producing agents typified by *p.* nitro-phenylethylamine.

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A SUGGESTED RELATIONSHIP BETWEEN THE PROTOPLASTIC BRIDGES AND VIRUS DISEASES IN PLANTS[1]

THE virus of onion yellow dwarf has been transferred from diseased to healthy onions by the bites of more than 75 species of aphids. Very little, if any, difference has been noted between the feeding habits of the different species and their capacities to transmit the virus. The systemic nature and rapid spread of the virus of yellow dwarf in the growing onion has been demonstrated by means of several species of aphids. After the inoculation by the bites of infective aphids the spread of the virus through the tissues is very rapid and apparently in all directions. In following the course of the stylets of the aphid's beak it was occasionally observed, in the case of intercellular penetration, such as is exemplified by *Myzus persicae* Sulz. and *Aphis rumicis* Linn., that the content of a cell adjacent to the path of the stylets apparently had been partially extracted without the cell walls having been punctured.

In connection with the study of the tracts of the stylets, both intercellularly and intracellularly, through the tissues and the spread and effect of the virus, attention was also given to the protoplasmic bridges or plasmodesms between adjacent cells, with the thought in mind that these structures may function in the spread of the virus from cell to cell and also afford a means by which intercellular feeders are able to make contact with the protoplasm without piercing the cell wall.

In the onion and in all the other plants examined for plasmodesms, including more than a dozen of our common plants that have virus diseases, protoplasmic bridges were found to be prevalent in all the living tissues of the leaves and stems—the study of plasmodesms having been so far confined to these parts. In the onion they were found in the leaves, in the meristematic tissues of the bulb and in the flowering stalk. They were variable in size, ranging from only a very few to 60 or more microns in diameter. They connected the cells usually in all directions. In case of cells with thin walls, as in the meristematic tissues and in the tissues of leaves, the plasmodesms were undivided. They were single strands, whereas in case of cells with thick walls, as in the flowering stalk of the onion, the plasmodesms were usually divided into a number of delicate strands in the region of the middle lamella of the cell wall. In all instances, however, the plasmodesms were visible under the ordinary high-power combinations of the microscope and therefore were ample in size to permit viruses and many other disease-producing agents to pass from cell to cell.

Each wall of a living cell was traversed by a number of plasmodesms. The number and distribution of the plasmodesms radiating in the different directions from a cell varied much according to the shape of the cell. In case of elongated rectangular cells the plasmodesms through the end walls were usually numerous, uniform in size and distribution and small and crowded, whereas those through the lateral walls were relatively few per unit area. The ones traversing the lateral walls varied somewhat in size, ranging from a few to many microns in diameter, and were irregularly distributed. Between irregularly shaped cells, where there is no distinction as to end and lateral walls, the plasmodesms through the different walls were similar in type and distribution. In character and distribution they were similar to those in the lateral walls of the elongated rectangular cells, except that they were more closely spaced. Even through those walls where there was the greatest sparsity of plasmodesms the stylets coursing, intercellularly, the region of the middle lamella could not penetrate very far without contacting plasmodesms unless they abruptly veered from their course. In case the plasmodesms are only incidentally encountered by the aphids during the feeding process these bridges are sufficiently numerous through any of the cell walls to be accessible and serve as a means by which the insect could inoculate the content of cells without having to pierce or rupture the cell walls. It is, therefore, quite plausible that these protoplasmic bridges have an important bearing relative to the intercellular movements, not only of solutions and other substances of various kinds which have to do with the normal functions of the plant, but also of viruses and other disease-producing agents as suggested by Samuel.

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