RAPHIDES, THE CAUSE OF THE ACRIDITY OF CERTAIN PLANTS.

By R. A. Weber, Ph. D.

At the last meeting of the American Association for the Advancement of Science, Prof. W. R. Lazenby reported his studies on the occurrence of crystals in plants. In this report he expressed the opinion that the acridity of the Indian turnip was due to the presence of these crystals or raphides. This opinion was opposed by Prof. Burrill and other eminent botanists, who claimed that other plants, as the fuchsia, are not at all acrid, although they contain raphides as plentifully as the Indian turnip. Here the matter was allowed to rest.

The U. S. Dispensatory and other works on pharmacy ascribe the acridity of the Indian turnip to an acrid, extremely volatile principle insoluble in water and alcohol, but soluble in ether. Heating and drying the bulbs dissipate the volatile principle, and the acridity is destroyed.

At a recent meeting of Ohio State Microscopical Society this subject was again brought up for discussion. It was thought by some that the raphides in the different plants might vary in chemical composition, and thus the difference in their action be accounted for. This question the writer volunteered to answer.

Accordingly, four plants containing raphides were selected, two of which, the *Calla cassia* and Indian turnip, were highly acrid and two, the *Fuchsia* and *Tradescantia*, or Wandering Jew, were perfectly bland to the taste.

A portion of each plant was crushed in a mortar, water or dilute alcohol was added, the mixture was stirred thoroughly and thrown upon a fine sieve. By repeated washing with water and decanting a sufficient amount of the crystals was obtained for examination. From the calla the crystals were readily secured by this means in a comparatively pure state. In the case of the Indian turnip the crystals were contaminated with starch, while the crystals from the fuchsia and tradescantia were imbedded in an insoluble mucilage from which it was found impossible to separate them. The crystals were all found to be calcium oxalate.

Having determined the identity in chemical composition of the crystals, it was thought that there might be a difference of form of the crystals in the various plants, from the fact that calcium oxalate crystalizes both in the tetragonal and the monoclinic systems. A laborious microscopic examination, however, showed that this theory also had to be abandoned. The fuchsia and tradescantia contained bundles of raphides of the same form and equally as fine as those of the acrid plants. At this point in the investigation the writer was inclined to the opinion that the acridity of the Indian turnip and calla was due to the presence of an acrid principle.

Since the works on pharmacy claimed that the active principle of the Indian turnip was soluble in ether, the investigation was continued in this direction. A large stem of the calla was cut into slices, and the juice expressed by means of a tincture press. The expressed juice was limpid and filled with raphides. A portion of the juice was placed into a cylinder and violently shaken with an equal volume of ether. When the ether had separated a drop was placed upon the tongue. As soon as the effects of the ether had passed away, the same painful acridity was experienced as is produced when the plant itself is tasted. This experiment seemed to corroborate the assumption of an acrid principle soluble in ether. The supernatant ether, however, was slightly turbid in appearance, a fact which was at first ignored. Wishing to learn the cause of this turbidity a drop of the ether was allowed to evaporate on a glass slide. Under the microscope the slide was found to be covered with a mass of raphides. A portion of the ether was run through a Munktell filter. The filtered ether was clear, entirely free from raphides, and had also lost every trace of its acridity.

The same operations were repeated upon the Indian turnip with exactly similar results.

These experiments show conclusively, that the acridity of the Indian turnip and calla is due to the raphides of calcium oxalate only.

The question of the absence of acridity in the other two plants still remained to be settled. For this purpose some recent twigs and leaves of the fuchsia were subjected to pressure in a tincture press. The expressed juice was not limpid, but thick, mucilagenous and ropy. Under the microscope the raphides seemed as plentiful as in the case of the two acrid plants. When diluted with water and shaken with ether, there was no visible turbidity in the supernatant ether, and when a drop of the ether was allowed to evaporate on a glass slide, only a few isolated crystals could be seen. From this it will be seen that in this case the raphides did not separate from the mucilagenous juice to be held in suspension in the ether. A great deal of time and labor were spent in endeavouring to separate the crystals completely from this insoluble mucilage but without avail. With the tradescantia similar results were obtained.

From these experiments the absence of acridity in these two plants, in spite of the abundance of raphides, may readily be explained by the fact, that the minute crystals are surrounded with and embedded in an insoluble mucilage, which prevents their free movement into the tongue and surface of the mouth, when portions of the plants are tasted.

The reason why the Indian turnip loses its acridity on being heated, can be explained by the production of starch paste from the abundance of starch present in the bulbs. This starch paste would evidently act in a manner similar to the insoluble mucilage of the other two plants.

So also it can readily be seen that when the bulbs of the Indian turnip have been dried, the crystals can no longer separate from the hard mass which surrounds them, and consequently can exert no irritant action when the dried bulbs are placed against the tongue.