

On interrupting the current the permanent magnetism will increase a little, but will not regain its original intensity. Repeated transmission of a current through the wire produces only a feeble diminution of its permanent magnetism. If a current be transmitted through the wire in an opposite direction, the magnetism will again be greatly enfeebled.

7. When a large portion of the permanent magnetism has been destroyed by repeated inversion of the current transmitted through the wire, and a current is made to pass through it first in one direction and then in the contrary direction, the magnetization in one case is found to be much stronger than in the other. At the same time a very gradual diminution of magnetism is continually observable.

In the opinion of Professor Wiedemann, these phenomena may be explained by the self-same hypotheses which he used to illustrate his former observations on the relation between torsion and magnetism. These are :—

1. The hypothesis of molecular magnets, which take a direction under the influence of a voltaic current and are thereby caused to rotate round their centres of gravity, and also to glide past one another, as in the case of torsion.

2. The hypothesis, that the molecular magnets, after their movements of translation and rotation, do not return quite to their original unmagnetic positions of equilibrium, even after the disturbing forces have ceased to act, so that bodies composed of these molecular magnets retain a permanent magnetism, and in certain cases, a permanent change of form, viz. torsion.

II. "Preliminary Notice of Researches into the Chemical Constitution of Narcotine and of its Products of Decomposition."

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I. *Composition of Narcotine.*

The announcement made by Wertheim* and Hinterberger† of the probable existence of various kinds of narcotine, rendered it necessary

* Liebig and Kopp's Jahresbericht, 1851, p. 469.

† Ibid.

to commence the present investigation by a series of analyses of our material, in order to ascertain which variety of narcotine we were dealing with.

• The narcotine employed was obtained from Mr. Morson, to whom we are greatly indebted for the scrupulous care bestowed on its preparation and purification. He stated that it was extracted from the residues which had accumulated during the preparation of very large quantities of morphine and codeine, from opium of various qualities and from various sources. If, therefore, distinct varieties of narcotine exist, there was reason to expect that our narcotine would prove to be a mixture of several of them. The results of all our analyses, however, agree with the formula $C^{22}H^{23}NO^7$, as shown by the following Table, which gives the highest, lowest, and mean results obtained :—

	Calculated.		Found.		
			Maxima.	Minima.	Mean.
C^{22}	264	63·92	64·00	63·42	63·79
H^{23}	23	5·57	6·05	5·69	5·81
N	14	3·39	3·40	3·26	3·32
O^7	112	27·12	27·53	26·72	27·08
$C^{22}H^{23}NO^7$	413	100·00			

The formula which has been generally admitted since the publication of Wöhler's* and Blyth's† researches on narcotine, namely, $C^{23}H^{25}NO^7$, requires the following per-centages :—

Carbon	64·61
Hydrogen	5·85
Nitrogen	3·30
Oxygen	26·24

We may here remark that the recorded analyses of narcotine and its salts, with the exception of one by Dr. Hofmann, published by Blyth, agree at least as well with the former as with the latter formula ; moreover, during the course of experiments made with several pounds of narcotine, we have observed nothing, either in the behaviour of this base itself, or in the nature or proportions of its pro-

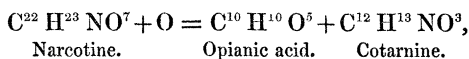
* Ann. Chem. Pharm. vol. l. p. 1.

† Ibid. p. 29 ; Mem. Chem. Soc. vol. ii. p. 163.

ducts of decomposition, to indicate that it was variable in composition. Further data are, however, needed for the final decision of this question, and we shall accordingly feel very much indebted to any chemist who has a specimen of narcotine of well-ascertained origin, or which he believes to have a different composition from that given above, if he will kindly spare us a sufficient quantity for analysis.

II. *Composition of Cotarnine.*

The combustion of cotarnine with oxide of copper and oxygen, as well as the determination of the proportion of platinum in its chloroplatinate, leads us to adopt the formula $C^{12}H^{13}NO^3$ for this base. The formula usually adopted contains one more atom of carbon; but, independently of our analytical results, the supposition that cotarnine contains only twelve atoms of carbon is supported by the simple manner in which the action of oxidizing substances on narcotine can then be expressed, namely, by the equation

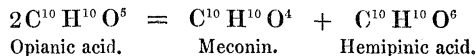


and, as will be shown hereafter, by the manner in which cotarnine is decomposed by dilute nitric acid.

III. *Decompositions of Opianic Acid.*

Opianic acid is readily decomposed when heated with strong hydriodic acid; no iodine is set free, but iodide of methyl is formed in considerable quantity at the same time as a non-volatile substance, very easily altered by heat and exposure to air, especially if in contact with alkali, the precise nature of which we have not yet been able to ascertain.

When opianic acid is heated with an excess of a very strong solution of potash, it splits up into meconin and hemipinic acid. These substances were found by experiment to be formed in proportions corresponding to the equation



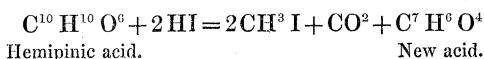
The meconin thus produced has all the characters which have been ascribed by previous observers to meconin obtained by other processes; its identity was further established by analysis, and by the preparation of chloro- and nitro-meconin, the former of which was analysed.

The hemipinic acid was also found to be identical with that obtained directly from narcotine: the acid and its silver-salt were analysed.

Having thus found a method by which meconin and hemipinic acid can be produced with certainty and in large quantities, we intend to make an extended investigation of them and of opianic acid, in the hope of discovering the nature of the relationship of these three bodies to each other and to narcotine. The principal results which we have hitherto obtained in this direction are as follows.

Action of Hydriodic Acid on Meconin.—Meconin is decomposed by hydriodic acid like opianic acid, giving iodide of methyl and an easily alterable substance, the nature of which has not been determined.

Action of Hydriodic Acid on Hemipinic Acid.—Hemipinic acid, heated with concentrated hydriodic acid to within a few degrees of the boiling-point of the latter substance, is decomposed into iodide of methyl, carbonic acid, and an acid of the formula $C^7 H^6 O^4$. It was found by direct experiment that two atoms of iodide of methyl are formed from each atom of hemipinic acid, so that the following equation probably represents the reaction:—



The new acid is moderately soluble in cold water, and very soluble in boiling water, alcohol, and ether; its solution has a strongly acid reaction with test-paper. It separates from hot water in small needle-shaped crystals containing 14·80 per cent. water of crystallization, which they lose at 100° (the formula $C^7 H^6 O^4 + 1\frac{1}{2}H^2 O$ corresponds to 14·92 per cent. water); at a higher temperature the acid melts and sublimates without apparent alteration.

Dried at 100°, it gave the following results on analysis:—

	Calculated.		Found. (mean)
C ⁷	84	54·55	54·38
H ⁶	6	3·89	3·91
O ⁴	64	41·56	41·71
	154	100·00	100·00

When the dry acid is heated in the air to a little above 100°, it

slowly oxidizes and becomes brown; the same change takes place more rapidly when a solution of it, especially if neutral or alkaline, is evaporated. A solution of the acid immediately reduces ammonio-nitrate of silver, even in the cold; with sulphate of copper and a slight excess of potash it gives a yellowish-green solution, from which suboxide of copper is precipitated on warming. The free acid, or its ammonia-salt, gives a very intense blue coloration with perchloride of iron. The colour thus produced is changed to blood-red (exactly resembling the red produced by the sulphocyanates) by ammonia, and is destroyed by strong acids, being restored by dilution with water, or by neutralization by an alkali: like the colouring matter obtained by Anderson by the action of sulphuric acid on opianic acid, it is entirely removed from solution by alumina.

We have not yet obtained any of the salts of the new acid in a state fit for analysis, and prefer not to propose a name for it until its relationship to other bodies has been more thoroughly examined; its formula, however, assigns to it a place in the following series—

$C^7 H^6 O$	Oil of bitter almonds.
$C^7 H^6 O^2$	Benzoic acid.
$C^7 H^6 O^3$	Salicylic acid.
$C^7 H^6 O^4$	New acid.
$C^7 H^6 O^5$	Gallic acid.
$C^7 H^6 O^6$	Tannoxylic acid (?).

It is remarkable that salicylic and gallic acids both give colorations with perchloride of iron much resembling that produced by the acid $C^7 H^6 O^4$.

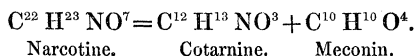
IV. *Action of dilute Nitric Acid on Cotarnine.*

By gently heating cotarnine with very dilute nitric acid, we have obtained nitrate of methylamine and a new acid, *cotarnic acid*, but have not hitherto found out the conditions necessary for the certain production of the latter substance.

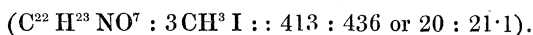
Cotarnic acid dissolves easily in water, giving a solution which reacts strongly acid with litmus-paper; it dissolves only sparingly in alcohol, and is precipitated from its alcoholic solution by ether. Heated with an excess of sodium, it gives no trace of cyanide, and therefore contains no nitrogen. With perchloride of iron it gives no coloration; with acetate of lead it gives a white precipitate insoluble in ex-

V. *Conclusion.*

In the absence of more definite knowledge of the constitution of meconin and opianic and hemipinic acids, it is obviously useless to try to assign a rational formula to narcotine. According to the formulæ which we have adopted for narcotine and cotarnine, narcotine contains the elements of cotarnine and meconin :—



It will be seen that these formulæ are the same as those of the methyl-narcotine and methyl-cotarnine of Hinterberger and Wertheim. The ground upon which Wertheim admitted the existence of ethyl- and propyl-narcotine was the formation of volatile bases containing $\text{C}^2 \text{H}^7 \text{N}$ and $\text{C}^3 \text{H}^9 \text{N}$ by the distillation of narcotine with potash. An experiment which we have made goes some way towards explaining the formation of these bases without assuming the existence of more than one variety of narcotine. Having so frequently observed the formation of methyl-compounds from the derivatives of narcotine, we tried the direct action of hydriodic acid on this base, expecting to obtain iodide of methyl. By distilling 20 grms. of narcotine with concentrated hydriodic acid, 19 grms. of pure iodide of methyl were obtained, a quantity which corresponds, as nearly as could be expected, with three atoms of iodide of methyl for one atom of narcotine*,



Narcotine therefore contains three atoms of methyl so combined as to be easily separable†; and it is very probable that when it is distilled with potash, according to the conditions of the experiment, sometimes nearly pure ammonia is evolved, while, at other times, methylamine, $\text{CH}^5 \text{N}$, dimethylamine, $\text{C}^2 \text{H}^7 \text{N}$, or trimethylamine, $\text{C}^3 \text{H}^9 \text{N}$, predominates.

We wish not to close without acknowledging our obligation to Dr. M. Holzmann for very valuable assistance rendered to us at the commencement of our investigation.

* It is possible that narcotine will prove to be an economical, as it is certainly the most convenient, source of iodide of methyl.

† Gerhardt (*Traité*, iv. 64) had previously observed the production of a volatile substance, which he supposed to be nitrate of ethyl or of methyl, by the action of nitric acid on narcotine.