a number of chordæ tendineæ to the posterior wall, where it makes its exit;" a contrivance which permits the blood to pass between the rectum and the little valves, but prevents its reflux.

BOTANICAL SOCIETY OF EDINBURGH.

July 9, 1857.—Professor Fleming, President, in the Chair.

Professor Balfour exhibited specimens of *Bryum pallescens*, collected by Mr. W. Wilson near Warrington.

The following papers were read:—

1. "Notice of Cryptogamic Plants found near New Abbey," by the Rev. Hugh Macmillan.

During May 1857, at New Abbey, in Kirkcudbrightshire, I was particularly struck with the immense profusion of *Parmelia Borreri* and *P. tiliacea*. They occurred on almost every tree—pines, oaks, and ashes indiscriminately, sometimes even to the complete exclusion of the common species, such as *P. saxatilis* and *pulverulenta*, which usually monopolize their bark. I found them, also, occasionally spreading in large patches over rough boulders of grey granite. I gathered here and there a few specimens of both species, covered with fine apothecia. They occur in a little wood, with a stream running through it, at the base of Criffel, a lofty mountain rising up immediately behind New Abbey; also in Shambelly Wood, along with immense quantities of *Parmelia caperata* and *perlata*, *Sticta limbata*, *fuliginosa* and *scrobiculata*, and *Opegrapha elegans*, which affects most of the smooth-barked trees, and is particularly beautiful and luxuriant on the hollies. *Hypnum Crista Castrensis* is very abundant on mossy boulders, in damp shady places in the same wood, and *Parmelia sinuosa* occurs sparingly on the exposed rocks at the top of the wood; while *Neckera pumila* spreads in large patches over the oak- and beech-trees, amid dark masses of *Jungermannia tamariscifolia*.

2. "On the occurrence of *Pertusaria Hutchinsiæ* and other rare Lichens on the Breadalbane Mountains," by Mr. Alexander C. Maingay.

3. "Notice of Localities for some of the rarer Plants collected during the recent excursions of the Botanical Class around Edinburgh," by Professor Balfour.

4. "Remarks on certain Glandular Structures in Plants," by Mr. George Lawson.

The author stated that our knowledge of this subject had not kept pace with other branches of vegetable physiology, for it was very much in the same position in which Meyen left it twenty years ago. He pointed out many instances in which the secretions of plants were poured out upon the surface and into the cavities of the plant, and not stored up in its constituent cells; and referred particularly to the glands of Rubiaceæ, Galiaceæ, Aurantiaceæ, Passifloraceæ, &c. The statement that glands are modified epidermal cells, has long remained unquestioned. Some years ago Dr. Weddell discovered peculiar glands in Cinchonaceæ, and the results of his observations, as well as of my own, on the similar glands of Galiaceæ were detailed to the Society (Ann. Nat. Hist. ser. 2. xiv.). The homological character of these glands was not then referred to; for when viewed in connexion with the glands of Sundew and some other plants, their structure did not appear explicable on the supposition that they were formed of epidermal cells. Since my former paper was published, an extended series of observations on vegetable glands, and especially on the stipules of plants belonging to the Apocynaceæ, has shown that the cinchonaceous glands, and all other forms, are reconcilable with the idea of epidermal origin. The cinchonaceous gland consists of two kinds of cells, one of which represents ordinary leaf-tissue, and the other may be regarded as the epidermal cells transformed for secretion. The gland is, in fact, the homologue of the leaf,—a leaf very much reduced in size, as stipular leaves usually are, and with its epidermal cells changed into secreting ones; and it closely resembles in structure the stipules of *Dipladenia*, which no one can regard as being other than reduced leaves. When we see a gland thus formed by a cone of tissue elevated above the general surface of the organ to which it is attached, with its whole epidermal surface consisting of secreting tissue, we can readily understand how an epidermal gland can also be formed in the tissue of the plant, by simply introverting the epidermis. In this way the remarkable ovarian glands of endogenous plants are explained, and probably also the imbedded glands of the Orange, the latter bearing the same relation to the cinchonaceous gland as the conical receptacle of the Strawberry does to the hollowed-out receptacle of the Fig. The ovarian glands of Endogens are especially deserving of attention on this point, for we find them of very frequent occurrence; and in cases where three or more carpels are united into one fruit, these glands always occupy a position corresponding with the points of union of the carpels. Irrespective of histological characters, the glandular tissue is seen in these cases to be necessarily formed by the contiguous layers of epidermis where the two surfaces of the carpels are brought into contact.

5. "On the Development of the Yeast Plant," by Mr. John Lowe.

Mr. Lowe observed, that, under the microscope, brewers' yeast consists entirely of cells, spherical in form, transparent and nucleated, varying from $\frac{1}{7500}$th to $\frac{1}{2500}$th of an inch in diameter. The nuclei are highly refractive, and vary from two to ten in number. These nuclei were termed 'globuline' by Turpin.

The growth of yeast has been divided by Pereira into three stages. 1st, that in which the cells are single; 2nd, that in which they have become elongated, and form a mycelium; 3rd, that of aërial fructification. The first stage, or that of yeast proper, is said by Mitscherlich to consist of two kinds, viz. *Oberhefe* (or surface-yeast) and *Unterhefe* (or sediment-yeast). These two varieties are propagated in different ways, and each produces specific results upon the fermenting liquor. The *Unterhefe* is the ferment of Bavarian beer, which is allowed to ferment very slowly and at a low temperature. The formation of lactic and acetic acids is thus avoided. The following is a brief account of the changes which I have observed yeast to undergo in the process of fermentation at the distillery of Messrs. Duncanson, and at the brewery of Messrs. Jeffrey, to whose kindness I am much indebted. Before its application to the wort, yeast is seen to consist of isolated cells of a spherical form, intermixed with some which are oval or tubular. These latter are only formed on the surface of the yeast where it has come in contact with the air. They are the commencing mycelium, and should never be present in any considerable quantity, as they materially affect the process of fermentation. The spherical cells are seen to be of two kinds; the one having a thin, very transparent cell-wall, containing from two to ten nuclei; these are found in yeast which has become sour, and they are usually met with at the bottom of the yeast-cask. They appear to correspond with the *Unterhefe* of Mitscherlich. In specimens of yeast kept in bottles, I have found that the cell-wall became thinner and the nuclei more numerous in proportion as the fluid became more acid. The other kind of cell has a thicker cell-wall, and contains, instead of a number of nuclei, a large, globular, granular mass or blastema, which, in older yeast, is converted into nuclei. This is the most perfect form of yeast, and is the only kind which should be used. Its activity I have found to be always proportionate to the thickness of the cell-wall; and this, a most important subject to brewers, can easily be determined under the microscope, and thus the value of any specimen of yeast made apparent. After being added to the wort, yeast, which consists of the two varieties of cells above mentioned, is observed to undergo two kinds of growth. The nucleated cells, with the thin walls, burst and liberate the nuclei (*globulins seminifères* of Turpin), which then increase in size and become like the second kind of cells. This is the form of propagation which Turpin observed in the rupture of the cells, although he makes the cell-contents appear to be finely granular instead of nuclear. I am satisfied that it only takes place in old, acid yeast, and not, as Turpin imagined, as a result of normal fermentation; and this explains why others have failed to observe the process of bursting in fermenting yeast, for it can only be seen on the first addition of the yeast to the wort; and, moreover, in new yeast these cells are often altogether absent. The thick-walled cells and the enlarging nuclei, after the period varying according to the temperature and the activity of the yeast, are observed to put forth minute bud-like processes, which soon separate and enlarge themselves, afterwards undergoing the same process. This is the second mode of growth noticed by Turpin, and is, in fact, the only result of true fermentation. My own observations confirm those of Mitscherlich, who thinks the two modes of propagation just mentioned are the only ones, and that the conversion of '*globuline*' into cells is entirely erroneous. The budding was observed by Turpin to begin after an hour, and the gemmations were doubled in size in three hours; in eight, they had attained the size of the maternal cell. There can, however, be no stated time for these changes, for they vary with the temperature. In distillery-wash, which is worked at a much higher temperature than brewery-wort, the process begins much sooner, and is sooner completed; and, as might be inferred from the fact of their rapid growth, the cell-walls are much thinner in the former than in the latter. One very important fact results from this, viz. that yeast which has been worked at a high temperature loses a considerable amount of its activity. It is, in fact, "forced;" and if yeast of this kind be applied at once to work at a lower temperature, the process of fermentation will be late in commencing, and will often stop. If, however, the yeast be allowed to stand for a day or two, it recovers some of its activity, but it is never so good for working at a lower temperature; and, therefore, as a general rule, yeast should always be worked at a higher temperature in each succeeding operation; that is, it should, if possible, be worked in cool wort before being applied to wort which requires to be worked at a greater heat. As soon as the process of fermentation has attained its maximum, the budding begins to decline, and ceases towards the close of the operation. The cells, which were before of very variable size, now become more uniform, and the nebulous mass in their interior assumes a more definite outline, and appears to be finely granular. After remaining on the liquor for five or six days, a portion of the cells which are exposed to the atmosphere become oval, and then elongated into tubes, multiplying still by gemmation and fissiparous division. Similar formations are also found in the sediment of the tun. This is the first stage in the formation of the mycelium, and exercises an influence of an important kind over the fermentation of the liquor. The subsequent changes consist in the formation of a mycelium composed of a network of ramifying tubes. These tubes are identical in form with those given in a previous paper, and need not therefore be again described. The perfect fructification in the specimens which I have examined is that of *Aspergillus glaucus*, but there can be no doubt, as I have before remarked, that other species and genera are also present. In proof of this, a series of experiments were made in Messrs. Jeffrey's brewery, with the following results: 1st, A quantity of mixed *Penicillia* and *Aspergilli* (*P. glaucum*, *Asp. glaucus*, *A. nigrescens*, &c.) were placed in a gallon of wort, at a temperature of 65° Fahrenheit, and allowed to stand in the tun-room. On the second day the surface was covered with specks of foam. On the third day the fermentation had fairly set in, and the surface became coated with pale yeast, which, under the microscope, exhibited oval non-nucleated cells in a state of gemmation. On the fourth day, the fluid gave off a nauseous 'foxy' odour, which disappeared on the sixth day, when the yeast-cells were observed to have become spherical, and in all respects like good yeast. On the eighth day the yeast was removed from the surface, and applied to a fresh quantity of wort at the same temperature. This entered into fermentation on the first day, and exhibited all the characters of perfect yeast. The second experiment was made by placing a portion of

Penicillium glaucum in wort under the same circumstances as in experiment 1. The same series of phænomena ensued, ending in the production of good yeast. A third and fourth experiment were made with *Aspergillus glaucus* and *A. nigrescens*, with like results, the only difference being that the sporules produced by the latter were at the commencement larger and more spherical than in either of the other species, from which it may be inferred that this species would yield a better kind of yeast. The idea that yeast can be produced spontaneously in nitrogenous fluids, we hold to be entirely erroneous, for we see that the lower class of Fungi are capable of yielding it, and from the general distribution of these, they must be present in every kind of exposed fluid.

Another subject which has not received the attention it deserves, is the growth of Fungi on malting barley. Whole floors of malt may be seen in summer-time covered completely with various Fungi, which grow from the interior of the grain, and ramify within the perisperm. These must have a most important influence on the saccharine matter contained in the grain, and there can be little doubt that they effect its decomposition, and cause an immense loss to the brewer. The fact that malt made in summer-time is never so sweet as that made in winter, sufficiently attests to the truth of this observation. It is not improbable, where the fungus is so abundant as I have sometimes seen it, that one-third of the saccharine principle is destroyed, and the foundation laid for the inefficient working of the wort during fermentation.

In conclusion, I would merely remark upon one or two cases of skin-disease which I have met with in those engaged amongst the yeast in breweries. Brewers, generally speaking, are not likely subjects for the growth of parasitic plants, but I have met with several cases which seem to me to prove that these are derived from the growing yeast, and thus tend to establish the proposition laid down in my last communication regarding the origin of skin-diseases. In one brewery I met with two cases of psoriasis annulata, and one of mentagra. These occurred in the only persons who were engaged amongst the yeast. The former were both situated on the right upper extremity, in the one case on the back of the hand, and in the other, on the anterior surface of the fore-arm, about 3 inches above the wrist. It commenced as a small red spot, and in eight days had attained to the size of a shilling. On examining it carefully under the microscope, a distinct mycelium was obtained, differing in no respect from the same growth in favus, with a recent specimen of which it was compared. I have not yet had an opportunity of making inquiries at all the other breweries, but I have little doubt that other instances of a like nature will be found. Drawings were exhibited in illustration of Mr. Lowe's observations.

6. "List of Desmidieæ observed in the neighbourhood of Dundee," by Mr. W. M. Ogilvie. Communicated by Mr. G. Lawson.

This list embraced upwards of fifty species, many of them rare.