylindrical cell, for instance, of a *Nitella*, or of a cylindrical vessel, for example, of the pitted tubes of a monocotyledonous plant, or the ring of an annular vessel. With the crossed position of the Nicol's prisms, such an organ presents itself in the black field of the microscope in the form of a ring, self-luminous with white light. But its light does not exhibit the same intensity in all parts. In the direction of two lines crossing at right angles in the centre of the ring and standing perpendicular to the transverse diameter of the rhombic surfaces of the Nicol, the ring is destitute of light, so that it is invisible at these places, and appears divided by thin black stripes into four quadrants, each of which exhibits the greatest illumination in the middle (at a distance of 45° from the dark stripe), and becomes gradually duller outwards toward the black stripes.

If the Nicols are placed parallel, the organ is seen on a bright field, as in the ordinary microscope, like a transparent body, but here again not uniformly bright, for now the previously black invisible parts of the ring transmit the brightest light, while the formerly most clearly illuminated parts appear more or less darkened.

To pause a moment at this long-known fundamental phænomenon, and give an explanation of it, may not be superfluous to many readers, and this is the more important, since the explanation of most of the subsequent observations follows at once on the comprehension of the facts above stated.

The lower Nicol's prism, placed between the mirror and the object, divides the light into two halves, which, according to the now generally accepted undulatory theory, are so separated from one another, that the plane in which the waves of one portion vibrate, stands perpendicular to the plane of vibration of the other portion. One of the halves of the light suffers total reflection by the Nicol, and hence does not arrive at the object; the other half, whose rays, as above said, all vibrate in one plane, pass through the Nicol to the object and through this into the microscope. This light however is incapable of passing through the Nicol placed above the eye-piece, when this is made to cross the lower Nicol at right angles; therefore the field of the microscope appears black. But these rays pass unobstructedly through the second Nicol when it is placed parallel to the first, and hence

* Dark colour of the membranes, as in many tropical woods, ferns, &c., offers great obstacles to the detection of phænomena of polarization. When such organs are investigated, it is requisite to destroy the colour by means of oxidizing agents, for instance, with Schulze's mixture of nitric acid and chlorate of potash.

in this case the field appears light, as in the ordinary microscope.

If, when the Nicols are in a crossed position, we place a simply-refracting body, for instance a crystal of common salt, in the focus of the microscope, this exerts no influence on the polarized light coming from the lower Nicol: the light passes through the body freely, without suffering any alteration of the direction of its vibration, and is incapable of arriving at the eye through the upper Nicol; so that the body is not seen. But the conditions are essentially different when a doubly-refracting body, *e. g.* a plate of mica, selenite, &c., is placed in the focus of the microscope. When such a body is revolved in a horizontal direction round the axis of the microscope, it will behave in four positions like a simply-refracting body, and be invisible; this invisibility will supervene anew each time the body is rotated a quarter of a circle from one of these positions, while in the intermediate positions the body will be visible. If now in each of these four positions in which the body is invisible, we draw in imagination, or in reality, upon it, passing through its centre, a line which stands perpendicular to one of the two Nicols, we find upon the body two lines crossing at right angles, which are designated as the neutral axes. In using this name, it must be kept in view, that it implies not only the lines drawn through the centre of the body, but also those which run parallel with them, and that these denote the two directions, crossing at right angles, of which one is parallel to the direction of vibration of the polarized light, the other perpendicular to the same, when the object is invisible. Therefore when it is desired to draw a figure of these axes, they must not be represented in the form of two lines crossing at right angles, but as two systems of parallel lines crossing each other at right angles.

If the doubly-refracting body is placed in any other position, it will be visible through the upper Nicol, and with a light proportionately brighter, as the angle under which its neutral axes are inclined toward the transverse diameter of the Nicol, approaches an angle of 45°. The undulatory theory explains this becoming-visible of the body by the assumption that the polarized light, when its plane of vibration is not parallel with one of the neutral axes of a doubly-refracting body, is divided in its passage through the latter into two portions, whose planes of vibration are perpendicular to each other, whereby the light modified in this way acquires the power of passing, certainly with more or less diminished intensity, through the upper Nicol, and of rendering the body in whose interior this division of the light into two bundles occurs, visible, as an apparently self-luminous object*.

* The reader who desires more detailed information respecting the

If the Nicols be placed parallel, the neutral axes of the object standing perpendicular to surfaces of the Nicols, the light will pass unaltered through the object and the upper Nicol; but when the neutral axes are rotated under 45° in relation to the Nicol, the light will suffer the above-described decomposition, and pass through the upper Nicol with diminished intensity, and the body will consequently appear more or less dark in comparison with the free part of the field.

The foregoing phænomena place us in a position to investigate whether a body possesses a doubly-refracting power, and in what direction its neutral axes lie.

If we direct our attention to the vegetable organs above mentioned, it is clear, from their becoming visible in polarized light, that their substance is doubly-refractive, and, from the position of the four black lines, that one of the neutral axes lies in the direction of the tangent of the circle, the other in the direction of the radius. Since it is known that the membrane of these annular structures is composed of concentric layers, the said phænomena indicate that in a lamellated cell-membrane viewed in its transverse section, one neutral axis is parallel with the lamellæ, the other perpendicular to them.

This is confirmed by the examination of any cellular tissue whatever, in which it is found without exception, that those side-walls of the cells which stand in a position perpendicular to one of the two Nicols, are invisible, and that those membranes appear in brightest illumination which are inclined at an angle of 45° towards the Nicol.

However, the phænomena differ to a certain extent in thick-walled and thin-walled cells. On the surface of a transverse section of a thick-walled cellular tissue, for instance of the albumen of *Phytelephas,* in which each individual cell, it is true, represents in its extreme outline a quadrangle with straight sides, but the secondary layers, in proportion as they lie more internally, approach more and more the form of a circle by the rounding-off of their angles,—it is impossible, from the curved form of the majority of the layers, that any side-wall of a cell can be placed perpendicularly to one of the Nicols in its whole extent. Hence, in such a cell almost the whole of the surface of the section will be visible in every position in polarized light, and all that is seen is, as in the circular structure alread mentioned, four black stripes, standing at right angles to each other, but less regular in form and position than in the trans-

optical matters here concerned, and in particular as to the intensity of the light dependent on the angle of inclination of the neutral axes to the diameter of the Nicol, will find a minute account in the treatise of Erlach above mentioned.

verse section of a cylindrical cell, because the inner and outer layers of the cell-wall have not the same accurate concentric arrangement as in the latter.

The transverse section of a thin-walled tissue formed of polyhedral cells, in which the cut surfaces appear in the form of straight lines, presents an appearance deviating in many respects. In such a section a more or less considerable number of the cell-walls are placed perpendicularly to one of the two Nicols; these consequently remain totally invisible, while the remainder of the walls, standing obliquely as regards the Nicols, appear uniformly bright in their whole length. From the apparent deficiency of part of the cell-wall, the figure acquires an unconnected appearance, and looks as if it were a torn and imperfect preparation. But if, while looking into the microscope, the object is rotated in a horizontal direction, the previously invisible cell-walls emerge from the darkness, while others previously illuminated become invisible.

To see these phænomena in their full beauty, choice should be made of a thin transverse section of a tissue composed of more or less elongated thin-walled cells, *e. g.* of the stem of herbaceous Monocotyledons, or of the wood of *Æschynomene paludosa*: the transverse section of short polyhedral cells, *e. g.* of Elder pith, is less advantageous, because in this, horizontal walls of cells and obliquely-directed side-walls come into view in many places in company with the horizontal external surfaces of the side-walls, which produces a complication of the phænomena. In making the preparation, two points must be borne in mind. In the first place, the section must be made thinner in proportion as the substance of the object acts more strongly upon polarized light. The best image is obtained when the preparation appears with bright white light: if the section be too thick, it presents more or less of prismatic colouring in its different parts, which is unfavourable in many investigations. The second precaution, which must never be lost sight of, relates to the fluid in which the object is kept. Most vegetable substances refract light far more strongly than water: in the same degree as this circumstance is favourable in ordinary microscopic investigations, is it unfavourable in researches with the polarizing microscope. In this the best image is obtained when the refractive power of the preservative fluid stands as near as possible to that of the object. Hence, when the nature of the object allows, as is the case with cellulose membranes, starch-granules, &c., it should not be examined in water, but in essential oil, for instance oil of turpentine, or mounted in Canada balsam or a similar resinous substance. The more transparent the preparation becomes, the more beautiful is the image that it gives.

We will examine, in the first place, whether the power of cell-membrane to doubly-refract light is connected with its lamellation. Schacht asserts this most decidedly, for he states that only thickened cell-membranes are doubly-refractive; that very delicate-walled vegetable cells (such as the cambium-cells of the vascular bundle of *Abies pectinata*, the parenchyma of young structures, the tissue of Fungi and Lichens) are completely invisible upon the dark field, and therefore simply refract light; and that consequently it may be determined by the polarizing microscope whether or not a cell has already deposited layers of thickening. These statements are false. Even from theoretical reasons, it was not to be assumed that a lamellated membrane which is traversed by light parallel with the planes of lamellation, acts as a doubly-refracting body on account of its lamellation,—the property of double refraction must depend upon the arrangement of the molecules in each of the separate layers. It is without doubt within the limits of possibility that primary membrane should be distinguished in this respect from the secondary layers; but observation proves that this is not the case. It is a known fact that a doubly-refracting body acts the more weakly upon polarized light the thinner it is, wherefore in very thin lamellæ of crystals, as well as in organic membranes, the effect may be reduced below the last degree of which the detection is possible. Hence in examining young vegetable structures we cannot expect to see their thin membranes upon the black field with the same brightness as in thick-walled cells. Nevertheless, in almost all the cases examined by me, the membranes which from their youth and organization we are accustomed to regard as primary, behaved to polarized light most clearly in the same way as those of thickened cells, that is, as doubly-refractive. In particular, the membranes of the cambium-cells of all the Dicotyledons I examined, *e. g.* of *Pinus sylvestris, P. nigricans, Impatiens Balsamina, Sambucus Ebulus,* and especially clearly that of *Viscum album,* appear in bright light when placed at an angle of 45° to the Nicol; still more clearly was this the case in the membranes of the clathrate cells (*gitter-zellen,* Mohl) erroneously referred to the cambium, both in Monocotyledons, for instance in *Musa, Canna, Renealmia nutans,* and Dicotyledons, *e. g.* in *Bignonia*; which membranes, it is true, are already, as their pits show, composed of a number of lamellæ. The same appearances were equally clear in the cell-membranes of the embryo of *Pinus Pinea,* in the cambial tissue of the apex of the stem of *Cocos coronata,* and in the primary coat of the spiral cells of *Echinocactus multiplex.* In certain very thin-walled fibrous cells, as in those of the leaf of *Sphagnum cymbifolium,* and those of the wing of the seed of *Swietenia Mahogani,* the action exerted upon polarized light by that portion of the membrane not covered by fibre was certainly so weak, that it could not be detected without the interposition of a doubly-refracting medium between the lower Nicol and the object; but by the aid of this, that is to say, by interposing a thin plate of mica, it appeared most clearly. The assertion that the primary cell-membrane forms an essential contrast to the layers of thickening in respect to its behaviour towards polarized light, is therefore decidedly incorrect. No better grounded did I find Ehrenberg's statement, repeated by Schacht, that the scales of the leaves of *Olea, Rhododendron* and *Myrica* do not act on polarized light; for the scales of *Olea europæa, Rhododendron hirsutum,* and *Myrica quercifolia,* especially the first two, most decidedly possess this power, although in a weak degree.

It is not meant here, however, that the substance of all cell-membranes acts with uniform force upon polarized light, and that the brightness with which a membrane appears upon the black field depends only on its thickness. On the contrary, most important distinctions in this respect occur, according to the modifications which the cellulose exhibits in different cells, and indeed according to the diversity of the foreign matters imbedded in the cell-membranes. In general, a cell-membrane acts the more strongly upon polarized light, and appears in the greater brightness, the more solid its substance is, and *vice versâ*; hence, in general, wood-cells and liber-cells appear most illuminated: the membranes of ordinary parenchyma likewise possess this property in a high degree, for which reason a delicate cross section of a stem, especially of a monocotyledonous plant, presents a most elegant picture, through the contrast which is made by the silvery lustre of its cell-membranes with the black ground of the field. But when the cell-membranes swell up more or less with water into a gelatinous condition, as in the Fucoideæ, or in the collenchyma-cells lying beneath the epidermis, *e.g.* of *Sambucus Ebulus, Beta,* or *Rheum,* their capability of becoming visible in polarized light diminishes to a more or less considerable extent. This is the case in a particularly high degree when the disintegration of the outer layers of the cells goes so far, that they are blended into what appears like a homogeneous intercellular substance. Yet even in these cases the power of acting upon polarized light is perhaps never totally lost; at least I found the intercellular substance of *Fucus vesiculosus* decidedly doubly-refractive; and the slimy substance of *Nostoc commune,* of *Collema nigrescens* and *C. flaccidum* behaved in a similar manner. The apparently perfectly structureless intercellular substance in the endosperm of many Leguminosæ also, for instance of *Sophora japonica* and *Schizolobium excelsum,* acts decidedly upon polarized light; here, however, in the irregular masses which these substances form in the swollen-up condition, the position of the neutral axes can no longer be discovered, but certain not clearly defined parts of the substance appear light, others dark, and on horizontal rotation of the object become alternately light and dark. In the swollen cells of gum-tragacanth likewise, traces of double refraction may still be detected.

Besides these more or less disorganized membranes, cell-walls occur in many plants which exert only a very weak effect upon polarized light. To these belong, for example, the parenchymatous cells of the cotyledons of *Lupinus hirsutus,* in spite of the considerable thickness they possess. The same is the case in most of the cells of the Lichens and Fungi. That these are simply-refracting bodies, as Ehrenberg asserted of the membranes of Fungi, and Schacht of these and of those of the Lichens, is incorrect. In the Lichens the looser filamentous cells of the so-called medullary substance exhibit an action upon light at least evident in all cases, for example in *Roccella fusiformis* and *Parmelia ciliaris,* while the firmer central substance of *Usnea,* and, above all, the cortical layer of all the Lichens I have examined, act with tolerable strength. In the Fungi the facts differ a good deal according to the species. While in many species of very delicate structure, for instance in the mycelium of *Erisyphe,* the effect, though always evident, is but weakly exhibited; in other species, the first glance removes all doubt that the thin cell-membranes behave towards polarized light in exactly the same way as the cellulose membranes of the Phanerogamia. Thus the threads of *Mucor Mucedo* and *Ascophora Mucedo,* and the filamentous Cells of *Merulius lacrymans,* presented themselves, notwithstanding their delicacy, in very bright light: still more evidently was this the case in Fungi of firmer consistence; for instance, in the cells of the outer peridium of *Geaster rufescens,* and more especially in the cells of the pileus of the harder *Polyporei, e.g.* of *Polyporus hirsutus,* in which, notwithstanding the small diameter of the cross section of the filaments, I repeatedly saw most distinctly the black cross corresponding to the neutral axes. These appeared on the surface of transverse sections of the rather thick coat of the unripe spores of *Tuber cibarium,* with a clearness equal to that in the cross section of a vessel of the Phanerogamia. The spiral cells of the capillitium of the *Trichiæ* also are among the membranes acting powerfully upon polarized light.

Not only do the cells of different plants, or the cells of different organs of the same plant, thus exhibit great distinctions in their effect upon polarized light, but not unfrequently a similar distinction occurs between the different layers of one and the same cell, whence the polarizing microscope is in many cases a means of rendering visible, lamellæ which are difficult of detection with the ordinary microscope. In this respect it is a pretty common phænomenon for the primary membrane, and likewise the tertiary layer immediately lining the cavity of the cell, to act more powerfully upon polarized light than the secondary layers; they therefore appear in far brighter white light than the latter. In particular cases, for instance in the parenchyma-cells of the cotyledons of *Lupinus hirsutus*, the secondary layers act so weakly, that when an objective which does not admit a great deal of light is used, they are almost invisible without the interposition of a doubly-refractive medium in the illuminating apparatus, while the primary and tertiary membranes appear in the form of delicate luminous lines. In like manner, in the collenchyma-cells of the stem of *Sambucus Ebulus* and *Cucurbita Pepo*, the primary membrane is most remarkably distinguished from the disintegrated secondary layers, which I formerly erroneously regarded as intercellular substance, by a far greater brilliancy, so that one may make most absolutely certain that the so-called intercellular substance is here not deposited between the cells, but is traversed by the primary cell-membranes. A similar, although not so clearly marked contrast between the primary and tertiary membranes, occurs also in many thick-walled wood- and liber-cells; for instance, in a high degree in the thick-walled cells of the vascular bundles of the outer layers of the stem of *Aletris fragrans* and in the liber-cells of *Rosa canina*; and in a less degree in the wood-cells of many Coniferæ, for instance of *Abies pectinata* and *Torreya taxifolia*. In other, but rarer cases, the primary membrane acts less strongly upon polarized light than the secondary layers, so that the latter appear separated from each other by a darkish line, for instance in the endosperm of *Phytelephas*.

Cellulose membranes undergo no essential alteration in their behaviour to polarized light when they are freed from the compounds deposited in their substance, by boiling in Schulze's mixture of nitric acid and chlorate of potash. We must conclude from this, that the action exerted by the cell-membranes is attributable to the cellulose itself of which they are formed, and depends upon the arrangement of their molecules connected with their organic structure. Ehrenberg, from the behaviour of the scales of certain plants, promulgated the opposite opinion. He thought he had found that many scales, such as those of the leaves of the Olive, do not act upon polarized light, while others, such as those of *Elæagnus* and *Tillandsia usneoides*, exert this influence in a high degree. Believing, further, that he had discovered that the said property might be abstracted from the latter scales by the aid of acids, he came to the conclusion that the efficiency of the scales was not attributable to them as a consequence of their organization and the arrangement of their cells, but that the cells of the effective scales were lined or coated with a doubly-refractive substance, removable by acids. Not only, as above noticed, is this statement of the want of action in the scales of the Olive incorrect, but the second statement, that acids remove the efficiency of the scales of *Elæagnus*, is only correct in the most limited degree, and is explicable in a different way from that in which Ehrenberg viewed it. Even twelve hours' maceration of these scales in fuming nitric acid or hydrochloric acid exerts no influence upon them, while sulphuric acid in a short time weakens the property in question extremely, without however fully destroying it. As to the cause of this, microscopic examination of the scales treated in this way leaves no doubt, since it demonstrates that the sulphuric acid dissolves the secondary lamellæ of the cells, and reduces the cell-membrane to an excessively thin pellicle. Consequently these scales cannot be adduced in evidence to prove that cellulose does not possess, independently and in itself, the property of double refraction. This renders superfluous any discussion of the hypothesis appended by Ehrenberg, that this unknown substance lining the cells may be crystallized.

It might be conjectured that the remarkably active effect which the epidermal cells of *Equisetum hyemale* exert upon polarized light, is to be ascribed to the deposition of abundance of silica in the substance of their cell-membranes. But this conjecture finds no confirmation in the circumstance that the effect of these membranes upon polarized light is exceedingly weakened when their organic substance is destroyed by heating to redness. However, this operation does not entirely destroy this action, neither does it in the Diatomeæ, in which, contrary to the statement of Ehrenberg, lately confirmed by J. W. Bailey (Quarterly Journal of Microscopic Science, 1856, p. 303), many forms, namely various species of *Navicula, Synedra,* but especially of *Pleurosigma,* and *Melosira arenaria,* were found by me to be decidedly doubly-refractive.

[To be continued.]

PROCEEDINGS OF LEARNED SOCIETIES.

BOTANICAL SOCIETY OF EDINBURGH.

January 14, 1858.—Dr. Seller, President, in the Chair.

The following papers were read :—

1. "On the Occurrence of a new *Muscari* on Mount Ida," by Dr. John Kirk.

In April 1856, the author and two other medical officers of the