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The behavior of crown gall on the rubber tree (*Ficus elastica*).By **MICHAEL LEVINE** (by invitation).

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Smith (1911-12) in his extensive studies on crown gall and its resemblance to animal cancer shows that the physiological effects of these tumors vary from species to species and also within the species and are generally less pronounced and speedy than one might expect. He holds that it is difficult to show conclusively that the substances produced in the tumor by the parasite are absorbed and act as slow poisons. This is especially difficult in view of the fact that the galls are often soaked by rains and become infected with other parasitic and saprophytic organisms.

Levin and Levine (1918) in a preliminary report on the malignancy of the crown gall and its analogy to human cancer pointed out that a number of the phenomena in both diseases are analogous. They contend that the neoplasms in plants produced by *Bacterium tumefaciens* are sometimes benign, though some are true malignant growths. The latter generally dwarf the plant so affected and cause the necrosis of the tissue above and below the gall.

These studies and those of other workers were carried out on annuals, biennials or deciduous trees in which the period of growth of the host as well as the crown gall is normally interrupted. The difficulty in determining the effects of crown gall, is made greater by the intervention of natural death, caused by changes in temperature and its concomitant factors, and second, by the occurrence of infections caused by fungi and even insect grubs, the eggs of which are deposited in the soft tissue of the young crown gall.

The purpose of this report is to bring forward further evidence on the malignancy of the crown gall experimentally induced on mature evergreen perennials such as the common rubber tree, *Ficus elastica*. In such plants where the growth is rather active all the year round, when kept under uniform, green house

conditions the effect of the crown gall organism and the neoplastic growth on the host can be kept under observation for an extended period. Drenching rains and destructive insects are avoided and very often other parasitic and saprophytic fungi. In this way and in such plants as *Ficus elastica* it is possible to show definitely whether and in what degree the crown gall has an effect upon the adjacent normal tissue of the host.

It was found that *Bacterium tumefaciens* inoculated into the apical internode of the branches, into the leaves or main stem of the rubber tree, *Ficus elastica*, stimulates the development of a neoplasm in the region of inoculation of a benign or malignant nature. The crown galls so formed, in this plant, are of two kinds, one in which growth is uniform and appears to be a swelling, the other is the characteristic convoluted type indicating a peripheral growth of isolated nodules. The early stages in the development of the crown gall in *Ficus elastica* does not interfere with the nutrition of the plant as a whole nor does it interfere with the growth of the inoculated branches. The crown gall in *Ficus elastica* after a number of months of active growth becomes hard and dry and finally dies. This is associated with the differentiation of the tissue which converts the gall into a mass of parenchymatous cells and nodules of woody fibers. The central portion of the crown gall which generally lies near the wood cylinder disintegrates.

The invasion of the stem by the new growth does not destroy the entire conducting system of the stem, yet that portion of the stem above the gall dies as well as considerable portion of the stem below. Cultures made from pieces of the crown gall and stem above and below the gall yield only a shizomycete which in appearance is not unlike *Bacterium tumefaciens* and which when inoculated into the stems of young geraniums and rubber plants produce crown galls in the region of inoculation. It is altogether possible that substances of the disintegrating crown gall or products of the crown gall forming organism are carried into the circulation of the stem and are responsible for the progress of the death of the stem from the gall upward and downward. The death of the plant due to crown gall is at least suggestive of the death caused by the invading and disintegrating malignant growths in animal cancer.