



DMITRII IVANOWSKI

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-1924

Dm. Ivanowski (Iwanowsky) published his first paper on tobacco mosaic in 1890, which was apparently also his first scientific contribution. His age was, therefore, probably close to that of Baur, but his work on the mosaic disease was more nearly contemporaneous with that of Mayer and Beijerinck, who were considerably older, although they outlived him. Ivanowski's first paper was published in the Russian language and was based on observations in Crimea. The work was evidently supported or sponsored by the Botanical Laboratory of the Academy of Science of St.-Petersbourg, whence he also published on alcoholic fermentation as early as 1894.

It was on February 12, 1892, that Ivanowski read the paper before the Academy of Science, St.-Petersbourg, in which he reported the filterable nature of the tobacco-mosaic virus. This paper is now universally accepted as the first report of the filterability of either plant or animal viruses. The influence of this discovery on later biological thought and activity can hardly be overestimated. Ivanowski's claim to recognition does not, however, stop here. In 1903 he published what is probably his best and most detailed study on the mosaic disease. In this paper he was first to describe the inclusion bodies in the host cells of virus-diseased plants. This contribution is all the more significant when it is recalled that the Negri bodies of rabies were described in the same year. Although the Guarnieri bodies of small-pox were described in 1894, it is doubtful that Ivanowski knew of them or suspected any similarity with his inclusion bodies. This paper was evidently his last on the mosaic disease, although he published on chlorophyll at least as late as 1914, his interests having evidently turned more directly to plant physiology.

In 1902-3, Dr. Ivanowski was listed as head of the Department of Botany of the Royal University of Warsaw. In

[25]

1907, he was Professor of Plant Physiology at the same institution, where he evidently continued his work for several years.

A notice only of Dr. Ivanowski's death is published in the 1924 volume of the *Berichte der Deutsche Botanische Gesellschaft*. It is unfortunate that more information is not now available about perhaps the most widely known man in virus research. An extensive search in the libraries in this country has failed to reveal any published biography. Correspondence with some European biologists in this country has failed to yield any clues on a published biography. Other efforts to secure information by correspondence with European biologists abroad have largely failed because of the war situation.

The great significance of Dr. Ivanowski's work was perhaps not fully recognized during his lifetime. His fame will no doubt grow with the passing of time, and it would be highly fitting and desirable for a biographer who knew him and his work to write a complete and satisfactory sketch of his life before it is lost to future generations of biologists.

CONCERNING THE MOSAIC DISEASE OF THE TOBACCO PLANT¹

Dmitrii Ivanowski

TWO YEARS AGO, in collaboration with Mr. Polowzow, I described a very wide-spread tobacco disease, which we called pock-disease (or pox-disease) and whose causes we set forth at that time.² On this occasion we also announced the supposition that the mosaic disease of tobacco,³ described by Ad. Mayer in Holland, really comprises two entirely different diseases, of which one (according to Mayer, the second phase of the mosaic disease) is the pock-disease studied by us. While investigating tobacco diseases in the Crimea in the summer of 1890, I was able to convince myself of the complete correctness of the supposition advanced by us at that time, for here I also met the form of disease described by Mayer as the first phase of the mosaic disease and could convince myself that this form is actually an entirely independent and in many respects a very interesting disease.⁴

Among the native tobacco planters (Tartars) it is known merely under the name of "bosuch" (i.e. disease); by some it also is called marble-disease. The outer appearance of the diseased plants, the course of development of the disease, and its distribution on the plantation correspond entirely to the description supplied by Mayer, so it will not be necessary to discuss this question. The difference in the statement begins only at the place where Mayer makes the assertion that "if the disease develops in the regular manner, some of the lighter and thinner parts of the leaf die prematurely, not entirely different from, only much more ex-

¹ Ivanowski, Dmitrii. Ueber die Mosaikkrankheit der Tabakspflanze. *St. Petersburg. Acad. Imp. Sci. Bul.* 35 (nouv. ser. i. e. ser. 4, v. 3): 67-70. Sept. 1892.

² *Memoir of the Imperial Academy of Sciences of St. Petersburg*, Vol. XXXVII, No. 7.

³ *Landwirtschaftliche Versuchstation* Vol. 32, pp. 451-67.

⁴ I shall designate it as mosaic disease even though it corresponds only to a stage of development in the disease described by Mayer under this name. *Melanges biologiques* Vol. 13, p. 237.

tensively than a similar spotting that often appears in fully ripe leaves without detriment to the value of the product." (p. 452). In the accompanying plate Mayer pictures a leaf densely covered with brown spots; these spots have become fused in places and some have dropped out of the leaf, as a result of which the leaf seems to have wide holes. In my opinion the leaf pictured has been attacked by two entirely different diseases: The mosaic disease (in the sense proposed by me) and the pock disease. Both diseases, although of an entirely different origin, may of course occur on the same plant.⁵ The brown spots are widely distributed and not always connected with the yellow parts of the leaf attacked by mosaic disease, which was the case according to Mayer; one can often find them in the middle of a dark green, healthy part. The independence of these two diseases may now no longer be doubted. For this I should like to adduce the following:

1. I observed the mosaic disease neither in Little Russia nor in Bessarabia, although the pock disease had reached a high degree of development there.

2. In the Crimea, where both diseases occur, one can, in inspecting the plantation, find examples [plants] that are suffering from the mosaic disease only; others, suffering only from the pock disease. These plants may most easily be differentiated through the very young leaves. In the plants attacked by mosaic disease, all new tissues (new leaves and shoots) show the changes peculiar to this disease (as Mayer has observed), that is, mosaic-like symptoms consisting of dark-green and yellow areas. When we, therefore, find examples of brown-spotted tobacco plants, in which, however, the very young leaves show no traces of the mosaic symptoms, one can say with certainty that these plants are suffering from the pock disease.

3. The mosaic disease is infectious, while the pock disease by no means has this characteristic.

4. The cause of the pock disease lies in the restriction of (water) transpiration through the leaves; the spots appear on entirely healthy leaves with a rapid and sudden increase in the transpiration of the plant; the causes of the mosaic

⁵ It may be possible even that the plant attacked by the mosaic disease is more susceptible to the pock disease than is the healthy one because diseased plants generally are more easily attacked by new diseases than are healthy ones.

disease are, on the other hand, of a very different sort, it is, as was mentioned above, infectious.

5. We found the pock disease in *Datura stramonium*, *Hyoscyamus niger* and many other plants; the mosaic disease, on the other hand, according to Mayer's observations, is not transmitted to other representatives of the family Solanaceae.

In support of the opinion that both diseases represent different stages of development of one and the same disease, Mayer only mentions the same geographical distribution and their succession in time. "It is true," writes Mayer, "that some growers recognize two independent diseases in the two forms, or better, stages of the disease, but only because the first stage may not be apparent through superficial observation."

"The same geographical distribution and the succession in time of the two forms speaks against this (theory)." (l.c., p. 553).

My investigations on the mosaic disease are not yet completed, since I have met with great difficulties that must first be removed (as, for example, the inability of the tobacco microbes to develop on the usual artificial media). Nevertheless, I am already able to confirm at this time the following statements of Mayer:

1. *That the sap of plants suffering from the mosaic disease is infectious; inoculated into healthy plants it produces after a certain time the mosaic disease in the latter.*

2. *That in heating the sap of the diseased tobacco plant to a temperature near the boiling point, it loses its infectious qualities.*

3. *That, considering the absence of fungi and other parasites, infection through bacteria may be ascribed to the disease.*

On the other hand, I must contradict most emphatically the author's statement that the sap of leaves attacked by mosaic disease loses all its infectious qualities after filtration through double filter paper. According to my experiments the filtered extract introduced into healthy plants produces the symptoms of the disease just as surely as does the unfiltered sap. Moreover, this opinion of the author does not agree with my conviction that the mosaic disease is caused by bacteria, for a double layer (of filter paper) cannot, as is well-known, hold back bacteria. If this observation of

Mayer's were correct, one should rather come to the conclusion that the mosaic disease is not caused by bacteria, but rather by fungi whose spores cannot pass through the filter paper. Yet I have found *that the sap of leaves attacked by the mosaic disease retains its infectious qualities even after filtration through Chamberland filter-candles*. According to the opinions prevalent today, it seems to me that the latter is to be explained most simply by the assumption of a toxin secreted by the bacteria present, which is dissolved in the filtered sap. Besides this there is another equally acceptable explanation possible, namely, that the bacteria of the tobacco plant penetrated through the pores of the Chamberland filter-candles, even though before every experiment I checked the filter used in the usual manner and convinced myself of the absence of fine leaks and openings.⁶ I see further proof of the perfection of the filter-candles used by me in the fact that the liquids, most favorable to the development of bacteria, remained entirely unchanged for several months after filtration through this candle.

In any case, I hope that further investigations will clear up this question; the remarks under consideration have only the purpose to establish the independence of the two diseases, the mosaic and the pock disease, and to prove that they do not represent, as Ad. Mayer assumes, different stages of development of one disease.

⁶ It was impossible by means of a rubber bulb to press air through the filter-candles submerged in a cylinder of water.