

The table shows clearly that as the yeast cells increased in number the quantity of alcohol also increased in a nearly corresponding degree, so that, taking the results at the end of twenty-four hours, there is a direct ratio between the two. During the first twelve hours this does not hold good, as during approximately that period there is a large growth of yeast, but no apparent fermentation, as is evidenced by the lack of gas given off. For this reason the time between the "pitching," or inoculation of the wort, and the beginning of active fermentation is called the "incubation" period.

Thanks are due to Mr. W. H. Test for assistance rendered in the work.

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THE CIRCULATION OF PROTOPLASM IN THE MANUBRIUM OF CHARA—CHARA FRAGILIS. BY D. W. DENNIS.

About the middle of May last Mr. Omer Davis, a student in the Biological Laboratory, at Earlham, while studying the fertilization of *Chara Fragilis* noticed that the nucleus of the manubrium traveled rapidly around the periphery of the cell, with the circulating protoplasm. The phenomenon was subsequently noticed by all the members of a class of eighteen, and the attention of many other persons was called to it, some of whom were familiar with many of the phenomena of moving protoplasm in the leaves of *Chara*, the stamen hairs of *Tradescantia* and in other stock illustrations, it astonished all alike. The circuits of the nucleus were timed by Mr. Davis and myself, and found to range from 15, when the phenomenon was first noticed, to 26, something like a half hour later in a minute.

The circuit of this particular cell was not measured, but a measurement of a large number of cells later convinces me that it could not have been less than five-eighteenths of a mm. This gives a rate of 7.2 millimeters in a minute, or more than four times as fast as the fastest rate given in Goodale's *Physiological Botany* for protoplasm in a closed cell. I reported these facts to Prof. Barnes, who said they were, so far as he could learn, entirely new, and he asked me to prepare the matter for publication in the "*Botanical Gazette*." Early in June I began what I hoped to make an exhaustive study of the phenomenon for this purpose, but could not find a single case in which the motion was going forward. Disintegration had taken place in most of the cells, and in all the motion had stopped. The phenomenon seems, therefore, to be one connected with the growth and maturation of the cell in which it occurs. All I can say is that next May we shall permit nothing to interfere with the most exhaustive study we can give to the

phenomenon. The observation requires no skill except what is necessary to find the male organs of reproduction at the right time, and crush them under the coverglass and recognize the manubrium. If nothing else comes of it it can not fail to add one, and that one the most striking and one of the most easily attainable of all, to the stock illustrations of the circulation of protoplasm.

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FUNGICIDES FOR THE PREVENTION OF CORN SMUT. BY WM. STUART.

During the present century the disease of the corn popularly known as "corn smut" (*Ustilago zeo-mays*, [DC.] Wint.) has engaged the attention of some of its most eminent botanists. It has only been within the last half of the present century that the life history of the fungus has been well understood. When we consider that corn is the principal cereal crop of America, it is not to be wondered at that any fungus disease causing it much apparent injury should arouse a desire on the part of investigators to devise some means of preventing it.

The successful treatment of the smuts of wheat and oats by disinfection of the seed, either by hot water or chemical solutions, naturally turned the attention of Experiment Station workers to employing the same remedies for the smut of corn. The experiments of Arthur,<sup>1</sup> of Indiana, Kellerman and Swingle,<sup>2</sup> of Kansas, and those of Pammel and Stewart,<sup>3</sup> of Iowa, are perhaps the most noteworthy. These experiments included the disinfection of the seed by hot water and chemical solutions; the attempted infection of the seed by rolling in the spores of the smut; and the spraying of the plants with fungicides, the latter experiment being conducted by the Kansas Experiment Station<sup>4</sup> in 1890. The results of all these experiments were of a negative character, due to the fact that the fungus plant of the corn smut, unlike that of wheat and oats, can enter any young growing tissue of the host, while in the last two mentioned it can only enter the host when it is very young. This point has been ably demonstrated by Brefeld,<sup>5</sup> who, by a long series of carefully conducted experiments, showed conclusively that the germinating spores, or conidia, are capable of penetrating any portion of the young

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<sup>1</sup>Fourth Annual Report Indiana Experiment Station.

<sup>2</sup>Kansas Experiment Station Bulletins, Nos. 22, 23, 40, 41.

<sup>3</sup>Iowa Experiment Station Bulletins Nos. 16, 20, Proceedings of Iowa Academy of Sciences, 1894, p. 74.

<sup>4</sup>Kansas Bulletin No. 23, p. 101.

<sup>5</sup>Journal of Mycology, Vol. VI, Nos. I, 11, and IV. (Translated from Nachrichten aus dem Klub der Landwirthe zu Berlin, Nos. 220, 222, by Erwin Smith.)