XXV.—*On Meconic Acid, and some of its Derivatives.* By Mr HENRY HOW.
Assistant to Dr ANDERSON. Communicated by Dr T. ANDERSON.

(Read 5th January 1852.)

In a paper on Comenic Acid, read before this Society in April of last year, and since honoured with a place in its Transactions, I mentioned my being engaged in an investigation on Meconic Acid; the details of the experiments referred to form the matter of the present communication.

My object in undertaking this subject was to ascertain if products corresponding to those described as derived from comenic acid were formed under similar circumstances in the case of meconic acid. I also thought it probable, that as the former is itself a derivative of the latter, the changes undergone by meconic acid in some reactions, would be found to result in substances apparently the immediate derivatives of comenic acid. This remark refers to the action of heat on meconate of ammonia; and it will be seen that the expectation was realised. A similar result was found in other instances, where it had not been anticipated.

The experiments I am about to detail were performed in the laboratory of Dr T. ANDERSON.

The process employed for the purification of meconic acid was that given by GREGORY in his "Outlines," excepting that ammonia was substituted for potass as the solvent of the crude acid. As in the case of comenic acid the volatile alkali was preferred, because, although in both cases a great deal of acid remains in the highly coloured mother liquors, from which it can only be recovered in a pure state at the expense of much time and labour, it was found that if ammonia was used, the whole of the mother liquors could be employed under circumstances where their impure state did not affect the results of the experiment. A considerable saving was thus effected. This point is of some importance, because the numerous solutions requisite for the purification of meconic acid occasion so much loss, that seldom much more than a fourth part of the weight of the crude acid started from, is obtained as the result of a careful preparation.

The process consists in dissolving crude meconic acid in hot water by aid of caustic ammonia. The crude acid is obtained from meconate of lime by treating it three successive times with twenty parts boiling water and three parts strong muriatic acid. The mixture of the acid so obtained, and about twice its weight of water, is kept hot in a water-bath and constantly agitated, till, by the addition of caustic ammonia, solution is complete; the salt formed is extremely soluble in hot water, and the fluid cools to a solid mass. The black mother liquor is squeezed

out by strong pressure, and the cake of salt redissolved twice or thrice in as small a quantity of boiling water as is found sufficient, the mother liquors being always pressed from the crystallised salt. By proceeding in this manner a perfectly white salt is obtained, from whose solution in hot water an excess of strong hydrochloric acid throws down the meconic acid in colourless brilliant scales; these require but a little washing with cold water, and one resolution in the smallest possible quantity of hot water, to be obtained on cooling of the fluid absolutely pure. This is another advantage in the use of ammonia, for the potass salt requires, at the least, three treatments with acid to abstract the alkaline base entirely.

Bibasic Meconate of Ammonia.—The ammonia salt obtained in the above given process, crystallises from tolerably dilute fluids left at rest, in groups of radiated fine silky needles: they have an acid reaction. In the following analysis the nitrogen was determined by adding hydrochloric acid to a solution of the salt, evaporating the filtrate with some bichloride of platinum, collecting the residue on a filter, and washing with alcohol and ether; the per-centage of nitrogen was calculated from the platinum remaining on ignition of the undissolved ammonia salt. This method was preferred in one or two other cases of ammonia salts, as more convenient than a combustion with soda lime, and less liable to loss; for it is not easy always to mix these salts with soda lime so quickly as to avoid the escape of ammonia.

{ 5·170 grains, dried at 212°, gave
6·732 ... carbonic acid, and
2·201 ... water.

{ 5·285 grains, dried at 212°, gave
4·505 ... metallic platinum.

Calculation.					
Carbon,	.	.	35·51	35·89	C ₁₄ 84
Hydrogen,	.	.	4·73	4·27	H ₁₀ 10
Oxygen,	.	.	...	47·88	O ₁₄ 112
Nitrogen,	.	.	12·09	11·96	N ₂ 28
			100·00	100·00	234

The hydrogen is rather above the calculated result, but the substance, when dried at 212°, is extremely hygroscopic: the numbers lead to the formula

as representing the constitution of bimeconate of ammonia in the dry state; the crystals appear to contain varying amounts of water of crystallisation, as numbers were obtained in drying different specimens indicating a loss of between six and sixteen per cent. of water. An aqueous solution of this salt may be boiled without any change; but when kept for a considerable time boiling with an excess of ammonia, it becomes altered.

Action of Heat on Meconate of Ammonia.

Comenamic Acid.—Some of the highly-coloured mother liquors of the purifying process, were retained at or near the boiling temperature for some hours, ammonia being kept present in excess. The addition of hydrochloric acid to the cooled fluid caused copious evolution of carbonic acid, and when added in proper quantity, a considerable precipitate. By repeated crystallisations from boiling water, and the use of pure animal charcoal, the precipitated substance was obtained in colourless shining scales; the following is its analysis before being rendered absolutely pure:—

$$\left\{ \begin{array}{l} 4.335 \text{ grains, dried at } 212^{\circ}, \text{ gave} \\ 7.287 \quad \dots \quad \text{carbonic acid, and} \\ 1.370 \quad \dots \quad \text{water.} \end{array} \right.$$

$$\left\{ \begin{array}{l} 6.295 \text{ grains, burnt with soda lime, gave} \\ 8.700 \quad \dots \quad \text{ammonio-chloride of platinum.} \end{array} \right.$$

				Calculation.		
Carbon,	.	.	45.84	46.45	C ₁₂	72
Hydrogen,	.	.	3.51	3.22	H ₅	5
Oxygen,	.	.	...	41.30	O ₈	64
Nitrogen,	.	.	8.67	9.03	N	14
			100.00	100.00	155	

The results of which are sufficient to shew this body to have the composition of comenamic acid; the characters and reactions of the acid left me no doubt as to its identity with that derived from comenate of ammonia under similar circumstances. It may be considered as formed from the bibasic meconate of ammonia, in the presence of an excess of ammonia, by the elimination of two eq. carbonic acid, two of water, and one of ammonia, as in the equation

This offers a convenient source of comenamic acid, as very impure meconic acid may be employed.

Action of Chlorine on Bibasic Meconate of Ammonia.

A current of chlorine gas passed through some of the coloured mother liquor of the above salt deprived it of colour considerably, and caused a speedy deposit of hard granular crystals adhering to the sides of the vessel. This was collected, and recrystallised from boiling water; it was found to be not very soluble, and the fluid on cooling deposited the substance in hard crystals, which, on being magnified, were seen to consist of thick needles radiating from a centre. It contained no chlorine, and proved to be an ammonia salt of meconic acid containing one equivalent of alkaline base. I am not aware that this salt has been obtained before, I therefore subjoin an analysis of it.

$$\left\{ \begin{array}{l} 4.708 \text{ grains, dried at } 212^{\circ}, \text{ gave} \\ 6.659 \quad \dots \quad \text{carbonic acid, and} \\ 1.505 \quad \dots \quad \text{water.} \end{array} \right.$$

$$\left\{ \begin{array}{l} 4.052 \text{ grains, dried at } 212^{\circ}, \text{ gave, by H Cl, \&c.,} \\ 1.780 \quad \dots \quad \text{platinum.} \end{array} \right.$$

Calculation.				
Carbon, . . .	38.57	38.70	C ₁₄	84
Hydrogen, . .	3.55	3.22	H ₇	7
Oxygen, . . .	...	51.63	O ₁₄	112
Nitrogen, . .	6.21	6.45	N	14
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	100.00	100.00		217

which gives as the formula of the monobasic meconate of ammonia, as dried at 212° ,

The crystallised salt contains two equivalents of water ;

$$\left\{ \begin{array}{l} 9.535 \text{ grains lost, at } 212^{\circ}, \\ 0.735 \quad \dots \quad \text{water.} \end{array} \right.$$

which is equal to 7.70 per cent. ; 7.65 is the number corresponding to the formula

The original mother liquor of this salt deposited a further quantity of the same on being concentrated ; and by continued evaporation a few crystals of a different appearance were obtained ; when these were separated, and recrystallised from boiling water, they presented themselves in the form of long square prismatic needles. In their appearance, and a few reactions, they shewed the characters of chlorocomenic acid. A determination of the chlorine is, I think, sufficient to prove that the crystals really consist of this acid,

$$\left\{ \begin{array}{l} 3.315 \text{ grains, dried at } 212^{\circ} \text{ gave, after burning with lime,} \\ 2.505 \quad \dots \quad \text{chloride of silver ;} \end{array} \right.$$

the per-centage of chlorine calculated from this experiment is 18.69, which agrees very closely with 18.63, the number corresponding to the formula of chlorocomenic acid in the dry state.

Oxalic acid is found in the last mother liquors of this process.

Action of Bromine on Meconic Acid.

Bromocomenic Acid ; Carbonic Acid.—I had no doubt of finding the action of bromine closely similar to that of chlorine on meconate of ammonia ; but it occurred to me it would be more readily learned from employing the acid itself, whether it gave a substitution product, or whether its molecule, under these circumstances, split up at once into carbonic acid and a substitution acid of comenic

acid. Accordingly, bromine water was poured upon powdered meconic acid; lively effervescence took place, which was found to result from the evolution of carbonic acid, and complete solution subsequently ensued. The fluid, when left at rest a considerable time, deposited a few long prismatic crystals of great beauty, a much more copious product was obtained by gentle evaporation. Recrystallisation from hot water gave groups of brilliant square prismatic crystals, of which,

$$\begin{cases} 6.787 \text{ grains, dried at } 212^{\circ}, \text{ gave, when burnt with lime,} \\ 5.480 \text{ ... bromide of silver.} \end{cases}$$

This experiment gives a per-centage of 34.36 bromine: 34.04 is that corresponding to the formula of dry bromocomenic acid,

The nature of the reaction is seen in the equation

Crystals of oxalic acid were obtained by evaporating the original mother liquors to a small bulk.

Ethers of Meconic Acid.

When absolute alcohol is poured upon meconic acid, and the mixture is agitated, partial solution takes place, accompanied by a considerable fall in temperature, amounting to about 10° or 12° Fahr.: application of a gentle heat causes complete solution. A stream of hydrochloric acid gas passed through the fluid is attended by the usual result observed in these cases, the formation of an ether compound; but in this instance more than one of such substances are produced, and the relative proportion of the individual products depends on the amount of acid gas and the strength of the alcohol employed; I say the strength of the alcohol, because rectified spirit serves to produce etherification, and I have employed it, but have found it disadvantageous, because whenever I did so, I observed the formation of an uncrystalline compound which very much impeded the purification of the other substances. The large amount of water of crystallisation of meconic acid, amounting to fully 25 per cent., tends to dilute the alcohol, and I have sometimes dried the acid at 212° Fahr. before using it, and found this a good plan when working with rectified spirit.

The results I have observed may be stated in a few words as preface to the description of the individual products; when a current of dry hydrochloric acid gas is passed through an alcoholic solution of meconic acid till it fumes strongly, and the fluid is set aside to cool, there appears, after a shorter or longer time, according to the circumstances above referred to, a deposit in feathery crystals; the fluid filtered from this, where absolute alcohol has been used, gives no further deposit; but, in the case of rectified spirit, another less crystalline substance ap-

pears after some little time. On evaporating the liquid which has ceased to give deposits to complete dryness, the chief constituent of the residue is found to be a substance fusing under boiling water ; it is more or less accompanied by the other bodies according to the said conditions.

Ethylomeconic Acid.

The first deposit I have usually found to be so nearly a pure and uniform substance, that one recrystallisation from hot water, after a little washing, was sufficient to render it completely so ; it then appeared as highly crystalline in brilliant short needles. The following is its analysis :—

I.	{	5.500 grains, air-dry, gave	
		9.558 ... carbonic acid, and	
		1.860 ... water.	
II.	{	5.110 grains, dried in vacuo, gave	
		8.830 ... carbonic acid, and	
		1.685 ... water.	

		Calculation.			
	I.	II.			
Carbon,	47.39	47.12	47.36	C ₁₈	108
Hydrogen,	3.75	3.66	3.50	H ₈	8
Oxygen,	...	...	49.14	O ₁₄	112
	100.00	100.00	100.00		228

from which it is obvious that we have here an acid ether, analogous to phosphovinic acid, in which one atom of water of a tribasic acid is replaced by an equivalent of ether ; its rational formula is, therefore,

according to which it is a bibasic acid : this I shall presently shew to be the case. I propose to call this the ethylomeconic acid, in preference to meconovinic acid, both as more expressive of one of its constituents, and to facilitate its comparison with another ether, to be described shortly, which I should hardly know how to name otherwise than by calling biethylomeconic acid, containing, as it does, two equivalents of ether.

Ethylomeconic acid, when pure, crystallises from boiling water in brilliant small crystals, which, when magnified, are seen to be square prismatic needles. It is very readily soluble in this menstruum, also in ether and common alcohol when warmed, less soluble in absolute alcohol. It separates from concentrated solutions in these three fluids in groups of stellate crystals, and when they are left to spontaneous evaporation, in long needles. It is anhydrous, its crystals lose no weight either in vacuo or at 212° Fahr. It fuses at about 316°–318° Fahr. to a transparent yellowish liquid, with the formation of a sublimate in very brilliant rhombic crystals.

Its aqueous solution reacts strongly acid, and readily coagulates the white of eggs. It imparts to persalts of iron a deep red colour. It decomposes carbonates with effervescence.

It is bibasic, forming two series of salts, the acid ones are readily crystallisable; its salts are very stable, the acid being recoverable from them by decomposition with stronger acids.

Acid Ethylomeconate of Baryta.—When carbonate of baryta is added in successive small quantities to water covering solid ethylomeconic acid, lively effervescence ensues and the acid quickly disappears; there is formed at the same time a small amount of an insoluble yellow salt. If the fluid be filtered immediately on the cessation of the effervescence, and the vessel be placed under the receiver of an air-pump and a vacuum made, a considerable deposit of carbonate of lime, which had been held in solution by the carbonic acid now liberated, takes place. By a second filtration a clear yellowish fluid is obtained, which yields, on evaporation in vacuo or at a gentle heat, very well-defined brilliant rhombic crystals of a yellow colour. A specimen prepared in this way gave the following results:—

$$\left\{ \begin{array}{l} 5.053 \text{ grains, dried at } 212^{\circ}, \text{ gave} \\ 6.708 \quad \dots \quad \text{carbonic acid, and} \\ 1.198 \quad \dots \quad \text{water.} \end{array} \right.$$

$$\left\{ \begin{array}{l} 5.455 \text{ grains, dried at } 212^{\circ}, \text{ gave on ignition with } \text{HO SO}_3, \\ 2.175 \quad \dots \quad \text{sulphate of baryta.} \end{array} \right.$$

				Calculation.	
Carbon,	.	36.20	36.53	C ₁₈	108
Hydrogen,	.	2.63	2.36	H ₇	7
Oxygen,	.	...	35.19	O ₁₃	104
Baryta,	.	26.17	25.92	BaO	76.64
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100.00			100.00	295.64	

which lead to the formula, for the dried ethylomeconate of baryta, of

The crystals contain water which they lose on drying, but I missed ascertaining the quantity.

Acid Ethylomeconate of Silver.—I obtained this salt by adding an aqueous solution of the former to nitrate of silver; a precipitate was immediately formed, which, upon resolution in boiling water, after washing, crystallised out on cooling of the fluid in groups of fine small stellate crystals, brilliant and white. This salt is remarkably stable, remaining perfectly unchanged in appearance when exposed a long time to the diffused daylight of summer; it gave the following results on analysis:—

$$\left\{ \begin{array}{l} 5.310 \text{ grains, dried at } 212^{\circ}, \text{ gave} \\ 6.215 \quad \dots \quad \text{carbonic acid, and} \\ 1.053 \quad \dots \quad \text{water.} \end{array} \right.$$

{ 4.595 grains, dried at 212°, gave, on ignition,
 { 1.468 ... silver.

Calculation.					
Carbon,	.	.	31.92	32.22	C ₁₈ 108
Hydrogen,	.	.	2.20	2.08	H ₇ 7
Oxygen,	.	.	...	33.45	O ₁₄ 112
Silver,	.	.	31.94	32.25	Ag 108.1
			<hr/>	<hr/>	<hr/>
			100.00	100.00	335.1

which lead to the formula

for the dried salt; the crystals contain two equivalents of water,

{ 10.40 grains lost, at 212°,
 { 0.545 ... water.

This number gives for per-centage 5.24; 5.08 is that corresponding to

An aqueous solution of acid ethylomeconate of baryta gives with acetate of lead a yellowish white, with sulphate of copper a pale green, and with perchloride of iron a red-brown precipitate; this last is readily soluble in an excess of the iron salt, forming with it a dark red fluid.

Neutral Salts of Ethylomeconic Acid.—I have not been successful in procuring these salts absolutely pure, although I have tried many. On one occasion I obtained, by saturating ethylomeconic acid as nearly as possible with carbonate of baryta at a temperature of 212°, and subsequent filtering of the fluid, a salt which deposited on cooling in small short yellow needles; of this

{ 3.442 grains, dried at 212°, gave
 { 2.197 ... sulphate of baryta.

The per-centage of baryta calculated from this is 41.89: 42.19 is the number corresponding to the formula

Although this result is satisfactory, I could not succeed upon repetition of the experiment in obtaining an analytical number sufficiently close to confirm it. Those I obtained by heating ethylomeconic acid with excess of carbonate of baryta, varied from 42 to 44.5 per cent. baryta, which lead to the conclusion that the acid forms basic combinations in addition to acid and neutral salts. The other alkaline earths shewed similar deportment with the acid, and when it is heated with an excess of carbonate of silver, it remains almost entirely undissolved,—in some basic combination.

When ethylomeconic acid is heated with an excess of caustic potass or soda, meconates of these bases are produced. An excess of caustic ammonia decomposes it very readily.

Meconamidic Acid.

When ethylomeconic acid is dissolved in warm water or alcohol, and an excess of strong aqueous or alcoholic solution of ammonia is added, the fluid assumes a deep yellow colour, and becomes very soon filled with a yellow semi-gelatinous-looking substance, which after being washed with dilute spirit, dries up in the air to an amorphous mass, which powders with some difficulty to a very fine yellow powder. This substance, when dissolved in hot water, smells of ammonia, and the solution gives, with dilute fixed alkalies, abundant evidence of its containing this body as a base. I was at first of the opinion that it was the neutral salt of an amide acid corresponding to ethylomeconic acid, and formed from it in the manner characteristic of the action of ammonia in these cases, in which one atom takes the place of an equivalent of alcohol. Upon submitting it to analysis, however, I found this not to be the case; and it appears to me to be the result of a complicated decomposition, which is, so far as I am aware, without analogy. Upon adding to its solution in hot water some hydrochloric acid, a white precipitate is obtained, which I presume to be the acid of the compound. I will first give its analysis, and the formula I deduce from it, to render more clear the only constitution I can assign to these two bodies. The following analyses were performed on specimens of different preparations, the acid was recrystallised from boiling water, it then appeared as a white crystalline crust or rind :

I.	{	5.972 grains, dried at 212°, gave
		8.700 ... carbonic acid, and
		1.775 ... water.
	{	5.623 ... dried at 212°, gave, when burnt with soda lime,
		7.020 ... platinum salt of ammonia.
II.	{	5.884 grains, dried at 212°, gave
		8.555 ... carbonic acid, and
		1.760 ... water.
	{	5.655 ... dried at 212°, gave, with soda lime,
		7.250 ... platinum salt.
III.	{	5.205 grains, dried at 212°, gave
		7.540 ... carbonic acid, and
		1.530 ... water.
IV.	{	7.925 grains, dried at 212°, gave, with soda lime,
		9.728 ... platinum salt.

					Mean.	Calculation.		
	I.	II.	III.	IV.				
Carbon, .	39.73	39.65	39.50	...	39.62	39.84	C ₈₄	504
Hydrogen, .	3.30	3.32	3.26	...	3.29	3.08	H ₃₉	39
Oxygen, .	...	...	...	...	...	49.34	O ₇₈	624
Nitrogen, .	7.84	8.05	...	7.70	7.86	7.74	N ₇	98
	<hr/>	<hr/>	<hr/>	<hr/>	<hr/>	<hr/>		<hr/>
	100.00	100.00	100.00	100.00	100.00	100.00		1265

shewn in the following analyses; they were performed on specimens prepared at different times,

- I. $\left\{ \begin{array}{l} 6.277 \text{ grains, dried a day at } 212^{\circ}, \text{ gave} \\ 8.395 \quad \dots \quad \text{carbonic acid, and} \\ 2.60 \quad \dots \quad \text{water.} \end{array} \right.$
- II. $\left\{ \begin{array}{l} 6.150 \text{ grains, dried in vacuo, gave} \\ 8.205 \quad \dots \quad \text{carbonic acid, and} \\ 2.750 \quad \dots \quad \text{water.} \\ 5.751 \quad \dots \quad \text{dried in vacuo, gave, burnt with soda lime,} \\ 14.650 \quad \dots \quad \text{platinum salt of ammonia.} \end{array} \right.$
- III. $\left\{ \begin{array}{l} 4.912 \text{ grains, dried in vacuo, gave, burnt with soda lime,} \\ 12.580 \quad \dots \quad \text{platinum salt.} \end{array} \right.$
- IV. $\left\{ \begin{array}{l} 4.925 \text{ grains, dried in vacuo, burnt with soda lime, gave*} \\ 12.445 \quad \dots \quad \text{platinum salt.} \end{array} \right.$

	I.	II.	III.	IV.	Calculation.		
Carbon, .	36.47	36.38	...	...	36.23	C ₈₄	504
Hydrogen, .	4.60	4.96	...	...	4.52	H ₆₃	63
Oxygen, .	...	...	...	...	43.01	O ₇₅	600
Nitrogen, .	...	15.99	16.08	15.86	16.24	N ₁₆	224
	<hr/> 100.00	<hr/> 100.00	<hr/> 100.00	<hr/> 100.00	<hr/> 100.00		<hr/> 1391

The formula expressive of the constitution of this substance as an ammonia salt of the above acid, is,

And the acid itself, considered with regard to its amount of basic water as indicated in the salt, is represented thus,

I attempted to determine directly the amount of nitrogen existing in the yellow salt as ammonia, but, upon reflection, I despaired of success, because the only method at my disposal being to decompose by hydrochloric acid, and evaporate the solution filtered from the precipitated amidic acid with bichloride of platinum, I saw that if this acid behaved as amidogen acids are known to do in concentrated acid fluids, namely to regenerate the parent acid and ammonia, I should inevitably obtain an excess. Nevertheless I made the experiment, and the lowest result I obtained was 10.4 per cent. nitrogen: now, 9.08 corresponds to 9 atoms of nitrogen. I also attempted to form other salts by precipitation of solutions by that of the ammonia salt, but the results were unsatisfactory and inconstant. The silver salt, a yellow gelatinous precipitate, dried up to a black mass; and the baryta compound, a yellow amorphous precipitate, insoluble in boiling water, gave varying numbers on analysis.

* I am indebted for this analysis to my friend Mr ROWNEY. He performed it on the substance mixed with sugar.

I have nothing to add descriptive of the acid to what little has been mentioned. It is a white powder as precipitated by acids from the yellow compound, crystallising from concentrated solution in hot water in a crystalline crust.

The yellow salt has a peculiar appearance. It does not present the least crystalline structure even under the microscope, but consists of round translucent granules; when deposited slowly from dilute fluids these have the appearance of small yellow vesicles or air-bubbles. It is readily soluble in hot water with a decided smell of ammonia; it is very sparingly soluble in hot, insoluble in cold, alcohol. It gradually loses ammonia when heated in the dry state at 212° Fahr.; at a higher temperature it blackens and fuses.

I have adopted the name of Meconamidic Acid for the acid of this salt, as simply expressive of its constituents, without any reference to the molecular arrangement of its elements.

Coupled Acid Ether of Meconic Acid.

The substance I have described as occurring in the process of making the ethers of meconic acid, when rectified spirit is employed, is deposited generally after the first product of ethylomeconic acid is filtered off. I have sometimes observed it also falling from the mother liquor, from which the first deposit had been crystallised, and also in the course of purification of the residue left on evaporation of the original acid mother liquor. Its constant occurrence induced me to examine if it were a substance of determinate composition; I accordingly redissolved some of it in hot water, in which it is extremely soluble, twice or thrice, and obtained, on cooling of the liquid, a white amorphous powder. I select the analyses of two specimens treated in this manner:—

I.	{	4.660 grains, dried at 212°, gave
		7.655 ... carbonic acid, and
		1.311 ... water.
II.	{	5.335 grains, dried at 212°, gave
		8.712 ... carbonic acid, and
		1.315 ... water.

	I.	II.	Calculation.		
Carbon, .	44.80	44.53	44.85	C ₃₂	192
Hydrogen, .	3.12	2.73	2.80	H ₁₂	12
Oxygen, .	...	...	52.35	O ₂₈	224
			100.00		428

I am inclined to think the approximation of the above numbers to the per-centages corresponding to the formula given, in a substance purified from different preparations, is too close to be accidental, and that the body in question is a determinate compound. The formula given contains the elements of one atom of meconic and one of ethylomeconic acid,

A substance of such constitution may be easily imagined to occur, when an insufficient quantity of acid gas had been employed to remove all the water from the meconic acid, or its power had been diminished in this respect by the ready formed water existing in the fluids.

That the substance is something more than an accidental mixture, is to be inferred from the action of ammonia. When its warm aqueous solution is supersaturated by strong ammonia, the fluid becomes yellow, but none of the yellow amidic salt is deposited, as might be expected in a mixture containing ethylomeconic acid. If, however, to a concentrated aqueous ammoniacal solution strong alcohol be added, a deposit in small radiated yellow silky tufts appears; and when such an aqueous solution is evaporated to dryness at 212° , a crystalline residue remains, part of which is extremely sparingly soluble in boiling water; the more soluble portion gives, with hydrochloric acid, a crystalline precipitate in the form of needles. I have not followed out the changes which these few experiments seem to indicate, for my material was small in quantity, and I had no means of readily preparing it tolerably pure at will.

I have called this substance Meconoethylomeconic Acid, as the name expresses most distinctly the constitution deduced from analysis, and represented by the formula given. I was anxious to have substantiated its constitution as such by a determination of its saturating capacity, but was unable to effect my purpose, owing to the impossibility I experienced of obtaining its salts. When it is treated with bases, the salts produced decompose into meconates with greater facility than those of ethylomeconic acid.

Meconic Ether containing two Equivalents of Ether.

Biethylomeconic Acid.—This substance is found in considerable quantity in the acid mother liquors from which the bodies before described have deposited, especially when absolute alcohol has been employed; its proportionate amount appearing to depend on that of the hydrochloric acid gas employed. It remains, on evaporation of the liquid, till acid ceases to be evolved at 212° Fahr., as a thick oil or viscid mass, becoming a solid crystalline mass on cooling. It may be rendered pure by two or three crystallisations, these serving to remove any of the former-mentioned bodies, of which small quantities are generally present in the residue left on evaporation. It is thus obtained in colourless flattened prisms: the analysis is as follows:—

I.	{	4.745 grains, dried in vacuo, gave
		8.932 ... carbonic acid, and
		2.055 ... water.
II.	{	4.865 grains, dried in vacuo, gave
		9.160 ... carbonic acid, and
		2.120 ... water.

		Calculation.			
		I.	II.		
Carbon, .	.	51.33	51.35	51.56	C ₂₂ 132
Hydrogen, .	.	4.81	4.84	4.68	H ₁₂ 12
Oxygen, .	.	...	...	43.76	O ₁₄ 112
		<hr/> 100.00	<hr/> 100.00	<hr/> 100.00	<hr/> 256

These numbers lead to the formula,

Having thus far succeeded in replacing one and two of the atoms of basic water of meconic acid by corresponding equivalents of ether, I was in hopes of being able to go still further and obtain a neutral compound. For this purpose I distilled some meconic acid with absolute alcohol and strong sulphuric acid. By application of a gentle heat, tranquil ebullition was commenced and sustained. The distillate consisted of alcohol and ether, and the contents of the retort gradually acquired a syrupy consistence; at this period they were poured into a comparatively large quantity of cold water; in a short time a crystalline precipitate of a delicate rose-pink colour was formed, which gradually increased in quantity. On recrystallisation from water it was obtained in colourless flattened prisms, which gave, on analysis, the following numbers:—

$$\left\{ \begin{array}{l} 4.860 \text{ grains, dried at } 212^\circ, \text{ gave} \\ 9.128 \quad \dots \quad \text{carbonic acid, and} \\ 2.135 \quad \dots \quad \text{water.} \end{array} \right.$$

which, when calculated for per-centages, are equal to

Carbon, .	.	.	51.22
Hydrogen, .	.	.	4.88

and shew the substance to be identical with that obtained in the former process. This method obviously furnishes a ready source of the pure ether. I may mention, that I have not been able to produce it this way by employing rectified spirit in place of absolute alcohol.

Biethylomeconic acid, in its pure state, as crystallised from water, occurs in the form of long, flattened, colourless, prisms; it fuses under boiling water before dissolving. It is very soluble in alcohol. In the dry state it fuses at about 230° Fahr. to a yellowish transparent liquid.

Its aqueous solution readily coagulates the white of eggs, has an acid reaction, and decomposes carbonates with effervescence. It imparts to persalts of iron a red colour.

As the above formula indicates, it is a monobasic acid; I add the analysis of two salts which shew this fact.

When subjected to the action of ammonia in the cold, biethylomeconic acid does not undergo decomposition; the substances simply enter into combination.

Biethylomeconate of Ammonia.—Some of the ether was dissolved in strong, nearly absolute, alcohol, and dry ammoniacal gas was passed into the fluid : the whole soon became a nearly solid yellow mass. When this was freed by pressure from the ammoniacal alcohol, it was found to crystallise from hot spirit in tufts of radiated silky yellow needles. From its analysis,

5.140	grains, dried in vacuo, gave
9.055	... carbonic acid, and
2.610	... water.
5.825	... dried in vacuo, gave, on burning with soda lime,
5.065	... platinum salt of ammonia.

Calculation.					
Carbon,	.	.	48.04	48.35	C ₂₂ 132
Hydrogen,	.	.	5.64	5.49	H ₁₅ 15
Oxygen,	.	.	...	41.04	O ₁₄ 112
Nitrogen,	.	.	5.46	5.12	N 14
			100.00	100.00	273

Its constitution is evidently represented by the formula,

it crystallises without water.

Biethylomeconate of ammonia is readily soluble in cold water to a yellow fluid ; acids precipitate from this the unchanged ether. Its aqueous solution gives the following reactions :—with nitrate of silver a yellow gelatinous precipitate insoluble in boiling water, and apparently unaltered by the elevation of temperature ; with sulphate of copper, a green gelatinous precipitate ; with acetate of lead, a heavy yellowish white, and, with sulphate of magnesia, a crystalline precipitate ; with the chlorides of barium, strontium, and calcium, it produces pale yellow semi-gelatinous precipitates, insoluble in boiling water, but readily soluble in excess of the earthy salts ; a determination of the base in the baryta salt was made,

5.533	grains, dried at 212°, gave
1.985	... sulphate of baryta.

Calculation.					
Carbon,	.	.	...	40.78	C ₂₂ 132
Hydrogen,	.	.	...	3.39	H ₁₁ 11
Oxygen,	.	.	...	32.15	O ₁₃ 104
Baryta,	.	.	23.54	23.68	BaO 76.64
			100.00	100.00	323.64

which leads to the formula for biethylomeconate of baryta, of

I believe, from an experiment made on a small scale, that biethylomeconic acid, when *heated* with ammonia, undergoes a change ; the result is probably an

acid amide; want of material, however, has prevented me as yet from arriving at a satisfactory conclusion on this point.

I subjoin a list of the substances described in this paper.

Salts and Compounds of Meconic Acid.

Bibasic meconate of ammonia,	dried at 212°,	HO, 2 NH ₄ O, C ₁₄ HO ₁₁
Monobasic	...	2 HO, NH ₄ O, C ₁₄ HO ₁₁
... ..	crystallised,	2 HO, NH ₄ O, C ₁₄ HO ₁₁ + 2 aq.
Ethylomeconic acid,	...	2 HO, C ₄ H ₅ O C ₁₄ HO ₁₁
Acid ethylomeconate of baryta,	dried at 212°,	BaO, HO, C ₄ H ₅ O C ₁₄ HO ₁₁
... .. silver,	...	AgO, HO, C ₄ H ₅ O C ₁₄ HO ₁₁
... ..	crystallised,	AgO, HO, C ₄ H ₅ O C ₁₄ HO ₁₁ + 2 aq.
Neutral baryta,	dried at 212°,	2 BaO, C ₄ H ₅ O C ₁₄ HO ₁₁
Meconamidic acid,	...	9 HO, C ₈₄ H ₂₄ N ₇ O ₆₃ + 6 aq.
Meconamidate of ammonia,	dried in vacuo,	9 NH ₄ O, C ₈₄ H ₂₄ N ₇ O ₆₃ + 3 aq.
Meconoethylomeconic acid,	dried at 212°,	3 HO, C ₁₄ HO ₁₁ + 2 HO, C ₄ H ₅ O C ₁₄ HO ₁₁
Biethylomeconic acid,	...	HO, 2 C ₄ H ₅ O, C ₁₄ HO ₁₁
Biethylomeconate of ammonia,	crystallised,	NH ₄ O, 2 C ₄ H ₅ O, C ₁₄ HO ₁₁
... .. baryta,	dried at 212°,	BaO, 2 C ₄ H ₅ O, C ₁₄ HO ₁₁

Products of Decomposition.

Comenamic acid,	HO, C ₁₂ H ₄ NO ₇
Chlorocomenic acid,	2 HO, C ₁₂ $\left\{ \begin{array}{c} \text{H} \\ \text{Cl} \end{array} \right\}$ O ₈
Bromocomenic acid,	2 HO, C ₁₂ $\left\{ \begin{array}{c} \text{H} \\ \text{Br} \end{array} \right\}$ O ₈