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Botanical Medicine Monographs and Sundry

A SPECIES OF COMMELINA.

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The attention of Professor Trimble was called to a species of *Commelina* (supposed to be *C. virginica*) by Godfrey Aschmann, a florist of Philadelphia, whose observations led him to believe that it was of medicinal value. He found that, when made into an ointment and applied to a surface wound, it not only stops the bleeding, but also exhibits remarkable healing properties.

That the plant does possess hemostatic properties is very probable, as there are several plants in Mexico belonging to this same family that are of notable therapeutic value. Alfonso Herrera, in AMERICAN JOURNAL OF PHARMACY, 1897, p. 290, describes these plants under the name of "Yerba del Pollo." He states that, "the most distinguished physicians use the extract of *Commelina* as a kind of hemostatic in the treatment of metrorrhagia and hemoptysis. They employ it, too, as an active remedy against leucorrhea, and as a general hemostatic in capillary hemorrhage." He was unable, however, to conclusively determine to what these properties were due, although he feels justified in attributing them to either the potassium chloride or a proteid principle.

During the term Of 1895 and 1896, Mr. G. L. Genz, Ph.G., analyzed the plant in the chemical laboratory of the Philadelphia College of Pharmacy, but found nothing to which its virtues could, with satisfaction, be attributed. The material upon which he worked had been gathered about two years before. He was unable to find a glucoside, but, like the writer, found evidence in the ethereal extract of a small amount of a substance which gave precipitates with alkaloidal reagents; while more of the same substance was found by him in the absolute alcohol extracts. The author has had the same experience in the present investigation. The specimen of *Commelina* under examination was collected on the banks of the Wissahickon near its junction with the Schuylkill. On careful study of the material, by the aid of the manuals and comparison with the specimens in the Martindale Herbarium in the Philadelphia College of Pharmacy, it was evident that the species was not *C. virginica*, but probably either *C. nudiflora* or *C. communis*.

CHEMICAL ANALYSIS.

The fresh plant was dried at a temperature of 30˚C. for several days, until it was in a fit condition for grinding.

The ground material lost 9.65 per cent. of moisture when dried to a constant weight at 110° C.

Upon incineration it yielded 15.33 per cent. of ash. The ash was brownish-gray in color, and retained somewhat the shape of the particles of the original material; 38.03 per cent. of the ash was soluble in water. The salts of the aqueous solution consisted chiefly of potassium chloride and sulphate, and a much smaller quantity of potassium carbonate. Hydrochloric acid dissolved 44.72 per cent. of the ash, from the residue insoluble in water; this amount included the carbonates which were decomposed by the acid. The solution in hydrochloric acid contained calcium, magnesium, iron, and phosphoric oxide. The remaining 17.25 per cent. of the ash was composed of siliceous matter.

A portion of the ground plant was macerated with cold water for some minutes and the mixture then filtered. The filtrate had a feebly acid reaction toward litmus paper. It also reacted as follows :

Ferric chloride caused no change in appearance.

Gelatin had no effect.

Gelatin and alum behaved likewise.

Bromine water produced no change.

Ammonio-ferric sulphate was without effect.

Calcium hydrate made a yellowish turbidity.

Basic lead acetate caused a gelatinous precipitate.

Neutral lead acetate yielded a precipitate of the same character.

Barium chloride gave no precipitate.

Silver nitrate, acidified-with nitric acid, threw down a brownishwhite precipitate, which was soluble in ammonium hydrate; on heating this ammoniacal solution a reduction to metallic silver occurred.

Gold chloride, acidified with hydrochloric acid, was reduced to metallic gold on heating.

These behaviors showed the absence of tannic and gallic acids, but the presence of some other substance having reducing power on salts of gold and silver.

The plant material that was left undissolved by cold water was boiled with water for a few minutes, the mixture filtered and the clear filtrate allowed to become cold. It was then tested with potassium tri-iodide, which gave the characteristic blue-color reaction for starch.

FIG. 1

Following this preliminary examination, a proximate analysis of the ground plant was made according to Dragendorff's scheme, with the results hereinafter stated.

Petroleum ether removed 1.56 per cent. of extractive matter consisting of 0.13 per cent. of caoutchouc, 0.48 per cent. of wax and 0.95 per cent. of fat.

Ether, U.S.P., 1890, extracted 1.24 per cent. of the weight of the ground plant; 14.54 per cent. of this extract was soluble in water.

The aqueous solution had an acid reaction toward litmus paper; it reacted as follows:

Calcium hydrate produced a copious, reddish, flocculent precipitate.

Both normal and basic lead acetate gave precipitates of the same kind as caused by calcium hydrate.

Ammoniacal silver nitrate solution was reduced on the application of heat. Gold chloride solution was also reduced when heat was applied.

Fehling's solution was reduced by the plain filtrate upon warming, and after heating some of the plain filtrate with acid and again applying Fehling's solution, an increased reduction of the latter took place.

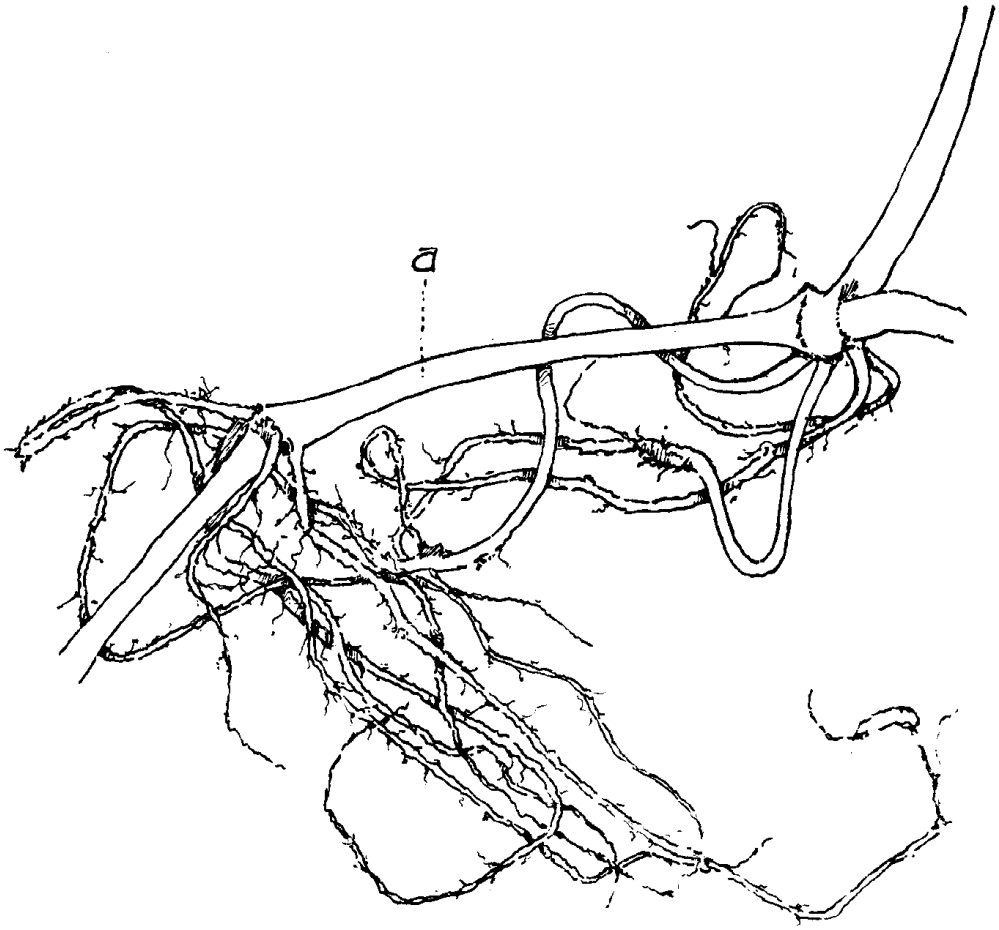

FIG. 2.

Mayer's reagent gave a very slight cloud.

Potassium tri-iodide gave still less cloud.

A portion of the solution which gave these reactions was acidified with diluted sulphuric acid, placed in a separating funnel, and agitated with two successive portions of petroleum benzin, and afterward with two portions each of ether and

chloroform. The two lots of each solvent were mixed, after being separated from the watery layer, and allowed to spontaneously evaporate. A reddish residue was left upon evaporation of the benzin. It was soluble in water; the solution possessed no reducing power on gold and silver salts, but it showed a reducing action on Fehling's solution, and, after boiling the liquid under investigation with acid, a greater reduction of Fehling's solution occurred.

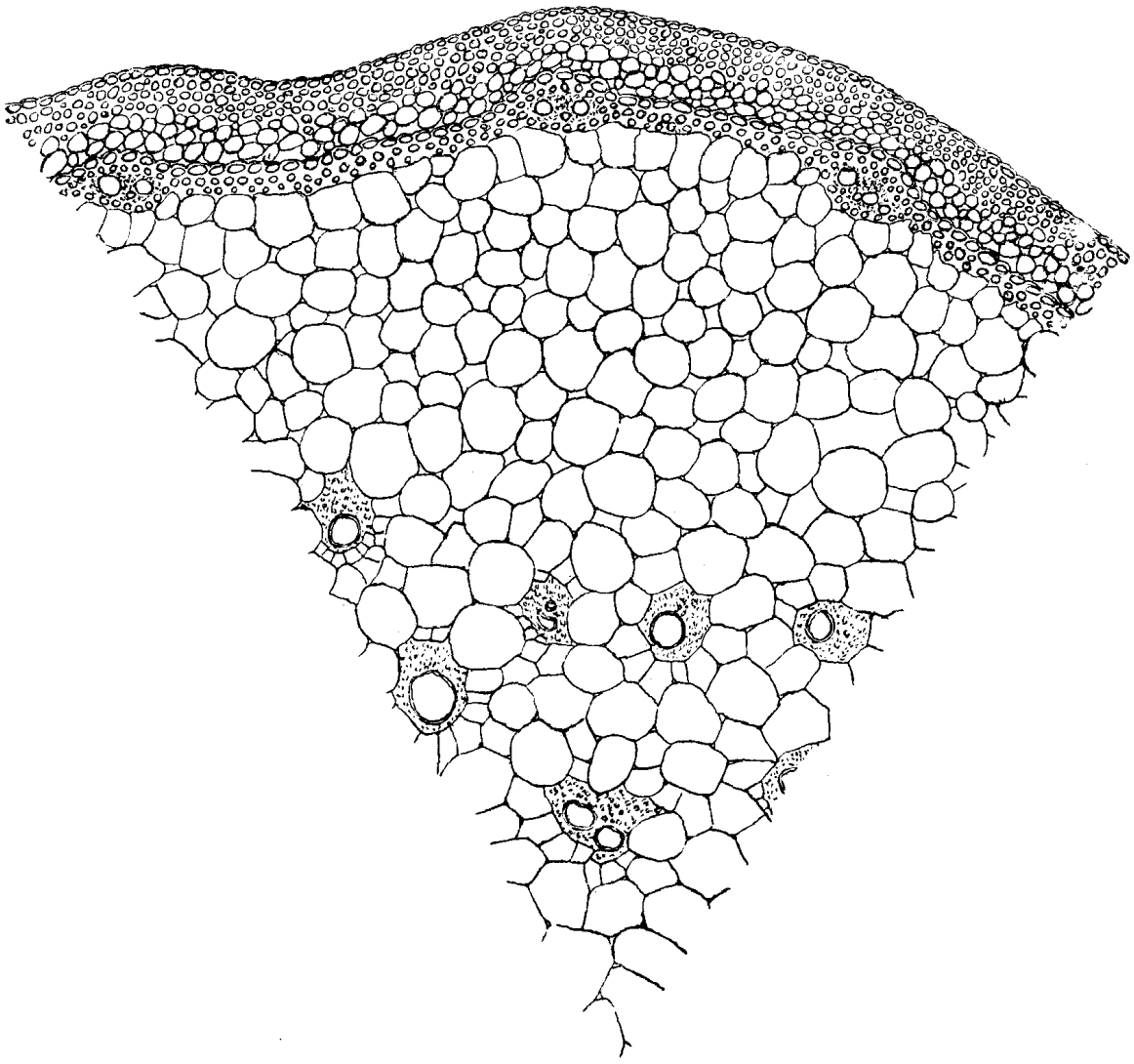

FIG. 3.

Neither ether nor chloroform removed anything from the acidified aqueous solution with which they had been agitated. The acidified aqueous solution was then rendered alkaline with ammonium hydrate, and again agitated in a separating funnel with benzin, ether and chloroform, as previously described. The benzin once more removed a small amount of reddish substance, which dissolved in water and reacted with Fehling's solution, as did the substance removed by benzin from the acid solution. Gold and silver salts were not reduced by this substance either. The treatment with

ether removed some substance having the same character as that material taken out by benzin. Mayer's reagent and potassium tri-iodide gave no evidence of alkaloids in the substances extracted from the alkaline aqueous solution.

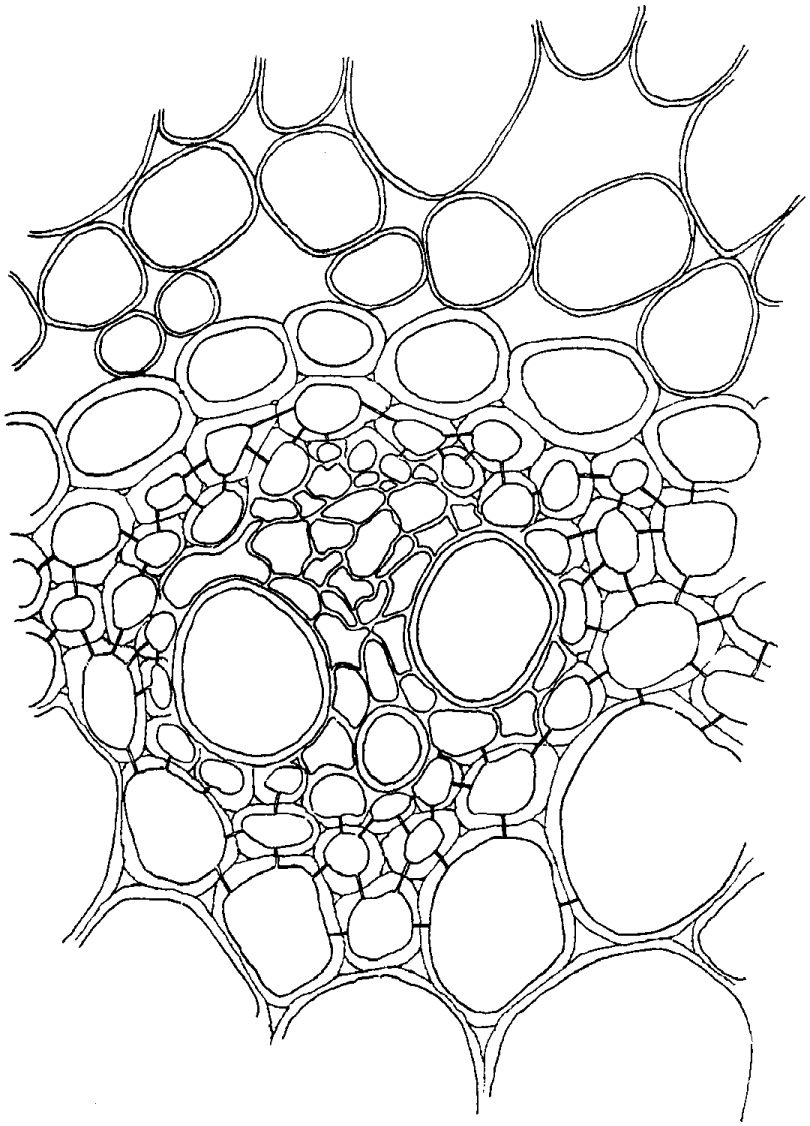

FIG. 4.

That part of the ether extract of the plant which was insoluble in water was treated with alcohol. This solvent dissolved 67.69 per cent. of the extract, leaving 17.77 per cent. of insoluble matter. The alcoholic solution gave the following evidence of resinous matter; the addition of water caused the precipitation of greenish resinous substance; alcoholic solution of ferric chloride gave a dark green color; alcoholic solution of lead acetate produced a green flocculent precipitate. The small amount of the ether extract, which water and alcohol failed to dissolve, was also insoluble in aqueous solution of potassium hydrate; alcoholic solution of potassium hydrate dissolved it, however, and it proved to be a mixture of chlorophyll and resinous matter.

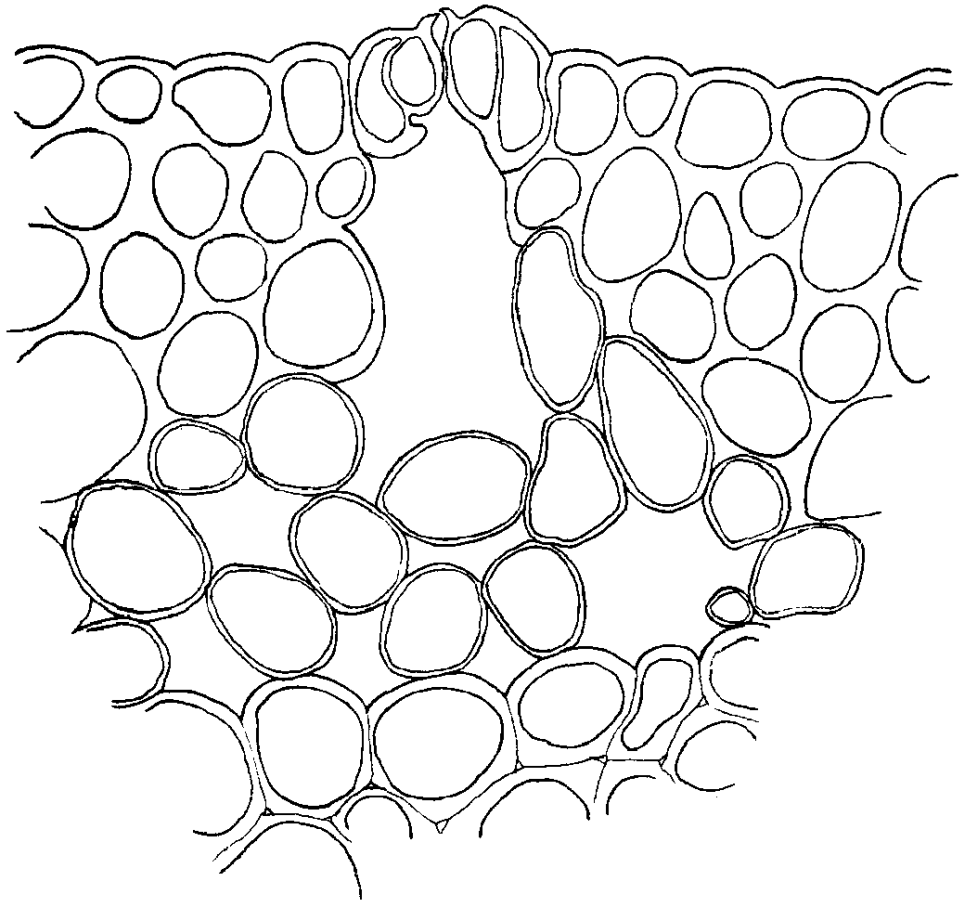

FIG. 5.

After the exhaustion with petroleum ether and ether, the plant yielded 1.04 per cent. of matter to the solvent action of absolute alcohol. Water dissolved 84-97 per cent. of the extract. The aqueous solution had a slight acid reaction toward litmus paper. It contained potassium chloride. A portion of the solution, acidified with diluted sulphuric acid, gave a copious red precipitate with Mayer's reagent; another portion, prepared in the same manner, yielded a copious reddish precipitate with potassium tri-iodide. Salts of silver and gold were reduced by still other portions of the aqueous solution of the alcoholic extract. Some of the same solution was agitated with benzin, ether and chloroform in the manner described under the treatment of the ether extract. The benzin and ether removed small quantities of matter from both acidified and alkaline solution. This matter dissolved in water, and afforded neutral solutions, which were without effect on salts of gold and silver. Nor were alkaloids indicated in the solutions by Mayer's reagent or potassium tri-iodide. But Fehling's solution was reduced by the plain aqueous solutions, and, after heating portions of the solutions with acid and again applying this reagent, more cuprous oxide was precipitated. Chloroform removed only a minute quantity of matter from either the acidified or alkaline aqueous solution of the alcoholic extract. Glucose and saccharose were tested for in

another portion of the aqueous solution of the alcoholic extract. The solution was first treated with lead acetate, which caused a precipitate; this was filtered off, the excess of lead removed from the filtrate by means of hydrogen sulphide, the resulting lead sulphide removed by filtration, and all traces of hydrogen sulphide expelled from the filtrate by boiling it. The liquid was then divided into two equal volumes. One of these volumes was tested quantitatively for glucose with Fehling's solution ; 0.03 per cent. of this substance was indicated by the cupric oxide weighed. The other half of the solution was boiled with acid to invert any saccharose present, then made alkaline and treated with Fehling's solution, but no increase in the amount of cupric oxide was found, thereby showing the absence of saccharose. With the exception of a slight residue, that part of the absolute alcohol extract which was insoluble in water dissolved in alcohol of .820 Sp. gr. The alcoholic solution was rendered turbid by the addition of water to it ; it gave a slight reddish coloration with alcoholic solution of ferric chloride, and a reddish precipitate when mixed with alcoholic solution of lead acetate.

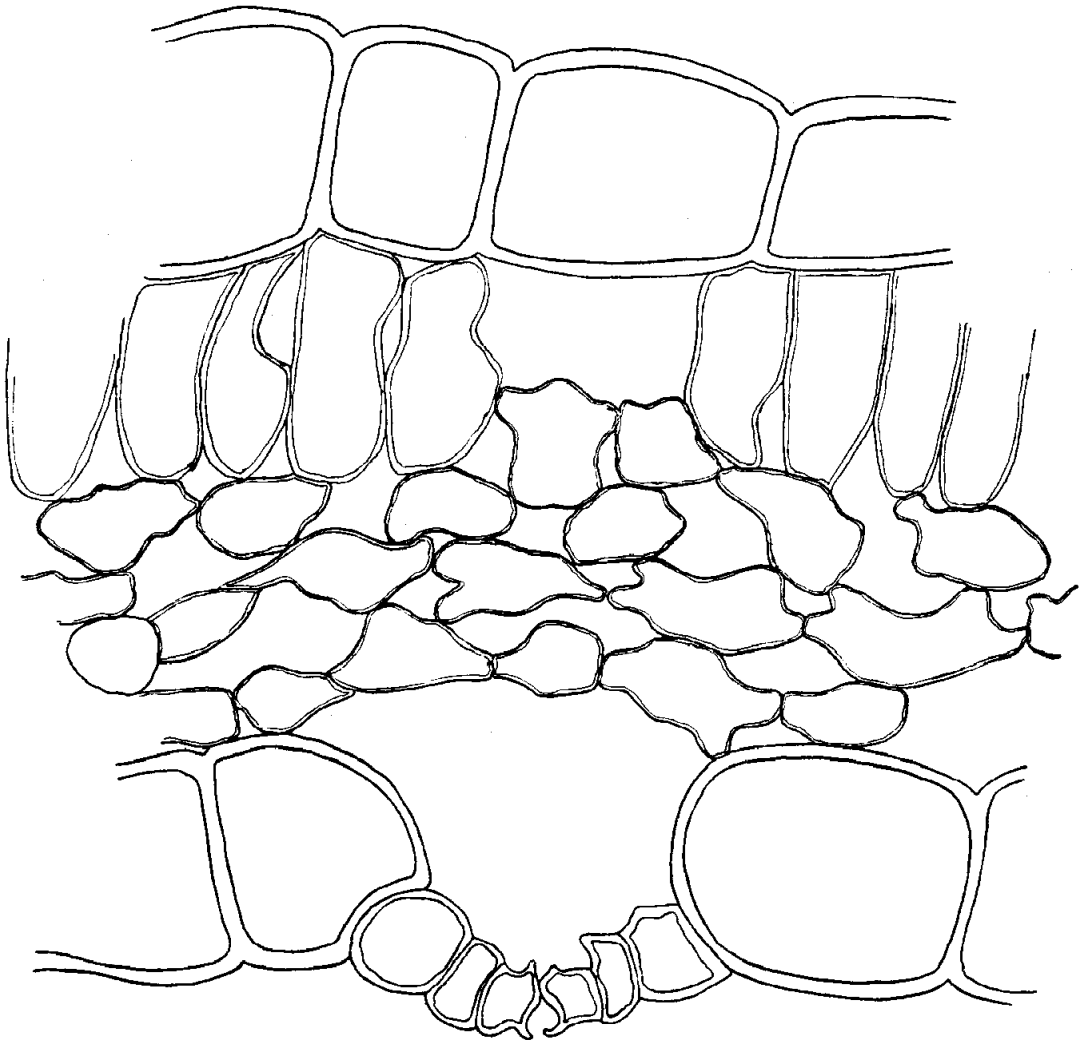

FIG. 6.

Cold water dissolved 16.34 per cent. of organic solids from the plant, after its treatment with the solvents already mentioned. The solution of these solids had an acid reaction toward litmus paper. When the solution was mixed with five times its volume of alcohol a precipitate was produced. It amounted to 3.40 per cent. Lassaigne's test revealed the presence of a trace of nitrogen in the precipitate, which must, therefore, have contained only a small amount of albuminous matter, and consisted almost entirely of mucilage; 0.41 per cent. of glucose was also found. Saccharose was not found. The precipitate caused by the addition of lead acetate to the solution of the water extract, in the examination for sugars, was suspended in water and decomposed with hydrogen sulphide. The lead sulphide was filtered off, and, after expelling the hydrogen sulphide by boiling, the filtrate was tested with ammoniacal silver nitrate solution and gold chloride solution, both of which were reduced.

The plant was next treated with a weak solution of sodium hydrate, in water, but an accidental loss of some of the liquid extract prevented an estimation of the dissolved substances. Neither mucilage nor albuminous matter was found in this extract.

Cold water moderately acidulated with hydrochloric acid extracted 13.30 per cent. of organic solids from the plant. The dissolved organic matter was not precipitated by making the solution alkaline with ammonium hydrate, or even upon the further addition of several volumes of alcohol; 0.14 per cent. of phosphates were precipitated when the acidulated water extract was rendered alkaline with ammonium hydrate.

In order to estimate the starch of the plant, the residue of the latter, from the foregoing extractions, was boiled with 5 per cent. hydrochloric acid for three hours to hydrolize the starch. The resulting glucose was treated with Fehling's solution, and the extent to which this reagent was acted on indicated the presence of 0.48 per cent. of starch.

After the conversion of the starch there remained 30.95 per cent. of cellulose, lignin and similar organic substances.

A special search was made for volatile acids. For this purpose a condenser was thoroughly cleaned by boiling distilled water in a flask into which the plant was afterward put, and conducting the vapors through the condenser until the drippings were perfectly neutral toward litmus paper. Ten grammes of fresh plant were then placed in the flask, distilled water added, and heat reapplied. The reaction of the distillate was tested with litmus, at intervals during the distillation, but no change in color was produced. The distillate was returned to the flask, and the contents of the latter acidified with diluted sulphuric acid, for the purpose of decomposing any salt of a volatile acid which might be present. The contents of the flask were then subjected to distillation, and the distillate occasionally tested during the process with litmus paper; the reaction was neutral.

The distillate was once more returned to the flask containing the plant, and the contents strained and filtered. The filtrate was made alkaline with ammonium hydrate and successively agitated with benzin, ether and chloroform in a separating funnel, but no evidence of alkaloids was obtained, from the small amounts of organic

matter which these solvents removed, upon the addition of Mayer's reagent, potassium tri-iodide, picric acid, phosphotungstic acid, and gold chloride to the acidified aqueous solution of this matter. When heated with them, the substance in solution had no reducing effect on either ammoniacal silver nitrate or gold chloride solutions. The alkaline aqueous liquid with which the benzin, ether and chloroform had been agitated was supersaturated with diluted sulphuric acid. A flocculent precipitate was produced by this treatment, but it redissolved in the course of a few minutes. This solution was divided into four portions, and tested for alkaloids with Mayer's reagent, picric acid, potassium tri-iodide and phosphotungstic acid. All of these reagents gave small, flocculent precipitates, but they may have been due to albuminous matter, and not to alkaloids. Another special search was made for alkaloids by macerating 12 grammes of fresh plant (dried) with alcohol of .820 specific gravity for several days. The alcoholic liquid was strained off, filtered clear, and then evaporated to dryness on a water-bath. The residue was treated with water previously acidified with diluted sulphuric acid, and the insoluble matter separated by filtration. The filtrate reacted for alkaloids as follows: phosphotungstic acid gave a large, whitish precipitate; potassium tri-iodide, Mayer's reagent and gold chloride gave slight precipitates; picric acid, tannic acid, mercuric chloride and platinic chloride gave no precipitates.

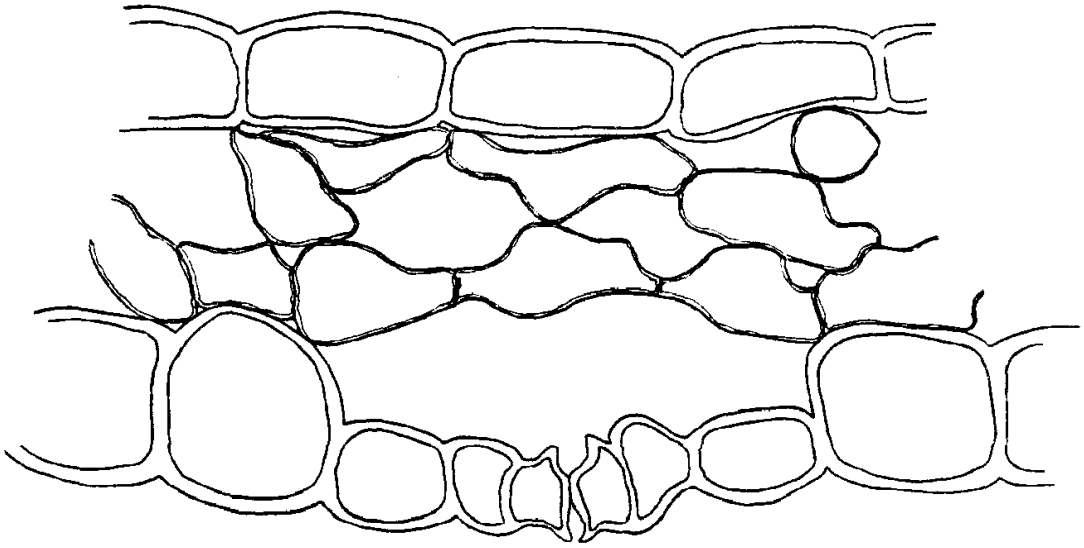

FIG. 7.

The existence of an alkaloidal substance in the plant is an unsettled matter, as the tests for it were in no case satisfactory, partly because of the very small amounts of the substances yielding the tests which could be separated.

Some of the last-mentioned filtrate which was tested for alkaloids was made alkaline with potassium hydrate and warmed with Fehling's solution, which reagent was reduced. An exactly equal volume of the same filtrate was boiled with some diluted sulphuric acid, then made alkaline and treated with Fehling's solution, as in the preceding case, when an increased amount of cuprous oxide was deposited. While this action is not taken as conclusive evidence of a glucoside, still, considering it in connection with behaviors of the same character noticed in the proximate analysis, it points to the presence of a substance allied to the glucosides. That it is not

saccharose is proved by the fact that this and similar sugars were not found in the plant, inasmuch as that the substance is removed from its aqueous solution by benzin and ether. That it is precipitated by lead acetate is shown by the fact that an aqueous solution which has been precipitated with that reagent and filtered does not develop an increased action on Fehling's solution by being boiled with acid. That it is not the substance which causes the reduction of gold and silver salts, nor the reactions with the alkaloidal reagents, is shown by the fact that the substances which affected Fehling's solution did not always influence the other reagents.

It has not been shown by the analytical data whether the substance which reduces the gold and silver salts and that which reacts somewhat like an alkaloid are identical or distinct.

And, finally, to what the plant owes its reputed medicinal effect is still an open question.

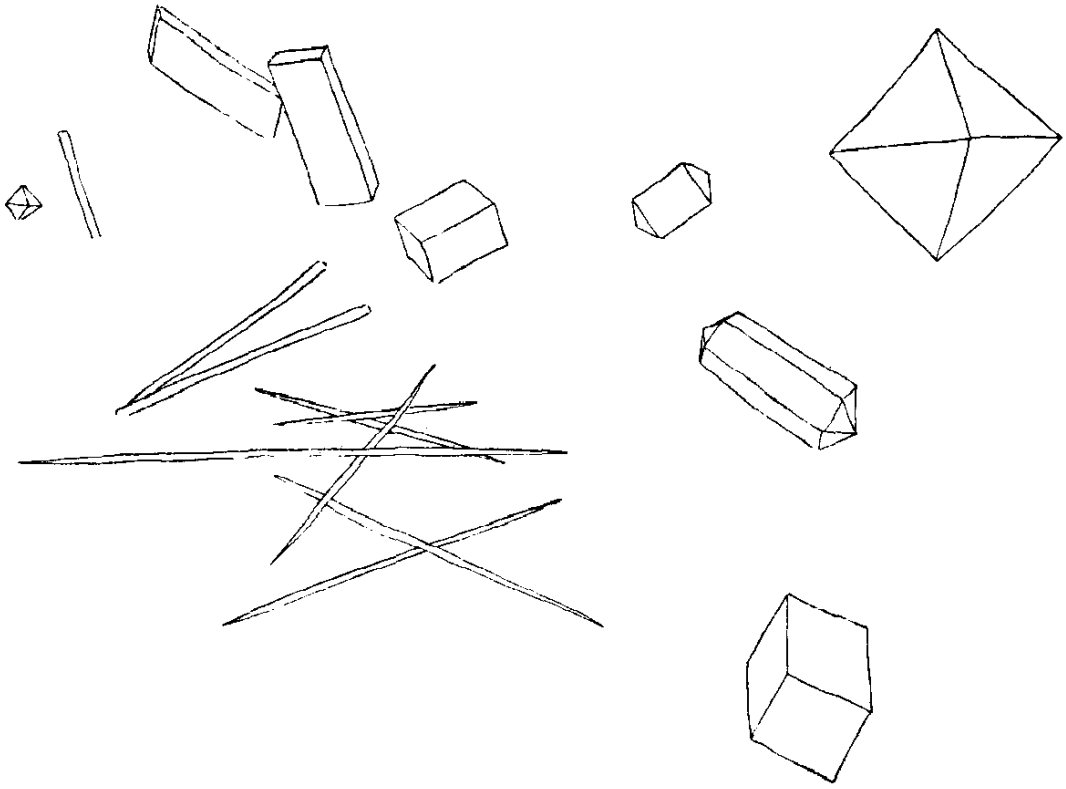

FIG. 8.

BOTANICAL EXAMINATION.

The systematic part of the work, in the identification of the species common in the locality where the specimens under examination were obtained, requires still some investigation. Suffice it to say that the specimen was not *C. virginica*. The latter possesses slightly tuberous roots, long grass-like leaves, and seeds perfectly smooth, while the specimen examined in the chemical and microscopical laboratories of the

Philadelphia College of Pharmacy has lanceolate leaves from 2 to 3 inches long, roots that are not tuberous (Fig. 2), and deeply reticulate seeds. The specimen appears much to resemble *C. communis*. According to Thomas Morong (Bulletin of Torrey Botanical Club, December 1893), "*C. communis* may be distinguished from *C. nudiflora* by its open spathe, generally much broader leaves and more robust habit." He also says that the seeds are rugose and deeply pitted, instead of being reticulated as in *C. nudiflora*. The specimen under examination appears to resemble *C. communis* rather closely.

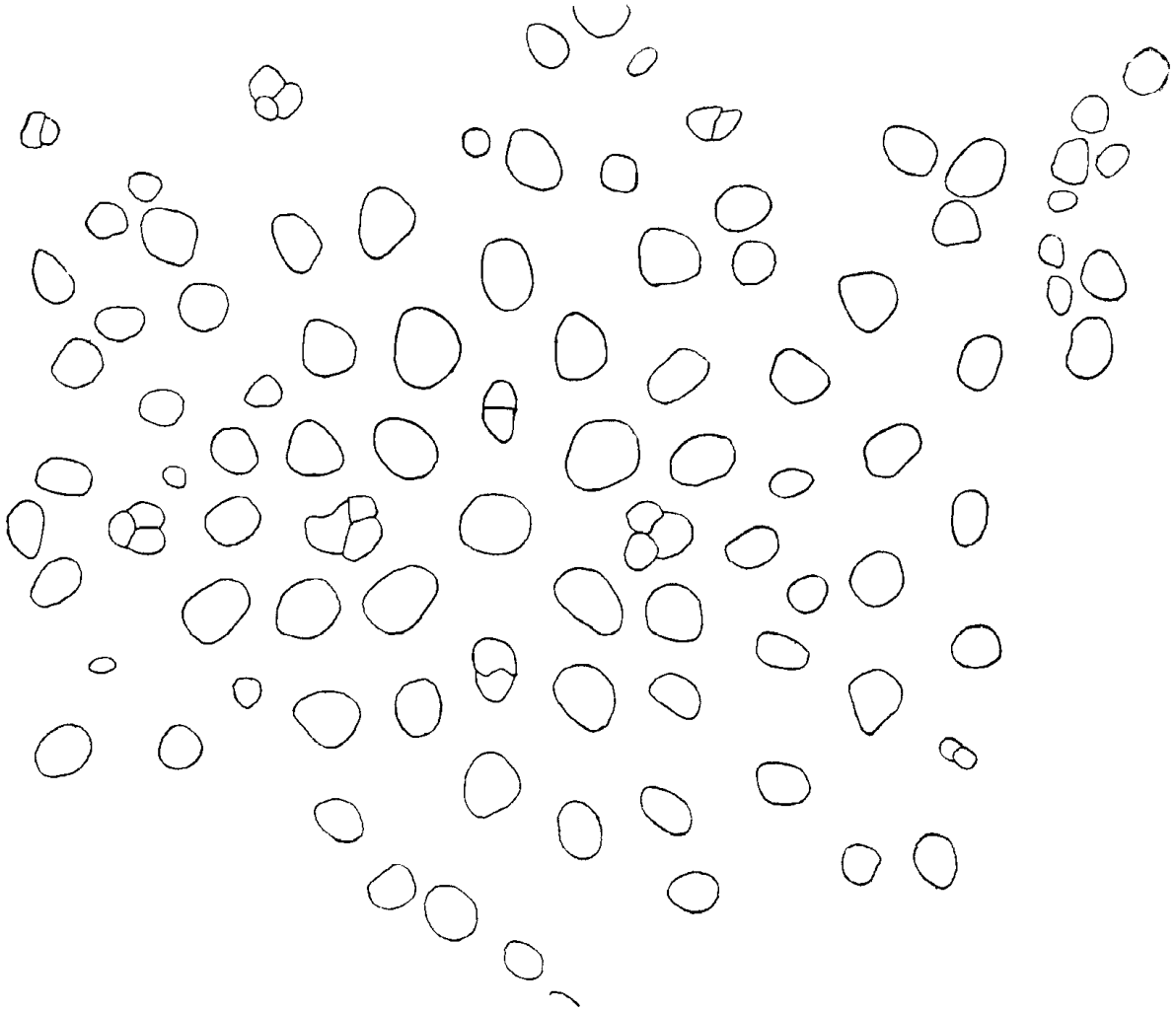

FIG. 9.

The stem is procumbent or creeping in habit, and roots are being constantly produced at the nodes (Fig. 2). The leaves are broadly lanceolate, acute at the apex, contracted at the base into sheathing petioles. The floral leaves are large, heart-shaped, clasping bracts, enclosing a 2-4 flowered cymose inflorescence (Fig. 1). More time was devoted to a study of the inner morphology (anatomy) of the the stem, leaf and bracts. The stem is more or less but irregularly cylindrical, somewhat flattened upon one side. It consists of the usual epidermis found in plants. The stomata, however, ate raised. Under the epidermis occur 3-6 layers of collenchymatic cells which are but 1/4 to 1/6

the size of the parenchyma cells underlying these layers. A well-defined cylinder sheath, composed of rather large and strongly suberized and lignified cells, extends around the fourteen fibro-vascular bundles. Between the latter are several layers of lignified cells. The remainder of the stem towards the center consists of parenchyma, in which are seventeen fibro-vascular bundles. Many of the large parenchyma cells of the pith contain mucilage which is readily detected by the iodine or methylene blue method recommended by Professor Kraemer (AMERICAN JOURNAL OF PHARMACY, June, 1898). The remaining parenchyma cells of both pith and cortex contain crystals of calcium oxalate (Fig. 8) and starch (Fig. 9). It may be worthy of mention that a movement of protoplasm was very perceptible in some of the parenchyma cells upon making a longitudinal section of the fresh stem.

The fibro-vascular bundles are of the collateral type characteristic of monocotyledons. The ducts vary in number from two to four, and are either annular or spiral. The nature of the cells of the cylinder sheath and mucilage cells were not studied to the extent that they warrant. The character of the substance on the external and internal walls and side walls of the cells of the cylinder sheath are peculiar, and differ from each other apparently. The mucilage has much the appearance as though it were in the nature of a cell-content mucilage. In longitudinal section the mucilage cells lie very near the fibro-vascular bundles of the pith and in juxtaposition to each other in longitudinal rows.

Transverse sections of the leaf show rather large epidermal cells. The walls of these epidermal cells are very thick. The stomata appear to be confined wholly to the lower surface. The guard cells, "Nebenzellen," and another row of cells are decidedly raised above the remaining epidermal cells. The respiratory cavity is rather large, The tissue between the upper and lower epidermis consists of palisade and loose parenchyma cells. The palisade cells are rather short and somewhat loosely arranged, and are made up of a single row of cells. The loose parenchyma cells are about three rows in number and the walls are much thinner than the palisade cells.

The tissues of the bract much resemble those of the leaf, save that the palisade cells are wanting and the epidermis has a tendency to become papillae-like. The epidermal cells are much larger in size compared to the cells of the remainder of the leaf. The loose parenchyma consists of about three rows of cells. The stomata occur only upon the lower (dorsal) portion of the epidermis, as in the leaf. The "Nebenzellen" of the stomata are likewise four.

The structure of the whole plant is interesting from a botanical standpoint. The peculiarity of the marked contrast in the thickening of all the cells of the leaf, as well as the cylinder sheath, and the presence of mucilage, lead to the conclusion that this plant possesses an arrangement for carrying on the work of transpiration that is peculiarly its own.

DESCRIPTION OF FIGURES.

FIG. 1-Upper portion of stem with leaves and inflorescence in the axils.
FIG. 2-Portion of creeping stem producing roots at the nodes.
FIG. 3-Transverse section of stem, for description of which see text.
FIG. 4.-One of the fibro-vascular bundles just within the cylinder sheath.

FIG. 5-Transverse section of stem showing a stoma.
FIG. 6.-Transverse section of leaf showing a stoma upon the under surface.
FIG. 7.-Transverse section of bract with a stoma upon the lower surface.
FIG. 8.-Various forms of crystals of calcium oxalate, found principally in the stem.
FIG. 9.-Starch-grains, mostly single, sometimes compound.