

## THE EFFECT OF ALKALOIDS AND OTHER VEGETABLE POISONS ON PROTOPLASM.

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It has not yet been satisfactorily determined whether the protoplasm of plants is affected by alkaloids and other vegetable poisons,\* and accordingly I have begun an investigation of this subject. I was enabled to begin this work at the Marine Biological Station at Wood's Hole, Mass., during a part of the summer of 1905, through the courtesy of the Carnegie Institution of Washington, D. C., which kindly placed at my disposal one of the rooms which it controls at that place. Naturally only a beginning could be made in this work which I am pursuing further now, but the results thus far obtained are not without interest.

Many alkaloids are only slightly soluble in cold water, as for example, strychnine, of which only about one part in seven thousand (7,000) is soluble in water. The salts of the alkaloids are, however, much more soluble in cold water, both fresh and sea water.

My first experiments were carried out with strychnine sulphate on volvox. This was found in great abundance in a pond some distance from the station. When the volvox was put in a solution of strychnine sulphate containing .125 gr. in 875 cc. of fresh water the movement of the plant was at first accelerated, but it was killed by this solution in one hour. The color of the vegetative cells became lighter and when colonies were present these were a little darkened. I then placed a drop of water on the slide and to this I added some crystals of the strychnine sulphate. The volvox individuals at first swam to these dissolving crystals, but coming too near entered a place where the concentration was fatal in five minutes. When put in a solution containing .01 gr. of strychnine sulphate in 100 cc. of water volvox was killed in one hour and thirty minutes. When placed in a solution containing .01 gr. of strychnine sulphate in 1,000 cc. of water volvox was killed in one hour and forty-five minutes. At the expiration of twenty-four hours the volvox individuals were perfectly discolored and disorganized. Distilled water does not affect volvox outside of the effects of nutrition, if properly prepared.

\*Pfeffer Pflanzenphysiologie zweite Auf. 1904, Bd. II, p. 333.

Other fresh-water forms such as *Oscillaria*, *Chroococcus*, *Cosmarium*, *Closterium*, *Desmids* and *Diatoms* were not killed in a solution of strychnine sulphate containing one gr. in 1,000,000 cc. of water. The movement of the protoplasm even did not stop. I have not yet determined the exact lethal concentration of strychnine sulphate for these forms.

Marine forms of the *Cyanophyceae* (as *Oscillaria* and *Rivularia*); also *Diatomes*; *Chlorophyceae*, as *Cladophora* and *Enteromorpha*; *Brown Algae*, as *Ectocarpus*; and *Red sea weeds*, as *Polysiphonia* and others were not killed in a solution of strychnine sulphate having one part in 100,000 of water. Nor was the movement of the protoplasm stopped by this concentration. A solution of the same having one part in 10,000 also had no effect.

A solution of the same having one part in 1,000 also had no effect. A solution of the same having one part in 250 killed all the plants in twenty-four hours, but the animals which happened to be present were killed in seven hours.

There are only a few animals that can bear transferring from salt to fresh water and vice versa. One of these is the form *Artemia salina*, which may bear such treatment, but in so doing it assumes a somewhat different size and shape. As a rule animals that are transferred from salt to fresh water or vice versa, show at first accelerated movements, but these become rapidly slower and slower, death ensuing in most instances in a few seconds.

All the marine forms experimented with were killed in two hours by a solution of strychnine sulphate containing .5 of a grain in 100 cc. of water.

The above mentioned marine forms were killed in a solution of cocaine containing .5 of a gram in 25 cc. of water, in two and one-fourth hours.