

LIX.—*The Alkaloids of Senecio latifolius.*

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ON account of the alleged poisonous effects on cattle, a number of plants from Cape Colony are being investigated in the Scientific and Technical Department of the Imperial Institute at the request of the Government of Cape Colony. Among these is *Senecio latifolius* (N.O. *Compositae*), a plant of common occurrence in certain parts of Cape Colony and the Transvaal. It is described by Cheeseman (*Manual of New Zealand Flora*, 1906, 374) as "a tall, erect, much-branched glabrous herb, two to four feet high; stem, flexuous, grooved. Leaves, membranous, two to eight inches long, very variable in shape."

Several members of the *Senecio*, or "Ragwort," genus have, from time to time, been proved to have caused the death of cattle, thus suggesting the presence of a toxic constituent. In the *Annual Report of the New Zealand Department of Agriculture* (1902, 300) an account is given of the occurrence of "Winton disease" in horses and cattle,

and this disease, in reality acute cirrhosis of the liver, is shown to be due to the consumption of *Senecio jacoboeus*. In the *Cape Agricultural Journal* (1904, 675), the administration of *Senecio Burchellii* to cattle is shown to have brought about all the symptoms of "Winton disease," and ultimately to have caused death. Finally, the Director of Agriculture for Cape Colony (*Report*, 1906, 41), referring to an outbreak of the same disease, says, "I have no doubt the cause is due to some plant or plants which are eaten, and which produce the action slowly," and adds that *Senecio latifolius*, a plant which has been experimentally proved to kill horses, grows profusely throughout the area.

In chemical literature, the only record of a chemical examination of members of the *Senecio* genus is contained in a paper by Grandval and Lajoux (*Compt. rend.*, 1895, 120, 1120). These authors state that they have made an examination of *Senecio vulgaris* (the common groundsel) and have obtained from it two new alkaloids, to which they give the names *senecionine* and *senecine*. The former, to which they assign the formula  $C_{18}H_{26}O_6N$ , is stated to crystallise in rhombic plates, and to have a rotatory power of  $[\alpha]_D - 80^\circ 49'$ . No other data regarding it are given, and no crystalline salts were prepared. The second alkaloid, which was not obtained in a crystalline state and to which a formula is not given, is stated to form an acid tartrate and to be more soluble in ether and more bitter than *senecionine*.

The materials used in the present investigation consisted of two small supplies of *Senecio latifolius* received from the Agricultural Department of Cape Colony, one being collected before flowering, and the other after flowering.

## EXPERIMENTAL.

*Preliminary Examination.*—Small portions of each sample of the coarsely-powdered plant were submitted to a systematic preliminary examination with a view to ascertain whether, or not, any substances of a glucosidic, phenolic, or resinous character, and likely to be physiologically active, were present; this work gave negative results, and attention was therefore directed to a search for alkaloids. The method adopted was that usually employed for the extraction of alkaloids, namely, the substance was exhausted with alcohol, the alcoholic extract distilled to remove alcohol, and the residue extracted with dilute acid; the acid solution was rendered alkaline with ammonia and extracted with chloroform, and finally the chloroform solution was distilled to dryness. When treated in this manner, both samples of the plant yielded dark-coloured, varnish-like residues, which were basic in character, and gave the usual alkaloidal reactions;

thus, with Mayer's reagent, a solution of the residue in dilute hydrochloric acid gave a white, flocculent precipitate, soluble in excess of the reagent; with Wagner's reagent, a similar acid solution gave a brown, crystalline periodide; and with gold chloride, a canary-yellow precipitate was obtained. In the case of *Senecio latifolius* "before flowering," the yield of crude alkaloidal residue amounted to 1.72 per cent., whilst in that of the "after flowering" sample it amounted to 0.76 per cent. These residues were subsequently dissolved in dilute acid, the solution so obtained rendered alkaline with ammonia and extracted with ether; on removal of the ether by distillation, they were obtained almost colourless, but still amorphous, and the weights of the purer materials represented percentages of 1.20 and 0.49 respectively on the two samples.

#### *Isolation of an Alkaloid.*

The whole quantity of each of the two samples of the plant was now coarsely powdered and separately exhausted with cold alcohol (95 per cent.) by percolation. As it was ultimately found that both samples contained the same alkaloids, a description of the methods adopted for the treatment of one of them will suffice.

The alcohol was removed from the alcoholic extract by distillation under diminished pressure, and the residue, when cold, treated with two per cent. hydrochloric acid. The acid solution was filtered and thoroughly shaken with ether, in order to remove colouring matter, etc.; it was then rendered alkaline with ammonia, and the alkaline liquor extracted with successive quantities of chloroform. The solution in chloroform was now extracted with 2 per cent. hydrochloric acid, and the acid solution so obtained was rendered alkaline with ammonia and shaken with chloroform. This solution in chloroform was washed with a small quantity of water, in order to remove traces of alkali, and, after removal of the solvent by distillation, the alkaloidal substance was obtained as a yellowish-brown, varnish-like mass.

The crude alkaloidal residue was neutralised exactly with one per cent. nitric acid; this solution was filtered and allowed to evaporate in a vacuum desiccator, by which means fine white crystals, together with a certain amount of non-crystalline matter, were obtained. The whole was dissolved in hot absolute alcohol, and, on cooling, crystals of a nitrate separated; after four crystallisations from absolute alcohol, the nitrate was obtained in colourless, elongated, rhombic prisms melting and decomposing at 240°.

The nitrate was dissolved in water, the solution rendered alkaline with ammonia, and extracted with ether. The ethereal solution was

washed with a little water to remove traces of alkali, and dried over anhydrous sodium sulphate; the solvent was then removed by distillation, and a colourless, varnish-like residue remained. On dissolving this residue in chloroform and cautiously adding light petroleum, the free base separated in colourless, rhombic plates. It is proposed to name this alkaloid *senecifoline*.

### *Properties of Senecifoline.*

*Senecifoline* is soluble in chloroform, ether, or alcohol, but is practically insoluble in light petroleum or water; it possesses a slightly bitter taste. With sulphuric acid, sulphuric acid and manganese dioxide, or with nitric acid, it gives no coloration. When, however, a drop of ferric chloride solution, and subsequently a drop of potassium ferricyanide solution, are added to an aqueous solution of the nitrate of the base, a greenish-blue coloration is obtained. *Senecifoline* darkens slightly when heated to  $190^{\circ}$ , and melts at  $194-195^{\circ}$ .

A solution of the alkaloid in alcohol is dextrorotatory. Determinations of the specific rotation were made in a Laurent's half-shadow polarimeter, and gave the following result as the mean of six readings:

$$\alpha^{(22^{\circ})} = +1^{\circ}5', c = 3.85, l = 1\text{-dm.}; \text{whence } [\alpha]_D + 28^{\circ}8'.$$

When heated at  $105^{\circ}$ , 0.1718 lost 0.0008; the alkaloid therefore crystallises uncombined with its solvent. Analysis of the free base gave the following results:

0.1060 gave 0.2187  $\text{CO}_2$  and 0.0667  $\text{H}_2\text{O}$ .  $\text{C} = 56.2$ ;  $\text{H} = 7.0$ .

0.1258 „ 4.36 c.c.  $\text{N}_2$  (moist) at  $20^{\circ}$  and 766 mm.  $\text{N} = 4.0$ .

$\text{C}_{18}\text{H}_{27}\text{O}_8\text{N}$  requires  $\text{C} = 56.1$ ;  $\text{H} = 7.0$ ;  $\text{N} = 3.7$  per cent.

Perkin's modification of Zeisel's method for the determination of methoxyl groups (Trans., 1903, 83, 1367) was applied to the alkaloid, but no indication of the presence of such groups could be obtained; on cooling, however, a crystalline substance was seen to have separated from the hydriodic acid. This was collected and recrystallised from absolute alcohol, when white crystals melting at  $210^{\circ}$  were obtained. The amount of substance so obtained was too small to allow of further investigation, but, as will be evident later, it did not consist of the hydriodide of the base.

If an aqueous solution of the nitrate of the base is rendered alkaline with sodium hydroxide, the free base can be obtained by extraction with ether and subsequent removal of the ether by distillation; hence it follows that the alkaloid does not contain any phenolic hydroxyl groups.

*Salts of Senecifoline.*

*Senecifoline nitrate* is prepared by neutralising the crude alkaloidal residue with one per cent. nitric acid as previously described; the solution is allowed to evaporate spontaneously in a vacuum desiccator, and the pure nitrate is obtained from the residue by recrystallisation from absolute alcohol until the melting point is constant. It crystallises in colourless, elongated, rhombic prisms, and melts and decomposes at  $240^{\circ}$ . It is fairly soluble in cold, and very soluble in hot, water; it dissolves in hot absolute alcohol, but is very sparingly soluble in the cold solvent; it is insoluble in ether, chloroform, or light petroleum.

A solution of the salt in water is levorotatory. The following result is the mean of six readings:

$$\alpha^{(20^{\circ})} = 0^{\circ}30', c = 3.165, l = 1\text{-dm.}; \text{whence } [\alpha]_D = -15^{\circ}48'.$$

When heated at  $100\text{--}105^{\circ}$ , 0.3190 lost 0.0020; the salt therefore crystallises uncombined with its solvent.

*Senecifoline hydrochloride* was prepared by dissolving the pure base in sufficient dilute hydrochloric acid to produce a neutral solution, and allowing this to evaporate in a vacuum desiccator, when a white, crystalline residue was obtained. This was dissolved in hot absolute alcohol, and caused to crystallise by the addition of sufficient ether to make the solution slightly cloudy; after some time, crystals of the hydrochloride separated in fine white needles, which melted and decomposed at  $260^{\circ}$ . *Senecifoline hydrochloride* is much more soluble in water or alcohol than the nitrate; it resembles the latter, however, in that it is quite insoluble in ether, chloroform, or light petroleum. A solution of the salt in water is levorotatory; the following result is calculated from the mean of six readings:

$$\alpha^{(20^{\circ})} = -0^{\circ}13', c = 1.08, l = 1\text{-dm.}; \text{whence } [\alpha]_D = -20^{\circ}.$$

When heated at  $100\text{--}105^{\circ}$ , 0.0748 lost 0.0003; the salt therefore crystallises uncombined with its solvent.

*Senecifoline hydriodide* was obtained as a white, crystalline precipitate by the interaction of the nitrate and potassium iodide in aqueous solution; it was collected, washed with a little water, dried, and recrystallised from absolute alcohol. The hydriodide thus prepared crystallised in flat plates—probably monoclinic—and melted and decomposed at  $248^{\circ}$ ; it is much less soluble in water or alcohol than the nitrate.

*Senecifoline aurichloride*.—By the addition of an aqueous solution of gold chloride to an aqueous solution of *senecifoline hydrochloride* acidified with hydrochloric acid, a bright canary-yellow, amorphous precipitate was obtained. The salt was collected, washed with water until free from acid, and dried in a vacuum desiccator. It was readily

obtained in golden, lath-shaped crystals—probably belonging to the rhombic system—by recrystallisation from absolute alcohol. As thus prepared, it crystallises with one molecule of alcohol, as shown by the following determination:

0.2455 lost, at  $105^{\circ}$ , 0.0142.  $C_2H_6O = 5.78$ .

$C_{18}H_{27}O_8N, HAuCl_4, C_2H_6O$  requires  $C_2H_6O = 5.96$  per cent.

The salt, dried at  $105^{\circ}$ , melts and decomposes at  $220^{\circ}$ .

A known weight of the aurichloride, dried at  $105^{\circ}$ , was suspended in water, and hydrogen sulphide passed through the liquid until the whole of the salt was decomposed. The sulphide was collected, dried, ignited, and the gold weighed as metal:

0.2940 gave 0.0787 Au. Au = 26.77.

Another portion of the salt, dried at  $105^{\circ}$ , was directly ignited and gave the following result:

0.1160 gave 0.0313 Au. Au = 27.16.

$C_{18}H_{27}O_8N, HAuCl_4$  requires Au = 27.17 per cent.

#### *Decomposition of Senecifoline by Alkali.*

An experiment was made to ascertain whether, or not, senecifoline could be hydrolysed in two stages in the same manner as indaconitine (Dunstan and Andrews, Trans., 1905, 87, 1620). The pure base (0.3850 gram) was dissolved in the requisite amount of *N*/10-sulphuric acid to form the neutral sulphate, and the solution was heated in a sealed tube to  $125$ — $130^{\circ}$  for six hours. After cooling, the contents of the tube gave a neutral reaction; the solution was rendered alkaline with ammonia, and extracted with ether; the ethereal solution was then distilled, when practically the whole of the pure base was recovered. This was converted into the nitrate, which, by determination of the melting point and specific rotation, was found to be identical with senecifoline nitrate. No hydrolysis had therefore been effected.

Another portion of the pure base (2 grams) was dissolved in 50 c.c. of absolute alcohol, and 4 c.c. of a 40 per cent. solution of sodium hydroxide were added. After twenty-four hours, the liquid was neutralised with hydrochloric acid, and the alcohol removed by distillation under diminished pressure; the residue was dissolved in a small quantity of water, the solution acidified with hydrochloric acid and extracted with ether, and the ethereal solution washed with a little water, dried, and concentrated to a small bulk by distillation. On standing, colourless crystals gradually separated from the solution. The substance so obtained was shown to exhibit acidic properties, and the name *senecifolic acid* is suggested for it.

*Properties of Senecifolic Acid.*

*Senecifolic acid* is soluble in chloroform, ether, or alcohol, sparingly so in water, and insoluble in light petroleum. It possesses a slightly acid taste, crystallises in colourless, six-sided plates belonging to the rhombic system, and melts at 198–199°. A solution of the acid in alcohol is dextrorotatory. The following result is the mean of six readings:

$$\alpha^{(20^\circ)} = +0^\circ 25', c = 1.468, l = 1\text{-dcm.}; \text{whence } [\alpha]_D + 28^\circ 22'.$$

When heated at 105°, 0.1488 lost 0.0020; the acid therefore crystallises uncombined with its solvent.

Senecifolic acid does not contain nitrogen. On analysis:

0.1922 gave 0.3642 CO<sub>2</sub> and 0.1220 H<sub>2</sub>O. C = 51.68; H = 7.05.

C<sub>10</sub>H<sub>16</sub>O<sub>6</sub> requires C = 51.72; H = 6.9 per cent.

By the addition of an aqueous solution of silver nitrate to an aqueous solution of the sodium salt of senecifolic acid, prepared by neutralising the acid with sodium hydroxide, a white, flocculent precipitate of the *silver* salt was obtained. This was sparingly soluble in hot water, and crystallised in needles on cooling. The salt was collected, washed with water, and dried in a vacuum desiccator. On ignition:

0.1514 gave 0.0724 Ag. Ag = 47.82.

C<sub>10</sub>H<sub>14</sub>O<sub>6</sub>Ag<sub>2</sub> requires Ag = 48.43 per cent.

By titration of the free acid with *N*/10-sodium hydroxide, using phenolphthalein as indicator, the following result was obtained:

0.1203 required 9.25 c.c. Na = 17.6.

C<sub>10</sub>H<sub>16</sub>O<sub>6</sub> requires Na = 20.0 per cent.

The end reaction was exceedingly indefinite.

The molecular weight of senecifolic acid was determined by the cryoscopic method:

0.1455 in 11.0807 glacial acetic acid gave  $\Delta t = -0.190^\circ$ . M.W. = 263.

C<sub>10</sub>H<sub>16</sub>O<sub>6</sub> requires M.W. = 232.

When a drop of a one per cent. solution of potassium permanganate is added to a neutral solution of the sodium salt of the acid, no immediate decoloration takes place; hence senecifolic acid does not appear to contain an ethylenic linking, and, in view of this fact, it is probably a monocyclic dihydroxydicarboxylic acid. Moreover, since no dibasic acid of the formula C<sub>10</sub>H<sub>16</sub>O<sub>6</sub>, and possessing the properties referred to above, has been previously described, senecifolic acid must be regarded as a new substance.

The acid solution which remained after the extraction of senecifolic acid and contained the remaining product of hydrolysis, was rendered alkaline by sodium hydroxide and extracted with chloroform; the

chloroform was then evaporated, but no residue was obtained. Thus it was proved that hydrolysis of the original base was complete, and that the hydrolytic base was too soluble in water to be extracted by chloroform; in this respect it resembles other bases obtained by the hydrolysis of alkaloids of the ester type, such as eegonine from cocaine and aconine from aconitine.

The alkaline liquid was then neutralised with hydrochloric acid, and evaporated to dryness under diminished pressure; the dry residue, which contained a considerable amount of sodium chloride, was extracted with three or four successive portions of absolute alcohol, and the solution was evaporated in a vacuum desiccator. By this means, crystals of a *hydrochloride* were obtained, and it is proposed to name the corresponding base *senecifolinine*.

#### *Properties of Senecifolinine Hydrochloride.*

Senecifolinine hydrochloride is readily soluble in water or alcohol, but insoluble in chloroform, ether, or light petroleum. On recrystallisation from absolute alcohol it is obtained in colourless, rhombic prisms melting at 168°.

A solution of the salt in water is lævorotatory:

$$\alpha^{(20^\circ)} = -0^\circ 11', c = 1.455, l = 1\text{-dcm.}; \text{whence } [\alpha]_D - 12^\circ 36'.$$

When heated at 105°, 0.1536 lost 0.0020; the salt therefore crystallises uncombined with its solvent.

On analysis, the following result was obtained:

0.1565 gave 0.2864 CO<sub>2</sub> and 0.1022 H<sub>2</sub>O. C = 49.9; H = 7.2.

C<sub>8</sub>H<sub>11</sub>O<sub>2</sub>N.HCl requires C = 50.66; H = 6.33 per cent.

The figure for hydrogen is somewhat high, but this may be explained by the fact that the salt is hygroscopic.

By titration of a solution of senecifolinine hydrochloride with *N*/10-silver nitrate, the following result was obtained:

0.0378 required 2.0 c.c. C<sub>8</sub>H<sub>11</sub>O<sub>2</sub>N.HCl requires 2.0 c.c.

#### *Other Salts of Senecifolinine.*

*Senecifolinine nitrate* was prepared by adding the theoretical quantity of an aqueous solution of silver nitrate to an aqueous solution of senecifolinine hydrochloride. After removing silver chloride, the solution was evaporated to dryness in a vacuum desiccator. The nitrate thus obtained was extremely hygroscopic, and could not be obtained in a definite crystalline form.

*Senecifolinine aurichloride*.—By the addition of an aqueous solution of gold chloride to an aqueous solution of senecifolinine hydrochloride acidified with hydrochloric acid, a bright canary-yellow, crystalline



precipitate was obtained. The salt was collected, washed with water until free from acid, and dried in a vacuum desiccator. The aurichloride was obtained in elongated, rhombic prisms by cautiously adding light petroleum to its solution in absolute alcohol. Senecifolinine aurichloride is much more soluble in water or alcohol than the corresponding salt of senecifoline, and is insoluble in light petroleum. It melts at  $150^{\circ}$ .

When heated at  $105^{\circ}$ , 0.1370 lost 0.0005; the salt therefore crystallises uncombined with its solvent.

The amount of gold in the salt was estimated by passing hydrogen sulphide through its aqueous solution:

0.1403 gave 0.0560 Au. Au = 39.9.

$C_8H_{11}O_2N, HAuCl_4$  requires Au = 39.96 per cent.

#### *Isolation of a Second Alkaloid.*

The alcoholic mother liquor, from which senecifoline nitrate was crystallised, was concentrated to a small bulk, and decanted from the crystalline nitrate which had separated; it was then evaporated in a vacuum desiccator, and obtained as a semi-solid, amorphous mass, which, after standing for several days, became crystalline. As the substance was now very dark in colour, it was dissolved in water, rendered slightly acid, and extracted with ether to remove colouring matter, etc.; the solution was then rendered alkaline with ammonia and extracted with chloroform. The chloroform solution was washed with a little water to remove traces of alkali, and, after removal of the solvent by distillation, the alkaloidal substance was obtained as a yellow, varnish-like mass. This was neutralised exactly with one per cent. nitric acid, the solution filtered, and allowed to evaporate in a vacuum desiccator, whereby the nitrate was again obtained as a semi-solid, amorphous mass, which, on long standing, became crystalline. The salt was then dissolved in the smallest possible quantity of absolute alcohol, and to this solution a small quantity of dry ether was cautiously added; the solution was set aside for three or four days, when a small amount of senecifoline nitrate was found to have separated; the supernatant liquid was decanted, and, on further keeping, colourless, needle-like crystals of a nitrate separated; these were purified by recrystallisation from a mixture of absolute alcohol and ether until the melting point was constant. The salt was dissolved in water, the solution rendered alkaline with ammonia, and extracted with ether. The ethereal solution was washed with a small quantity of water, dried, and the solvent removed by distillation, when a colourless, crystalline residue was obtained. This was purified by dissolving it in absolute alcohol and allowing the solution to evaporate spontane-

ously, when the free base was obtained in colourless, rhombic plates. The name *senecifolidine* is suggested for this alkaloid.

### *Properties of Senecifolidine.*

Senecifolidine is less soluble in chloroform, ether, or alcohol than senecifoline, but resembles the latter in being insoluble in light petroleum or water; it possesses a slightly bitter taste. With sulphuric acid it gives a pink coloration, but no further colour is developed on the addition of manganese dioxide to the mixture. The nitrate of the base gives a greenish-blue coloration with a solution of ferric chloride and potassium ferricyanide solution, as described under senecifoline. When heated to 200° it darkens, and melts at 212°.

A solution of the alkaloid in alcohol is lævorotatory, as shown by the following result:

$$\alpha^{(20^\circ)} = -0^\circ 24', c = 2.87, l = 1\text{-dm.}; \text{whence } [\alpha]_D - 13^\circ 56'.$$

When heated at 105° it did not lose in weight, and therefore crystallises uncombined with its solvent.

On analysis, the following results were obtained:

0.2017 gave 0.4368 CO<sub>2</sub> and 0.1266 H<sub>2</sub>O. C = 59.06; H = 6.97.

0.1200 „ 4.3 c.c. N<sub>2</sub> (moist) at 20° and 762 mm. N = 4.1.

C<sub>18</sub>H<sub>25</sub>O<sub>7</sub>N requires C = 58.9; H = 6.81; N = 3.81 per cent.

### *Salts of Senecifolidine.*

*Senecifolidine nitrate* was obtained, as previously described, by fractional crystallisation from the mother liquor which remained after the crystallisation of senecifoline nitrate. It crystallises in colourless, acicular prisms belonging to the rhombic system, and melts at 145°. It is very readily soluble in water or absolute alcohol, but is insoluble in ether or chloroform.

An aqueous solution of the salt is lævorotatory, as shown by the following result:

$$\alpha^{(20^\circ)} = -0^\circ 37', c = 2.532, l = 1\text{-dm.}; \text{whence } [\alpha]_D - 24^\circ 21'.$$

Senecifolidine nitrate crystallises with half a molecule of alcohol, as shown by the following determination:

0.2060 lost, at 105°, 0.0095. C<sub>2</sub>H<sub>6</sub>O = 4.6.

(C<sub>18</sub>H<sub>25</sub>O<sub>7</sub>N, HNO<sub>3</sub>)<sub>2</sub>.C<sub>2</sub>H<sub>6</sub>O requires C<sub>2</sub>H<sub>6</sub>O = 4.89 per cent.

*Senecifolidine hydrochloride* was prepared by dissolving the pure base in sufficient dilute hydrochloric acid to produce a neutral solution; this was allowed to evaporate in a vacuum desiccator, when a colourless, hygroscopic residue was obtained. Owing to the readi-

ness with which it absorbed water, it was not isolated in a crystalline condition.

*Senecifolidine aurichloride*.—This salt was obtained as a bright canary-yellow, amorphous precipitate by the addition of an aqueous solution of gold chloride to an aqueous solution of senecifolidine hydrochloride acidified with hydrochloric acid. The salt was collected, washed with water until freed from acid, and dried in a vacuum desiccator; the pure salt was subsequently obtained in yellow, hair-like crystals by recrystallisation from absolute alcohol.

After heating at 105°, 0.1623 lost 0.0009; the salt therefore crystallises uncombined with its solvent.

The amount of gold in the salt was estimated by passing hydrogen sulphide through its aqueous solution, and treating in the same manner as in the case of the corresponding salt of senecifoline:

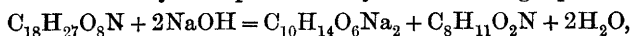
0.1614 gave 0.0448 Au. Au = 27.75.

$C_{18}H_{25}O_7N \cdot HAuCl_4$  requires Au = 27.86 per cent.

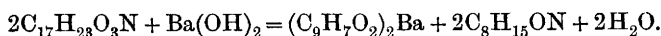
### *Summary and Conclusions.*

As a result of the present investigation, two new alkaloids have been added to the small number of such compounds which are known to occur in plants belonging to the N.O. Compositæ. The names *senecifoline* and *senecifolidine* are proposed for these alkaloids, and the formulæ  $C_{18}H_{27}O_8N$  and  $C_{18}H_{25}O_7N$  respectively assigned to them; thus it appears that the two substances differ by the elements of a molecule of water. Senecifoline has been hydrolysed by alkalis into a dibasic acid,  $C_{10}H_{16}O_6$ , for which the name *senecifolic acid* is suggested, and a base,  $C_8H_{11}O_2N$ , which it is proposed to term *senecifolinine*. The free base was not isolated.

From a consideration of the products of this action, it would appear that the reaction may be represented by the following equation:



which is analogous to the decomposition of atropine into atropic acid and tropine by means of barium hydroxide:



The pharmacology of senecifoline and senecifolidine is being studied by Prof. A. R. Cushny, F.R.S., who has already found that the former is poisonous to animals.

It is hoped to proceed further in the investigation as soon as adequate supplies of material are available.

This investigation has been carried out in the laboratories of the

Scientific and Technical Department of the Imperial Institute, and I desire to express my indebtedness to Prof. Wyndham R. Dunstan, F.R.S., for the facilities which he has accorded me for carrying out the work.

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