XXVII. *Observations on the Cause of Ergot.* By Mr. JOHN SMITH, A.L.S.

Read November 6, 1838.

THE substance called Ergot being a production which has given rise to a diversity of opinions, in regard to its nature and origin, and the more than usual quantity this season on several species of *Elymus* and other grasses in the Royal Botanic Garden at Kew having attracted my attention, I was induced to examine it, and I beg to lay the result of my observations before the Linnean Society.

Ergot is well known to be a black fungoid-looking body, seated within the floret, and protruding beyond the glumes (in the manner of a spur) of many species of grasses, especially the Rye. DeCandolle considers it as a fungus, and refers it to the genus *Sclerotium*. Fries also includes it among fungi, giving it the name of *Spermoedia Clavus*, with the following generic character:—“Variable, rounded, entophytal, rootless; of a fleshy, mealy, homogenous texture, with a rind concrete, scaly, or somewhat pruinose. Proper fructification none.” He concludes, however, by stating, that “it is only a morbid condition of the grain of corn, not propagated by seeds, but generated by a particular combination of external influences;” and observes that some consider Ergot to be caused by the puncture of insects. I had paid some attention to the subject for several years past, and from the circumstance of observing a peculiar species of fly settling on the ergot-bearing spikes, I was led to suppose that they were in some way instrumental in producing it; but what more particularly attracted my attention this autumn was, early one morning observing large drops of a brown-coloured liquid hanging from the spikes of an *Elymus*, which contained a number of full-grown ergots; and towards the apex of the spike, where the ergots were younger, I also observed nearly similar but more transparent drops.

This liquid in either state was found to be viscid, and of a sweet taste; and

as it has the smell of sugar and water, it occurred to me that the object of the fly's visits was to feed on this liquid. I collected part of this fluid in a phial, and on examining it in the microscope I found it entirely composed of myriads of generally uniform oblong transparent bodies, like sporidia of a fungus, slightly bent, with one indistinct spot near each end; these sporidia-like bodies freely dispersed on diluting the viscid fluid with water, but retained their forms: I at the moment considered them to be the sporidia of the ergot, and I was led the more to believe so, as on applying a drop of water to a full-grown ergot, multitudes of them became disengaged from its surface, and from the cracks or longitudinal fissures, which generally characterize the ergot, the water so impregnated having a milky appearance.

I also found the same bodies on the glumes and other parts, with which the liquid, having run, had come in contact, and which, when hardened by evaporation, gave the parts a dark appearance.

On further examination I found the same bodies on ergots of all sizes, even on the youngest, and on opening yet unexpanded florets towards the apex of ergot-bearing spikes, I frequently detected them on the surface of different parts of the fructification, especially on the anthers and ovarium, and in little clusters on the hairs and feathery stigmas. Many florets, however, were destitute of them.

Now as these bodies have been found to accompany the ergot through all its stages, and are present before the impregnation of the ovarium, at least before the discharge of the pollen, and, consequently, before there is any appearance of an ergot being about to be formed, they cannot be its seeds, but no doubt are in some way the primary cause of it; and it now remains to determine what these sporidia-like bodies are. On examining an ergot of *Elymus* (or of any other grass) before it has been moistened, its surface is seen to have a chalky or dirty white colour, which viewed in the microscope is seen like a thin crust having a pruinose snowy appearance, and readily separating on the least application of moisture into myriads of the sporidia-like bodies: on viewing this crust in a dry state, the pruinose appearance is seen to be caused by these bodies being joined together lengthways into slightly elevated spicula, and thus forming a crust.

On extending this examination to the anthers, where they appear to me first

to originate, I found the anther irregularly covered with numerous distinct, short, simple or ramifying articulated filaments, the articulations or side ramules being of the size and form of the sporidia; sometimes the filaments were more elongated and naked, or destitute of lateral sporidia. On examining a spike of *Phalaris aquatica*, in which the anthers had been developed, I found their withered remains adhering to the apex of the glumes bearing the same kind of filaments, but black by exposure; they gave out the same-shaped bodies in water, and on the glumes lower down there was a concrete chalky-like substance entirely composed of them; but the ovaries had yet no appearance of being ergotized, although ergots were found on other spikes of the same plant. From the above statement I am led to consider these bodies as the joints of a minute articulated fungus, which is developed in the early stage of the floret, and increases rapidly, ultimately forming a crust, and propagating itself by a total separation of the joints on the application of moisture; this, no doubt, impregnates the soil or adheres to the perfect seeds of the grass, which on germination and subsequent growth, carry up some of the reproductive matter of the fungus, which again developes itself in the anther*, where it may act with the pollen in the impregnation of the ovulum, causing a morbid growth of the albumen, which continues to swell, and forms an elongated oily fungoid body or ergot on which the minute fungus seems to originate. My conclusion therefore is, that Ergot is not an organized fungus, but the result of the action of a fungus.

List of Grasses on which Ergot was found.

Elymus giganteus.	Arundo Phragmites.
——— sabulosus.	Molinia cœrulea.
——— canadensis.	Milium multiflorum.
Lolium perenne.	Arrhenantherum avenaceum.
Agropyrum maritimum.	Phalaris aquatica.
————— caninum.	Phleum pratense, no ergot, but the
Dactylis glomerata.	fungus on the apex of the glumes.
Avena pubescens.	

* Similar to what Mr. Bauer has shown to be the way in which the smut, and grainworms of the wheat are propagated.

I had not the opportunity of examining the rye in a young state, but have found the oblong bodies on old rye ergots.

Note.—It is right for me to state, that when these observations were written I was not aware that much of what I have mentioned had already been noticed by earlier writers; for I find that so long ago as 1783, Tessier speaks of having seen the fluid hanging in drops from ergot-bearing spikes, and several succeeding observers notice the oblong bodies contained in the fluid, and which were by them considered as the sporules or seeds of the ergot. But the nearest approach to the correct view of the subject is given in the Transactions of the Linnean Society of Paris for 1826, by Leveillé, whose account differs but little from my observations. Leveillé is the first who distinctly states the oblong bodies (which are found accompanying the ergot) to be the seeds of a very minute fungus, to which he gives the very appropriate name *Sphacelia segetum*; and which fungus he regards as the cause of Ergot.

The question now is, in what way the ovarium becomes infected with this fungus so as to cause it to become an ergot? And although my observations (since my original paper was written) do not yet enable me to speak with certainty on this point,—yet, on viewing all circumstances, I am still induced to consider Ergot to be a constitutional disease of the plant, brought about by the reproductive matter of the fungus being absorbed during germination, and carried up by the fluids of the plant, and becoming developed in the fructification even before the opening of the floral envelopes,—but whether the ovarium is at this time infected with the disease, or whether it is communicated to it during impregnation from the already diseased anther, is a question still to be solved.