PHILOSOPHICAL

TRANSACTIONS.

VII. *On Fairy-rings.* *By* W. H. Wollaston, *M. D. Sec. R. S.*

Read March 12, 1807.

THE circles of dark-green grass frequently observed in old pastures, and known to most persons by the name of Fairy-rings, although in themselves of no importance, yet seem to claim some attention, if we consider the many ingenious attempts that have been made to explain their origin. On such a subject I shall be excused offering any examination of opinions previously formed by others, and shall therefore proceed briefly to relate such observations as I made, during a few years residence in the country, on the progressive changes of these circles, and which seem to me to lead to a clear and satisfactory conclusion.

That which first attracted my notice, was the position of certain fungi which are always to be found growing upon these circles, if examined in a proper season. In the case of mushrooms, I found them to be solely at the exterior margin of the dark ring of grass. The breadth of the ring

in that instance, measured from them toward the centre, was about twelve or fourteen inches, while the mushrooms themselves covered an exterior ring about four or five inches broad.

The position of these mushrooms led me to conjecture that progressive increase, from a central point, was the probable mode of formation of the ring. I was the more inclined to this hypothesis, when I found that a second species of fungus presented a similar arrangement, with respect to the relative position of the ring and fungi; for I observed, that in all instances the present appearance of fungi was upon the exterior border of a dark ring of grass. I thought it not improbable that the soil, which had once contributed to the support of fungi, might be so exhausted of some peculiar *pabulum* necessary for their production, as to be rendered incapable of producing a second crop of that singular class of vegetables. The second year's crop would consequently appear in a small ring surrounding the original centre of vegetation, and at every succeeding year the defect of nutriment on one side would necessarily cause the new roots to extend themselves solely in the opposite direction, and would occasion the circle of fungi continually to proceed by annual enlargement from the centre outwards. An appearance of luxuriance of the grass would follow as a natural consequence, as the soil of an interior circle would always be enriched by the decayed roots of fungi of the preceding years growth.

By reference to Dr. HUTTON'S* "Observations on certain natural appearances of the ground of the hill of Arthur's Seat near Edinburgh," we find the progressive enlargement

* Edinburgh Transactions.

distinctly noticed; but as he happened not to observe any of the fungi that occasioned them, he speaks of it merely as "a piece of natural history worth recording, and for which, a theory is wanting."

Respecting the enlargement, he says, "from all the observations I have made, this progress seems always to have proceeded in the direction of a line bisecting the segment, that is to say, those portions of concentric circles are never inscribed but always circumscribed; and for this reason it appears, that those circles of which segments are exhibited to our observation must be increasing and not diminishing in their diameters."

Although Dr. HUTTON has overlooked the real origin of these appearances, Dr. WITHERING has ascribed them to their true cause; but his remarks are confined to one species of agaric (the *Ag. orcades* of his Arrangement), and do not appear to have been confirmed by any subsequent observation of their annual progress.

"I am satisfied," says he, "that the bare and brown, or highly cloathed and verdant circles in pasture fields called Fairy-rings are caused by the growth of this agaric."—"Where the ring is brown and almost bare, by digging up the soil to the depth of about two inches, the spawn of the fungus will be found of a greyish white colour; but where the grass has again grown green and rank I have never found any of the spawn existing."

Had Dr. WITHERING frequently repeated this examination of the soil he would have corrected the last remark, which is not universally true, as the grass may at some period be found luxuriant even over the undecayed spawn. During the growth

of the fungi, they so entirely absorb all nutriment from the soil beneath, that the herbage is for a while destroyed, and a ring appears bare of grass surrounding the dark ring. If a transverse section be made of the soil beneath the ring at this time, the part beneath the fungi appears paler than the soil on either side of it, but that which is beneath the interior circle of dark grass is found on the contrary, to be considerably darker than the general surrounding soil. But in the course of a few weeks after the fungi have ceased to appear, the soil where they stood grows darker, and the grass soon vegetates again with peculiar vigour; so that I have seen the surface covered with dark grass, although the darkened soil has not exceeded half an inch in thickness, while that beneath has continued white with spawn for about two inches in depth.

The section of the space occupied by the white spawn has in general nearly the same form, and may be compared to that of a wave proceeding from the centre outwards, as its boundary on the inner side ascends obliquely toward the surface, while its exterior termination is nearly in a vertical position. The extent occupied by the spawn varies considerably according to the season of the year, being greatest after the fungi have come to perfection, and is reduced to its smallest dimensions, and may in some cases not be discernible before the next year's crop begin to make their appearance.

For the purpose of observing the progress of various circles I marked them three or four years in succession, by incisions of different forms, by which I could distinguish clearly the successive annual increase, and I found it to vary in different circles from eight inches to as much as two feet. The broadest rings that I have seen were those of the common

mushroom (*Ag. campestris*); the narrowest are the most frequent, and are those of the champignon (*Ag. orcades* of Dr. WITHERING). The mushroom accordingly makes circles of largest diameter, but those of the champignon are most regular. There are, however, as many as three other fungi that exhibit the same mode of extension, and produce the same effect upon the herbage. These are the *Ag. terreus*, *Ag. procerus*, and the *Lycoperdon bovista*, the last of which is far more common than the two last mentioned agarics.

There is one circumstance that may frequently be observed respecting these circles, which can satisfactorily be accounted for, according to the preceding hypothesis of the cause of their increase, and may be considered as a confirmation of its truth. Whenever two adjacent circles are found to interfere, they not only do not cross each other, but both circles are invariably obliterated between the points of contact: at least in more than twenty cases, I have seen no one instance to the contrary. The exhaustion occasioned by each obstructs the progress of the other, and both are starved.

I think it also not unworthy of observation, that different species of fungi appear to require the same nutriment; for in a case of interference between one circle of puff-balls and another of mushrooms, they did not intersect; but I cannot say positively that I have seen more than one instance.

I once found that a tree had interrupted the regular progress of a circle; but this appeared to be only a temporary impediment, as the extension had proceeded at the usual rate, and by passing obliquely from each side into the soil beyond the tree, had given the ring the form of a kidney, so that

another year or two would probably reunite the two extremities into one curve surrounding the tree.

Being desirous of ascertaining in what length of time a soil might again recover the power of producing a fresh crop of fungi, I cut a groove, in one or two instances, along the diameter of a mushroom-ring, and inserted a quantity of spawn taken from its circumference, with the hope of seeing it vegetate for some distance near the center; but the experiment failed altogether: and as I shortly after quitted my residence in the country, I had no opportunity of repeating the experiment, and must leave it to be prosecuted by those who are more favourably circumstanced.