

THE CAUSE OF MOSAIC DISEASE OF SUGAR-CANE.

A STEP TOWARD THE SOLUTION OF THIS MYSTERY.
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The term "germ" is very broad in its significance and is frequently employed as indicating practically any sort of organism causing infection or disease in animals or plants. It is, nevertheless, a far call from the bacteria, or minute vegetable organisms which reproduce themselves by fission, which are the cause of such human diseases as cholera, typhoid fever, leprosy or charbon, to the filamentous moulds, which are responsible for so many skin diseases in man as well as the domestic animals, or to certain forms of yeasts, which cause diseases amongst animals. In the Tropics the majority of the most dreaded diseases of human beings, such as malaria and sleeping sickness, are caused by the introduction into the system of a small animal organism composed of a single cell, and recent scientific investigations have tended to indicate that a considerable number of the diseases of cultivated plants may be due to this same class of "germ."

There are a number of diseases, human as well as plant, of which the causative organism is still not definitely determined, notwithstanding the fact that some of our most prominent bacteriologists and mycologists have dedicated entire decades to searching for them. Amongst the plants the group of diseases known as "Mosaics" from the form of the discolorations in the leaves of the affected plants, has received much attention and investigation without any definite isolation of the causative organisms being yet accomplished. To this class of disease belongs that affliction of sugar-cane which has been the cause of so much havoc in various sugar-producing countries—Sugar Cane Mosaic.

It is evident that this disease is caused by an organism, since it may be transmitted from infected to sound plants, as has been demonstrated by Brandes in Cuba, Kunkel in Hawaii, Chardon and Veve in Porto Rico and others. In recent years the concensus of opinion amongst the workers with this disease has tended to place the causative organism in that class of minute bodies generally denominated as *ultravisible* or *filtrable virus*. The term *filtrable* indicates that the virus or serum is so fine that it can be forced through the pores of the best cooked porcelain—pores so small that they can hardly be distinguished with the most powerful microscope—and yet retain their virulence, although this class of filtration will eliminate all organisms commonly visible under the microscope.

The well-known "Foot and Mouth Disease" of bovine animals also belongs to this class of diseases which is supposed to be caused by a *filtrable virus*, and it is with the organism causing this particular disease of perhaps the most important amongst domestic animals that discoveries have recently been made in Germany by the bacteriologists Doctor Paul Frosch and his colleague Prof. Dahmen which may throw considerable light in the path of future investigation of the causal agent of sugar-cane mosaic. Franz Schikora, associated with the two eminent bacteriologists above-mentioned in this piece of scientific research which may be epoch-making in its

consequences, has written for the *Vossische Zeitung** under the striking title of "Our Most Minute Enemies Unmasked" a fascinating account of this discovery which admirably demonstrates not only the importance of the work of Doctors Frosch and Dahmen, but also the complete interdependence of the various branches of modern science.

In speaking of the invasion by the German bacteriologists of what he aptly calls "the hypothetical field of unknown vegetable life" and the annexation of this territory to the field of recognized bacteriology, Schikora says:—

"Dr. Frosch reasoned that the invisibility of these disease producers is the result of their extremely small size which inhibits our seeing them even with the most powerful of microscopes. It may be that the layman does not realize that even the microscope has its limitations. If an object be so small that it deflects or interrupts only a few rays of light of distinct lengths, which rays combine to form white light, the image which reaches the retina of the microscope observer is absolutely undefined; or if the object is sufficiently small no image whatsoever is produced. Such objects are really invisible even to the best aided human eye. It was necessary to find some way of making them visible.

"It is the essence of scientific genius to be able to utilize a method developed in some other branch of science for solving a problem along the line of one's own particular speciality. To this inspiration we have to give thanks for many of our discoveries."

Dr. Frosch followed this procedure in utilizing a very original and ingenious microphotographic apparatus designed by Prof. Kohler of Jena, who had originated it with the idea of employing the ultraviolet rays, invisible to human sight, for increasing the clearness and definition of certain visible objects. The greatest contribution of Dr. Frosch, according to Schikora, was "the utilizing of this same apparatus and this same method in obtaining images of objects which were before invisible."

The first disease attacked by Dr. Frosch was bovine pneumonia, the causative "germ" of which had already been propagated by him and Prof. Löffler some time before, but the organism of which they had not yet been able actually to see, since it manifested itself in a sort of white cloud which up to that time they had not been able to resolve into its component parts. After long and patient experimentation Dr. Frosch succeeded in obtaining with the above-mentioned apparatus photographs of these organisms which proved to be inconceivably minute fungous structure.

Successful in this attempt, Dr. Frosch turned his attention to the "foot and mouth disease," the causative organism of which had never yet been cultivated in dry culture—something absolutely indispensable for Dr. Frosch's purposes. "Here," Schikora tells us

"Dr. Dahmen comes upon the scene. This expert bacteriologist devoted himself to discovering not only an appropriate culture medium, but also some method of propagation which would render it feasible to grow the organism outside of the body and without moisture. Only a specialist can

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appreciate the difficulties here presented. Fortunately Dr. Dahmen not only settled this problem satisfactorily, but also made discoveries which will aid us materially in combating the pest."

In order not to enter into details of too complex a nature, it is sufficient to say that, as the result of long and patient endeavour, the enthusiastic scientists finally succeeded in obtaining microphotographs revealing the bodies causing "foot and mouth disease." It is a bacillus of a maximum length of not more than one ten-thousandth of a millimetre—about one quarter millionth of an inch! Schikora concludes:—

"The course to follow in future investigations has been plainly set. One of the great victories on the field of medical exploration has been won. Besides the term "ultravisible virus" now passes out of fashion."

It appears that, with the author of this interesting and suggestive article, we may have confidence, now that the black continent of unknown bacteriology has twice been crossed, that other of her secrets will be revealed to the man of science, and we hope that amongst these and perhaps at no far distant date we shall learn more of the mysterious secret of the organic cause of sugar-cane mosaic disease.—The International Sugar Journal, Vol. XXVI, No. 310.
