and proper development of plants depend upon radiant energy, such as that emitted by the sun, is a well known fact. We believed, however, that animal cells were independent of the necessity of direct irradiation for proper growth. The observations cited may make it necessary for us to revise this opinion. The far reaching generalization is dawning upon us that, without radiant energy acting directly upon it, no organism can grow properly.

An interesting parallel is to be found in connection with the clinically well established value of cod liver oil in tuberculosis. This disease is, like rickets, a disease of civilization and of darkness. Out-door-life and sunshine have a therapeutic value in both, and so has cod liver oil. Cod liver oil is, of course, not curative in tuberculosis as it is in rickets, because in the latter it supplies the deficiency that causes the disease, while the former is a much more complicated process, being a fight between the tissue cells and the tubercle organisms. How the cod liver oil helps in this fight whether, by favoring through its vitamins, the proper maturing of tissue cells and the walling off of the germs, or in some other manner, remains to be determined by future studies.

A PARTIAL ANALYSIS OF THE FRUIT OF EUPATORIUM URTICÆFOLIUM.

BY F. S. BUKEY.

Eupatorium urticæfolium Reichard[1] (*Eupatorium ageratoides* L.f.) is known by the common names of white snakeroot, rich weed and white sanicle. The name white snakeroot is the most commonly used. The plant is very widely distributed. Its range extends from Canada to Georgia and westward to Kansas and Nebraska. The plant appears to be most common in Indiana, Illinois, Ohio, Pennsylvania New York and the New England states. The conditions best suited to its growth are rich woods bordering streams, or in shaded mountain woods usually on the northern slopes. In northern Ohio the white snakeroot is found mostly on the northern slopes of wooded hillsides. The plant is a member of the Composite family, and of a genus in which there are some nineteen species in the region covered by "Gray's Manual" (seventh edition). Many of these species resemble each other so closely as to render recognition extremely difficult.

Eupatorium urticæfolium is a herbaceous perennial one to two meters in height. The surface of the typical plant is practically free from trichomes and other hairy growths. The leaves are opposite on long, slender, very much branched stems. They vary from five to fifteen centimeters in length, and from three to eight centimeters in width. They are netted-veined, palmately three-nerved. The blade is thin and broadly ovate, having an acuminate apex, dentate-serrate margin and a truncate or cordate base which in the smaller leaves may be abruptly narrowed into a slender petiole. The petiole is usually three to seven centimeters in length. The inflorescence is a compound corymb, each head having from ten to thirty flowers. The receptacle is flat. The involucre is of narrow lanceolate

[1] The species was identified by Dr. E. E. Stanford, Head of the Department of Pharmacognosy, Western Reserve University School of Pharmacy.

bracts two to four millimeters in length which appear mostly in one series. The corollas are white with pubescent lobes. The fruit is a glabrous achene of about five millimeters in length and half a millimeter in width. The pappus is composed of a single row of from twenty-five to thirty fine spreading hairs.

Eupatorium urticæfolium has been a subject of study for the last seventy-five years. Most of the work has been largely pharmacological and concerned with the supposed causal relationship of this plant to the disease known as Trembles in animals and Milksickness in man. The most extensive recent study which has come to the writer's attention is that of F. A. Wolf, R. S. Curtis and B. F. Kaupp.[1] This publication also contains an excellent bibliography.

The principal chemical researches reported thus far have been in attempts to isolate from the herbage of the plant a toxic constituent which might be connected with the disease. E. L. Moseley[2] found the leaf of white snakeroot to contain 8 per cent of ash, and the stems only 4 per cent. His ash analysis of the leaf showed 1.8 per cent of CaO, 1 per cent of MgO and 0.1 per cent of Fe_2O_3 while 0.9 per cent of CaO and 0.3 per cent of MgO were present in the stems. He also reports the presence of $AlPO_4$, which he thought for some time was the cause of the disease. Later, Moseley[3] found a resin which he thought was the toxic agent. C. B. Jordan, J. P. Whelan and W. F. Gidley[4] found that the herbage contains a volatile oil which is lighter than water and has an odor of pinene. They found that on acidifying an extract of the plant with concentrated HCl a volatile substance was formed which was heavier than water, yellowish brown in color and with an apple-like odor. They also state that it is possible that organic aluminum compounds are present.

The object of the experiments reported in this paper has been to determine the chemical composition of the fruit of *Eupatorium urticæfolium*. Because only a limited supply of the fruit was available, the scope of the experiments was necessarily somewhat limited. A supply of white snakeroot was found growing on a hill-side in one of the city parks. The material was gathered in the early part of September before frost. The leaves and flower heads were stripped from the stalks and thoroughly dried. The dried material was then shaken in a sieve which had meshes of about half an inch. The fruit passed through leaving the leaves and stems in the sieve. These were retained for further experimental work. The pappus was removed from the fruit by rubbing it between the palms of the hands and then sifting through a No. 20 sieve held in front of a fan. This latter process was similar to the old method of cleaning grain by use of the fanning mill. After repeating this process several times the achene was almost entirely freed of the pappus. The cleaned fruit was ground so that it would pass a No. 60 sieve.

The ground achene was greenish gray and of an oily appearance due to the presence of fatty material. It was thought best to remove the fatty substance in order to facilitate analysis. Therefore a small amount of the powder was re-

[1] *Technical Bulletin* 15 (1918), North Carolina Agricultural Experimental Station.

[2] "The Cause of Trembles and Milksickness," *Med. Rec.* (N. Y.), 75. No. 20, 1909.

[3] "Milksickness and Trembles Caused by Resin of White Snakeroot," *Med. Rec.* (N. Y.), 92. No. 10, 1917.

[4] A Study of the Cause of Trembles (in Domestic Animals) and Milksickness (in Man). JOUR. A. PH. A., Vol. 13, No. 3, 1924.

tained and the remainder percolated to exhaustion with petroleum benzine (b. p. 38° C.). The benzine was removed from the percolate by distillation, care being taken in this step to keep the temperature below 100° C., so as not to cause any change in the oil obtained. After the benzine had evaporated from the marc the latter was found to be light brown due to the loss of coloring substances.

The following procedure was taken to determine what per cent of the fruit was soluble in benzine. Three ten-gram samples were weighed from material which had been dried in an oven at 105° C. for an hour. These samples were placed in weighed soxhlet thimbles and extracted in a soxhlet apparatus for eight hours, using petroleum benzine as a solvent. At the end of the extraction the thimbles were removed, dried at 105° C. for an hour and then weighed. No attempt was made to determine the per cent of oil from the extracts as the error in manipulation would be too great.

	No. 1, grams.	No. 2, grams.	No. 3, grams.
Wt. of soxhlet thimble	7.1648	7.4803	6.9841
Wt. of the thimble and fruit	17.1648	17.4803	16.9841
Wt. of the fruit	10	10	10
Wt. of the thimble after extracting	15.4394	15.7422	15.2504
Wt. of the oil in the fruit	1.7254	1.7381	1.7337
Per cent of oil in the fruit	17.25%	17.38%	17.33%

Average per cent of oil 17.32.

The product obtained on the evaporation of the benzine was a viscid dark greenish brown oil having a heavy narcotic like odor. On attempting to determine the boiling point decomposition took place at about 260° C., a resinous substance being formed. The solidifying point of the oil was found to be —24° C., determined by use of CO_2 snow. Like most fixed oils obtained from plants, it was found to be insoluble in cold alcohol and only very slightly soluble in hot alcohol. It was, however, soluble in such volatile solvents as chloroform, benzol, ether and carbon tetrachloride. The specific gravity was 0.9116 at 20° C., determined by use of a pyknometer. The refractive index (Abbe) was 1.475 at 20° C. The iodine number was determined by the Wijs chloriodine method. Six different determinations were made and the iodine number as determined was between 145.3–155.2. The saponification number was determined by the Koettstorfer method as between 157.3–163.2. A determination of the insoluble fatty acids showed about 95 per cent. The solidifying point of these fatty acids was —23° C. and the refractive index 1.483 at 22° C. The low solidifying point of the fatty acids would indicate that a large portion of the unsaturated acids were present. On exposure to the air a skin formed on the surface of the oil. These two points lead to the conclusion that the oil is of the drying type.

The water soluble content of the fruit was next determined. Three ten-gram samples which had been dried at 105° C. for an hour, were placed in liter boiling flasks with 800 cc. of water and the mixture boiled for an hour and then filtered. The residue was returned to the flask and the process repeated twice. After the final washing the residue was removed from the filter, dried at 105° C. for an hour, and then weighed. The results showed an average loss in weight of 3.2630 grams. The water soluble content of the fruit was therefore 32.63 per cent.

The amount of moisture in the fruit was determined by heating three one-

gram samples at 105° C. for an hour. The average loss was 0.0530 gram. Therefore the amount of moisture present was 5.30 per cent.

The following determinations with ash were made by the A. O. A. C.[1] methods. The ash present (*loc. cit.*, p. 105) was found to be 8.82 per cent. The water soluble ash was 4.40 per cent, the water insoluble ash 4.29 per cent (*loc. cit.*, p. 105). The alkalinity of the soluble ash was equal to 2 cc. of N/10 HCl per gram of ash (*loc. cit.*, p. 105). The alkalinity of the insoluble ash was equal to 6 cc. of N/10 HCl per gram of ash (*loc. cit.*, p. 106). The acid insoluble ash (*loc. cit.*, p. 257) was 0.73 per cent.

An analysis was made to determine the elements present in the ash. About ten grams of ash was placed in 100 cc. of water, this was heated to boiling and filtered. This filtrate gave positive tests for chlorides, sulphates, phosphates and potassium. The tests indicated that there was only small amounts of chloride and phosphate present. The residue was then added to 50 cc. of dilute HNO_3, heated to boiling and filtered. This filtrate gave positive tests for aluminum, calcium and phosphates. The residue was mostly silicates and carbon. The aluminum was determined quantitatively as Al_2O_3, with the following results.

	No. 1, grams.	No. 2, grams.	No. 3, grams.
Wt. of ash used	1	1	1
Wt. of Al_2O_3 present	.2849	.2845	.2856
Wt. of Al_2O_3 in 1 gram of fruit	.0250	.0251	.0252
Per cent of Al_2O_3 in the fruit	2.50%	2.51%	2.52%

The weight of Al_2O_3 in 1 gram of fruit was obtained by multiplying the weight of Al_2O_3 in the ash by 0.0882 gram which is the ash equivalent of 1 gram of fruit. A check determination was made using the fruit in place of the ash. This resulted in 2.53 per cent of Al_2O_3. The average of the two methods being 2.52 per cent.

A determination of the crude protein made by the Gunning method showed an average result of 25.07 per cent. The following were the results of the experiment.

	No. 1.	No. 2.	No. 3.
Number of cc. of N/10 HCl used in neutralizing the NH_3 formed	28.5 cc.	28.6 cc.	28.8 cc.
Wt. of sample used	1 gram	1 gram	1 gram
Determined wt. of the protein	.2495 gram	.2504 gram	.2521 gram
Per cent of protein	24.95%	25.04%	25.21%

The crude fiber was determined to be 20.37 per cent by A. O. A. C. methods. Experimental results were as follows:

	Grams.	Grams.	Grams.
Wt. of sample used	2	2	2
Wt. of residue	.4500	.4753	.4645
Wt. of ash	.0485	.0618	.0574
Wt. of crude fiber	.4015	.4135	.4071
Per cent of crude fiber	20.08%	20.67%	20.35%

The form of the aluminum was determined by the following method. An aqueous extract of the fruit was tested for the presence of aluminum with negative results. The residue left after this extraction was added to a dilute solution of

[1] "Official and Tentative Methods of Analysis of the Association of Official Agricultural Chemists," Second Edition (1919).

HNO_3 heated to boiling and filtered. On adding NH_4OH to this filtrate a heavy precipitate of $Al(OH)_3$ formed. A confirmatory test with $Co(NO_3)_2$ gave positive results. The only basic radical present was phosphate. This would indicate that aluminum was present in the form of the phosphate.

SUMMARY.

The principal results of the above experiments may be summed up as follows:

1. The fruit contains a drying oil having the following properties.

Specific gravity .9116; Solidifying point —24° C.; Refractive index (20° C.) 1.475; Iodine number 145.3–155.2; Saponification number 157.3–163.2.

2. The chemical composition of the fruit is as follows:

Moisture 5.30%; Ash 8.82%; Crude protein 25.07%; Crude fat 17.23%; Crude fiber 20.37%; Carbohydrate (by difference) 23.21% = 100.00%.

3. The fruit contains aluminum phosphate.

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PHARMACY IN THE DAYS OF THE PHARAOHS.*

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Our knowledge of medicine and pharmacy in Ancient Egypt is largely drawn from four papyri though there are five others which contain references to medicine and the practice of the healing art. But these five are mainly devoted to mystical incantations. The four which give us most of our knowledge of medicine in the days of the Pharaohs (1) are the "Berlin Medical Papyrus," a photostat of which is shown here,[1] and which covers 23 pages; (2) "The Ebers Papyrus," of 109 pages, a reproduction of which is shown here[1] through the courtesy of the Lloyd Library; (3) the "Edwin Smith Papyrus," of 22 pages, one page of which is shown,[1] and (4) the "Hearst Papyrus," owned by the University of California, which has been published with notations, this published form being shown.[1] This contains 18 pages.

From these we learn that in Egypt, as in most of the early civilizations, medicine was a part of the priestcraft. The Egyptians seem to have had a very good idea of the circulation of the blood, and of the function of the heart.

A great many of the drugs named are still in use, while others are known to us though their use has been discontinued. The preparations used were made up for each individual case, and were generally polypharmacal, containing anywhere from three to two dozen ingredients. Little or no attention seems to have been paid to appearance or palatability. Beer was much used as a vehicle.

Something like 150 drugs have been identified as having been used by the pharmacists of the Pharaohs, a list of which will be found in the "Handbuch der Pharmacognosie" by Tschirch, Vol. 1, part 11, page 463. This included absinthe,

* Abstract of paper presented before the Section on Historical Pharmacy, Buffalo meeting, 1924.

[1] Exhibited during the meeting of the Section.