

patches. Leaves having white dots or patches were evident in all species studied, with the exception of the cacti. One plant of *Antirrhinum* showed a remarkable condition in its cotyledons in that a white band about 5 mm wide crossed each cotyledon in exactly the same place.

In *Myosotis*, deeply cleft cotyledons occurred in about one fifth of the seedlings. This condition was not observed in any of the other species studied.

Leaves which were slightly notched or deeply cleft were observed frequently in *Myosotis* and *Antirrhinum*, but only twice in *Oenothera franciscana*—no variation of any kind being observed in *Oenothera blandina*. Each of the two parts of a leaf resulting from a deep cleft often showed a separate, well-developed midvein.

In a large number of cases a considerable part of

a leaf was deleted so that there was no tissue on one side of the midrib, only a small irregular mass with or without veinlets going into it from the midrib; or the leaf was perfectly normal except for a small deleted area. A number of rather twisted and grotesque forms resulted from the radiations.

In summary, the bombardment of dry seeds of certain species by stray neutrons had no effect on germination, whereas in other species it caused a decrease in germination directly proportional to the duration of exposure. Seedlings and mature plants grown from the neutron-bombarded dry seeds showed a number of morphological variations from the normal condition.

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## SCIENTIFIC APPARATUS AND LABORATORY METHODS

### THE SEPARATION OF PLANT VIRUSES BY CHEMICAL INACTIVATION<sup>1</sup>

SOME virus complexes, which may occur in nature or in accidental mixtures in experimental work, are often difficult to separate by known or convenient means. An investigation of the possibility of the use of chemicals for this purpose was therefore undertaken, with the expectation that some additional light might be thrown on the nature of the viruses themselves by their reaction toward chemical substances.

The separation of certain combined viruses has been accomplished by treatment of the plant extracts containing the viruses with chemicals which have proved to be specific inactivators for certain viruses. Water solutions of the chemicals were added to the extracts and allowed to act at 20° C. for one hour. These preparations were then diluted to one part in fifty parts of water in order to reduce any possible chemical injury when inoculated to the host (*Nicotiana tabacum* Havana variety). If symptoms caused by only one virus were apparent, extracts from such plants were tested for purity by further inoculations to Havana tobacco. Repeated trials were made with such chemicals as showed promise, and a wide variety of chemicals in various concentrations have been tested.

The separation of a mixture of the viruses of cucumber mosaic and potato ring spot may serve for illustration in this preliminary note. Tests were made to determine the minimum concentrations of chemicals necessary to inactivate each of these viruses, and it was found that cucumber mosaic virus could withstand higher concentrations of silver nitrate and mercuric chloride than could the potato ring spot virus. Con-

versely, it was found that the potato ring spot virus could withstand higher concentrations of potassium permanganate, lithium carbonate and copper sulfate. Mixtures of these two viruses were treated with concentrations of potassium permanganate ranging from 0.1 to 0.9 per cent. in ten separate experiments, and only the potato ring spot virus remained infective, except in one trial where both viruses were inactivated by the same concentration of the chemical. In three trials 1 per cent. lithium carbonate and 2 per cent. copper sulfate gave similar results. However, using the same extracts as above the potato ring spot virus could be inactivated, leaving the cucumber mosaic virus infective. This result was secured in four trials by treatment with silver nitrate ranging in concentration from 0.1 per cent. to 0.5 per cent., and eleven times by treatment with 0.1 per cent. to 0.9 per cent. mercuric chloride in as many trials. The exact chemical concentrations necessary for a definite separation can not always be accurately determined since fairly wide variations in behavior have been observed.

The reasons for the differential action of the chemicals used are obscure. In preliminary determinations, hydrogen-ion concentration did not seem to be correlated with the inactivation of the viruses in these experiments.

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### A METHOD FOR FINDING THE FREE WATER IN PLANT TISSUE

ABOUT a month ago I was approached by the scientists at the Northern Rocky Mountain Forest Experi-

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