

## SMUT IN WHEAT.

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GARDENS.

At the last meeting of the Royal Society a communication from Mr. Joseph Barwick was read on Smut in Wheat, in which he relates his own tests for the purpose of ascertaining the cause, and suggests that further experiments should be carried out in the Botanical Gardens for a like purpose. Having carefully read Mr. Barwick's communication, I can but think that he, as well as others with whom I have conversed, are not acquainted with much that has been done of late in the investigation of this subject, and that, therefore, the following general notes may interest many:—The various species of Ustilaginæ, especially *U. Segetum*, causing smut in wheat and other plants have been under observation by a host of competent scientific observers for many years past, and it is only of late, after much patient research and many thousands of anatomical observations, more in the laboratory than the field, that the life history of the fungus has been elucidated. In the *Gardener's Chronicle* for February 23 and March 2, a detailed account of recent discoveries as to the nature of Ustilaginæ is given by H. Marshall Ward. As this account is replete with information at present little known, arrangements have been made for its publication in *Webster's Gazette* for August and September, where full details may be found. To others into whose hands this publication may not come, the following brief notes may be of interest: The dark substance, popularly called smut, is in reality dense masses of spores arising in tufts at the ends of fine filaments, formed in the ovary or young grain at the expense of the food material, which is destroyed. These spores, of which there are enormous numbers, every ear of smutted corn producing, it is estimated, not less than ten millions, are capable of germinating when placed under favourable circumstances, and multiply their conoidal cells with great rapidity in the soil; fresh manure or manure washings greatly favour their development, and should in all cases be avoided; in material of this description the fungus produces generation after generation in vastly increasing numbers, waiting as it were for the coming of its host, into which it quickly penetrates, and with which it continues to grow. The spores ripening in the grain of the smutted cereal are garnered with the latter, become scattered on the healthy grain and are sown with it, the fungus germinating at the same time as the cereal, produce their prymocella, the germ tubes of which penetrate the embryo plant. Experiments

have proved that the fungus is only able to effect an entrance to its host by attacking the embryonic tissue; once inside, it gradually permeates the whole plant, extending with its growth from cell to cell, and finally meeting in the young fruit conditions favourable to the production of spores. As the fungus can only enter the tender tissue at the color of the young seedling, it is very important that the cultivator should endeavour, by the selection of good, sound, clean seed only, and a good and properly prepared seed bed, to encourage a rapid growth from the first. Anything that tends to retard this growth in its earliest stages lengthens the time during which it is possible for the fungus to effect an entrance, and greatly increases the chances of infection; a few hours even may make all the difference, for though thousands of sporidia may be near the color of the young seedling, no entrance can take place unless the germ tubes reach it at the critical time. Experiments have been made with a view of infecting the leaves and stem of the growing corn with the germinating spores, but have invariably resulted in failure, except on the tender growing point, where the tissues remained sufficiently soft for the sporidia to effect an entrance, but under natural conditions this point is not subject to attack. As regards suitable dressings, there is yet a large field open to investigators; if freeing the seed coat from spores superficially attached was all that was necessary, the matter would be simple enough, but much more than this is required, as the smut fungus may be present in the soil itself, ready to attack the grain at the critical time. Dressings, to be effectual, must be sufficiently permanent to destroy in the soil any prymocelia or conoidal cells that may happen to be in proximity with the seed corn. The following are said to be as efficacious as any at present known:—A strong solution of Glauber's salts, in which the seed grain is to be well washed, and afterwards, while still moist, dusted over with quicklime; by the application of the lime the caustic soda is set free and destroys any fungoid growths it may come in contact with. The application of copper sulphate to the grain as a dressing before sowing is a well-known remedy, but though it destroys the fungus it greatly retards the growth of the wheat, which is an objection to its use. Lime applied after the copper salt neutralises its prolonged effect, and is a good practice. The presence of lime itself in the soil is likewise beneficial. The foregoing notes are the result of the labours of many competent investigators, who have bestowed much time and care on the subject, the elucidation of which necessitated thousands of artificial cultures of the fungus and microscopical examinations. One or two points in Mr. Joseph Barwick's communication will be better accounted for, if viewed with the light thrown on the subject by recent investigations. Mr.

Barwick points out in one of his experiments that it was the strong and deep-rooted plants that escaped infection; this is only what might have been looked for, as upon the strength and rapidity of growth of the plant depends in great measure its immunity from infection. And, again he points out that it was only in the annual species of grasses that he detected smut; here again is precisely what might be expected, as the perennial grasses would have become too consolidated at the part subject to infection for the fine filaments of the fungus to effect an entrance, and thus would remain free from attack. With reference to the suggestion that experiments should be undertaken in the Botanical Gardens for the purpose of throwing light on the subject, I doubt much if any good result could be obtained by such experiments. There is no doubt but the life history of fungoid pests effecting cultivated plants is one of great interest to the cultivator, but the subject is so intricate, the same fungus presenting many varying forms during its growth, that if any satisfactory progress is to be made in its elucidation, it is absolutely necessary that cultivators in many and varying localities accurately record facts coming under their notice, and these facts, which are only so much crude material, will need to be arranged and investigated by the mycologist. Only after very many and oft repeated experiments, made for the purpose of verification, have been made can any definite result be obtained.