VI.—*On the Products of the Destructive Distillation of Animal Substances.*

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In the fourth part of these researches, I described a new base produced by the action of sodium upon picoline, to which I gave the name of Parapicoline, because it has the same composition as picoline, although the circumstances of its formation appeared to show that it had been produced by the combination of two molecules of that substance, so that its true formula would be $C_{12}H_{14}N_2$. Unfortunately, its high boiling point, and tendency to decompose when distilled, made it impossible to determine its vapour density, which afforded the only means of ascertaining whether this hypothesis was correct; and it was only assumed, because similar cases of polymerisation had been established beyond a doubt in the case of other classes of organic compounds. In the hope of obtaining a similar base of lower boiling point, and therefore better adapted to the necessary experiments, I have submitted pyridine to the action of sodium, and the results of the inquiry are contained in the following pages.

My earlier experiments were conducted in precisely the same manner as those with picoline. Dry pyridine was heated to its boiling point along with small pieces of sodium, amounting to about one-fifth of its weight, in a flask furnished with a long cohobating tube. As the temperature rose, the pieces of sodium became covered with a brown coating; purple streaks appeared in the fluid, which, however, soon disappeared again; and after some hours the whole fluid was converted into a dark-brown or black mass, which was viscous when hot, and on cooling solidified into a hard brittle resin. In this a few white powdery nodules are disseminated, which explode violently when brought in contact with water. A large portion of the sodium employed remains unacted on, and if the operation has been well performed, is generally found collected into one or two large pieces, which can be easily separated from the resinous mass. After the sodium has been removed as thoroughly as possible, the crude product is thrown into water in small successive portions, so as to avoid the risk of explosions from any particles of sodium which may have remained disseminated through it. The water soon becomes alkaline, owing to the presence of caustic soda; unchanged pyridine makes itself manifest by its powerful smell, and the resin is slowly converted into a thick, viscid oil of dark-brown colour, and nearly, or altogether, insoluble in water, which collects at the bottom of the vessel. This oil is washed several times with water, dried over calcic-chloride, and distilled. The distillation is best effected in a current of hydrogen, and at a temperature

below the boiling point of the oil. A little unchanged pyridine distils at first, accompanied by a small quantity of a light oil, insoluble in water, having a pungent smell similar to, and yet appreciably different from, that of pyridine; and which, as we shall afterwards see, appears to be a mixture of several bases. As the temperature rises, a thick, heavy, and yellowish oil, having a peculiar smell, in no degree pungent, but dull, heavy, and somewhat resembling that of soot, passes over. As the distillation proceeds, crystals make their appearance in the neck of the retort. At a certain stage of the process the product becomes nearly solid, and on cooling, crystals are deposited from the fluid distillate. Towards the close of the distillation some ammonia and very volatile bases are evolved, obviously produced by the decomposition of the oil passing over; and a dark resinous mass remains in the retort, which can be forced over by raising the temperature, in doing which a large part of it is decomposed, and a residue of charcoal is left in the retort.

The products of the action being obviously complicated, the whole was cautiously redistilled, and the portion which solidified in the neck of the retort collected apart, while the fluid portions having been introduced into a freezing mixture of snow and salt, soon gave an abundant crop of crystals. These were purified by pressure between folds of filtering paper, and crystallisation from water or alcohol, in both of which they are soluble, until they have lost the smell of the oil by which they are accompanied.

After having proceeded some way in the investigation, I found that the same substances could be obtained with greater certainty by a modification of the process just described. It is by no means necessary to heat the sodium and pyridine together, for the action takes place in the cold; but in this case it is slower, and the phenomena are somewhat different. The brown appearance on the surface of the sodium and the purple streaks appear in the fluid at the beginning of the action, but the pyridine does not become brown, it retains its colour, and the sodium is covered with a black crust, which, after two or three days, exceeds it in bulk, is quite brittle, and sometimes shows a tendency to separate into layers. The pyridine acquires a yellowish tint, and then contains in solution an oil insoluble in water. When the action is judged to have gone sufficiently far, the sodium with its crust is removed from the fluid and washed with a small quantity of pure pyridine, so as to get rid of any of the oily base which may remain attached to it. The crust is then detached as thoroughly as possible from the sodium and thrown into water, any sodium still adhering to it burns, and a dark gray, almost black, powder falls to the bottom of the glass. This is washed first by decantation, and afterwards on a cloth filter until it is free from soda, and on being opened out and exposed for some time to the air, it is entirely converted into a snow-white mass of interlaced acicular crystals identical with those obtained by the first process.

DIPYRIDINE.

The substance so obtained is a base to which, for reasons that will be immediately apparent, I give the name of dipyridine. It forms white crystals fusing at 108° Cent., and solidifies on cooling into a crystalline mass. It volatilises slowly at 100°, and sublimes unchanged at a high temperature, giving long needle-shaped crystals. It is rather sparingly soluble in cold but readily in boiling water, and the fluid, on cooling, becomes filled with a mass of interlaced needles. It is readily soluble in alcohol and ether, and the boiling solutions give acicular crystals on cooling. It likewise dissolves in pyridine and in volatile oils. From the oily base along with which it distils in the first process of preparation, it crystallises in short, thick, four-sided prisms, which are transparent so long as they remain in the fluid, but soon become opaque when they are removed from it. When well purified they are inodorous, but in general they have a faint smell, due, apparently, to a trace of the fluid base adhering to them. Dipyridine is a very stable compound. It is not decomposed by hydrochloric, sulphuric, or nitric acids. Potash and ammonia precipitate it from its solutions in acids as a mass of minute crystals. Its aqueous solution gives no precipitates with solutions of sulphate of magnesia, zinc, nickel, acetate of lead, or perchloride of iron. With sulphate of copper it gives a pale bluish-white precipitate, with corrosive sublimate a white amorphous powder insoluble in boiling water, and with nitrate of silver a white precipitate insoluble in cold and sparingly in boiling water, from which the compound is obtained in crystals on cooling. Its most characteristic reactions, however, are those it gives with the ferro- and ferri-cyanides of potassium. If a few drops of the ferrocyanide of potassium be added to a not too dilute solution of the dipyridine hydrochlorate, a pale precipitate makes its appearance, which rapidly changes to a dirty indigo colour, increasing at the same time in quantity. If the proper concentration is hit, the precipitate consists entirely of very minute needle-shaped crystals having a dark indigo colour. They dissolve in boiling water, forming a very deep and rather dull purple solution, and are again deposited on cooling; but if the boiling be continued for some time, the compound appears to undergo some change, for the fluid retains its red colour at ordinary temperatures, though a great part of the substance is still deposited in crystals. A saturated cold solution of dipyridine in water gives no precipitate with ferrocyanide of potassium, but on the addition to the mixture of a drop or two of hydrochloric acid the dark precipitate instantly makes its appearance, and is deposited in small crystals. The precipitate is readily soluble in excess of hydrochloric acid. When ferricyanide of potassium is added to dipyridine hydrochlorate no immediate effect is observed, but on standing, the interior of the test-tube becomes lined with minute prisms of sulphur yellow colour and high lustre. If the solution be boiled, it acquires a dark colour, and partial decomposition takes place.

Dipyridine carefully dried in the water bath was found on analysis to give these results:—

I.	{	0.2802 gramme dipyridine gave	
		0.7782 ... carbonic acid, and	
		0.1497 ... water.	
II.	{	0.3000 gramme dipyridine gave	
		0.8367 ... carbonic acid, and	
		0.1575 ... water.	

	Experiment.		Calculation.		
	I.	II.			
Carbon, . . .	75.74	76.07	75.94	C ₅	60
Hydrogen, . . .	5.94	5.83	6.33	H ₅	5
Nitrogen, . . .	...	...	17.73	N	14
			100.00		79

These numbers lead to the formula C₅H₅N, which is that of pyridine itself.

The platinum compound of the base, which is thrown down as a yellow crystalline powder, gave the following results:—

I.	{	0.3345 gramme gave	
		0.1175 ... platinum.	
II.	{	0.2007 gramme gave	
		0.0685 ... platinum.	
III.	{	0.4335 gramme gave	
		0.1473 ... platinum.	
IV.	{	0.4052 gramme gave	
		0.3087 ... carbonic acid, and	
		0.0905 ... water.	

	Experiment.			Calculation.		
	I.	II.	III.			
Carbon, . . .	...	...	20.78	21.02	C ₁₀	120
Hydrogen, . . .	...	...	2.48	2.10	H ₁₂	12
Nitrogen, . . .	...	...	...	4.90	N ₂	28
Chlorine, . . .	...	...	...	37.30	Cl ₆	213
Platinum, . . .	34.11	34.12	34.03	34.68	Pt	197.4
				100.00		570.4

This agrees with the formula (C₅H₅NHCl)₂PtCl₄, which is identical with that of the pyridine salt. In order to fix the true constitution of the base, it was necessary to determine its vapour density, and as its boiling point was beyond the range of the mercurial thermometer, it was necessary to use a bath of metallic lead and an air thermometer. The air thermometer was a bulb of the same size as that used for containing the vapour, and the details of the experiment were as follows:—

Weight of vapour bulb empty, . . .	22.2530
... full of vapour, . . .	22.4806
Temperature at weighing, . . .	13°5
Barometer,	753 mm.
Volume of bulb,	127.1 C.C.
Residual air,	0.2 C.C.

Hence

Weight of bulb and vapour, . . .	22.4806
... air displaced, . . .	0.1552
Weight of bulb and vapour in vacuo, . . .	22.6358
... bulb,	22.5230
	<hr/>
	0.3828
Residual air,	0.0003
	<hr/>
Weight of vapour,	0.3825
Weight of air thermometer, . . .	264 grains.
... partly full of mercury, . . .	14391
Barometer 753 — 67.5	685.5 mm.
Temperature,	17°5 C.
Air thermometer full of mercury, . . .	26930

Hence

Weight of mercury partially filling bulb, . . .	14127
... completely,	26666

and

$$26666 - 14127 = 12539.$$

Now, we have here in the formula

$$W(1 + kt) = w \cdot \frac{h}{H} \times \frac{1 + \alpha t}{1 + \alpha t'}$$

$$\begin{aligned} W &= 26666 \\ w &= 12539 \\ H &= 753 \\ h &= 685.5 \\ \alpha &= 0.00366 \\ k &= 0.00003 \\ t' &= 17^{\circ}5 \end{aligned}$$

whence

$$t = 414^{\circ}4 \text{ Cent.}$$

Now

$$127.1 - 0.5 = 126.5,*$$

and

$$\frac{126.5}{1 + 414^{\circ}4 \times 0.00366} \times \frac{753}{760} \times \frac{1.29366}{1000} = 0.0646,$$

and

$$\frac{0.3825}{0.0646} = 5.92.$$

The formula $C_{10}H_{10}N_2$ requires 5.46. This result is as close as could be expected under the circumstances, and proves that the base must be formed by the com-

* 0.5 is the volume of the residual air at 414°.

bination of two molecules of pyridine, and hence the name of dipyridine which I have applied to it.

Salts of Dipyridine.—Though dipyridine is not a very powerful base, it gives a number of salts, most of which crystallise well, though some of them are not easily obtained of definite composition.

Hydrochlorate of Dipyridine.—This salt is best obtained by adding a slight excess of hydrochloric acid to the aqueous solution of the base and evaporating to crystallisation; the crystals, after being pressed and recrystallised from water, are sufficiently pure for analysis. They are flat needles readily soluble in water, especially when hot—insoluble in ether. The salt is very apt to retain hydrochloric acid, and it is advisable to heat it to 130° for analysis.

				$\left\{ \begin{array}{l} 0.6104 \text{ gramme of the hydrochlorate gave} \\ 0.7633 \quad \dots \quad \text{iodide of silver.} \end{array} \right.$			
				Experiment.		Calculation.	
Carbon,	.	.	...	51.94	C ₁₀	120	
Hydrogen,	.	.	...	5.19	H ₁₂	12	
Nitrogen,	.	.	...	12.13	N ₂	28	
Chlorine,	.	.	30.93	30.74	Cl ₂	71	
				100.00		231	

Sulphate of Dipyridine.—Dipyridine is added in slight excess to dilute sulphuric acid, and this fluid is evaporated nearly to dryness; on cooling, crystals of the sulphate are deposited; they are washed with alcohol, in which they are scarcely soluble, and again crystallised from water. It is thus obtained in needle-shaped crystals, which deliquesce in moist air. One determination of sulphuric acid was made of a specimen of this salt dried in vacuo over sulphuric acid, which gave 26.85 per cent. of SO₃. This would correspond with a salt containing two molecules of water of crystallisation with the formula C₁₀H₁₀N₂H₂SO₄ + 2H₂O, which requires 27.39 per cent.

Nitrate of Dipyridine is obtained by adding a slight excess of nitric acid to solution of dipyridine, evaporating on the water-bath and recrystallising. It forms pale yellow needles of moderate solubility in water. When exposed for some time to a temperature of 100° , it acquires an orange colour, but is not sensibly decomposed. A combustion of this salt gave

				$\text{I. } \left\{ \begin{array}{l} 0.5162 \text{ gramme of the nitrate gave} \\ 0.7915 \quad \dots \quad \text{of carbonic acid, and} \\ 0.1820 \quad \dots \quad \text{of water.} \end{array} \right.$			
				Experiment.		Calculation.	
Carbon,	.	.	41.81	42.25	C ₁₀	120	
Hydrogen,	.	.	3.92	3.92	H ₁₂	12	
Nitrogen,	.	.	...	20.38	N ₄	56	
Oxygen,	.	.	...	33.45	O ₆	96	
				100.00		284	

Double Salt with Chloride of Zinc.—This substance is prepared by adding to dipyridine a mixture of hydrochloric acid and zinc chloride, and allowing it to stand for some time, when small prismatic crystals are deposited. Their formation is materially assisted by the addition of alcohol and ether. The compound may even be obtained from the crude product, in which the dipyridine is mixed with the oily base distilling along with it. For this purpose zinc chloride, along with hydrochloric acid and a considerable excess of alcohol and ether, must be added to the crude product, when, especially on stirring, the zinc salt deposits, and can be purified by crystallisation from water. This process can even be employed for separating the two bases. The salt is in long white needles, soluble in eight times their weight of water, less so in alcohol, and quite insoluble in ether. On the addition of potassic hydrate in excess it gives the pure base in minute crystals. A chlorine determination gave

				$\begin{cases} 0.3660 \text{ gramme zinc salt gave} \\ 0.5755 \text{ ... dichloride of zinc.} \end{cases}$																														
				<table> <tr> <th colspan="2">Experiment.</th> <th colspan="2">Calculation.</th> </tr> <tr> <td>Carbon,</td> <td>...</td> <td>32.70</td> <td>C₁₀ 120</td> </tr> <tr> <td>Hydrogen,</td> <td>...</td> <td>3.27</td> <td>H₁₂ 12</td> </tr> <tr> <td>Nitrogen,</td> <td>...</td> <td>7.62</td> <td>N₂ 28</td> </tr> <tr> <td>Chlorine,</td> <td>38.90</td> <td>38.68</td> <td>Cl₄ 142</td> </tr> <tr> <td>Zinc,</td> <td>...</td> <td>17.73</td> <td>Zn 65</td> </tr> <tr> <td colspan="2"></td> <td>100.00</td> <td>367</td> </tr> </table>			Experiment.		Calculation.		Carbon,	...	32.70	C ₁₀ 120	Hydrogen,	...	3.27	H ₁₂ 12	Nitrogen,	...	7.62	N ₂ 28	Chlorine,	38.90	38.68	Cl ₄ 142	Zinc,	...	17.73	Zn 65			100.00	367
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Double Salt with Nitrate of Silver.—This salt is best obtained by mixing hot solutions of dipyridine hydrochlorate, and silver nitrate, the latter being in excess, and at once filtering off the precipitated silver chloride. On cooling, the salt is deposited in brilliant needles, of sparing solubility in water. This compound could not be obtained of constant composition, but one specimen gave 35.09 per cent. of silver, while the formula $C_{10}H_{10}N_2(HNO_3)_2(AgNO_3)_2$ requires 34.61.

Platino-chloride of Dipyridine.—The analysis of this salt has been already given. It is obtained as a crystalline yellow powder of very sparing solubility.

Palladio-chloride of Dipyridine is obtained as an orange precipitate on mixing the hydrochlorates.

DERIVATIVES OF DIPYRIDINE.

Diethylo-Dipyridine.—The compounds of this base were obtained in the usual manner. The ethyl-iodide is easily prepared by exposing dry dipyridine with iodide of ethyl to the temperature of 100° in hermetically sealed tubes. The action is complete in half an hour. It is obtained in acicular crystals, which are brilliant and perfectly colourless if they have not been exposed to the air. They are very soluble in water, much less so in alcohol and in ether.

- I. { 0.3997 gramme ethyl-iodide gave
 0.5195 ... carbonic acid, and
 0.1530 ... water.
- II. { 0.3512 gramme gave
 0.3513 ... iodide of silver.

Experiment.				Calculation.		
Carbon,	.	.	35.44	35.74	C ₁₄	168
Hydrogen,	.	.	4.25	4.26	H ₂₀	20
Nitrogen,	.	.	...	5.96	N ₂	28
Iodine,	.	.	54.05	54.04	I ₂	254
				100.00		470

Corresponding with the formula $C_{10}H_{20}N_2(C_2H_5I)_2$. Heated with silver chloride and water this salt was converted into the chloride, which, on the addition of platinic-chloride gave the platino-chloride in very sparingly soluble small red needles.

- { 0.2780 gramme platino-chloride gave
 0.0685 ... platinum.

This corresponds with 31.12 per cent., and the formula $C_{10}H_{10}N_2(C_2H_5Cl)_2PtCl_4$ requires 30.44.

The base itself, when separated from the iodide by silver oxide, forms a highly alkaline solution, having generally a red or purple colour, which, on evaporation, leaves a dark-coloured uncrystallised residue. It obviously belongs to the class of ammonium bases, but I have not pursued its investigation further.

Dibromo-Dipyridine.—This base is thrown down when bromine is added to a solution of dipyridine hydrochlorate, or hydrobromate, as a white powder, insoluble in water, sparingly soluble in cold, more so in hot alcohol, from which it is deposited in flattened needles on cooling. If too much bromine has been used in its preparation, these crystals are pink. Its basic properties are extremely feeble, and it is a somewhat unstable compound; for, on boiling with water, or with hydrochloric acid, the original base appears to be more or less completely regenerated. An analysis, in which the hydrogen was lost, gave

- I. { 0.3560 gramme dibromo-dipyridine gave
 0.4902 ... carbonic acid.
- II. { 0.3420 gramme gave
 0.4078 ... silver iodide.

Experiment.				Calculation.		
Carbon,	.	.	37.56	37.97	C ₁₀	120
Hydrogen,	.	.	...	2.53	H ₈	8
Nitrogen,	.	.	...	8.87	N ₂	28
Bromine,	.	.	50.74	50.87	Br ₂	160
				100.00		316

Its platinum compound could not be obtained in a state fitted for analysis. On boiling with hydrochloric acid, and adding platinic-chloride, a yellow precipitate was obtained, which, in one experiment, gave 32·39 per cent. of platinum; and in another, in which the boiling was continued longer, 33·53 per cent. was obtained. Dibromo-dipyridine requires 30·94, and dipyridine itself 34·68; so that there can be little doubt that the latter has been regenerated.

OILY BASE.

The oily base from which the dipyridine was deposited in crystals, has been as yet but imperfectly examined. It was purified by redistillation and cooling, by which it yielded a small additional quantity of dipyridine, and this was repeated as long as it gave crystals. The base so obtained is a rather thick, pale-yellow oil, heavier than water, having a peculiar heavy smell, quite distinct from that of pyridine. It is insoluble in water, but dissolves with great ease in alcohol and ether. It boils at a high temperature, and if distilled rapidly, it undergoes partial decomposition, yielding a small quantity of what appears to be a mixture of several bases with pungent smell, and sparingly soluble in water. If, however, the distillation be carried on very cautiously at a temperature below its boiling point, it passes over unchanged. It dissolves in acids and forms salts, most of which, however, are uncrystallisable, and dry up into gummy masses. It was prepared for analysis by drying over calcic-chloride, distilling and separating the first part of the distillate which might retain moisture.

I.	{ 0·3420 gramme of the base gave		
	0·9605	...	carbonic acid.
	0·2135	...	water.
II.	{ 0·3662 gramme of the base gave		
	1·0140	...	carbonic acid.
	0·2300	...	water.

	Experiment.		Calculation.		
	I.	II.			
Carbon, . .	76·59	75·51	75·94	C ₅	60
Hydrogen, .	6·94	6·98	6·33	H ₅	5
Nitrogen, .	...	...	17·73	N	14
			100·00		79

These results, it will be seen, correspond with those given by pyridine and dipyridine, and they are confirmed by the analysis of a platinum salt, prepared in the usual way.

{	0·2991 gramme of the platinum salt gave		
	0·1015	...	platinum.

This corresponds to 33·94, and calculation for the formula (C₅H₅NHCl)₂PtCl₄ requires 34·68. It is obvious, therefore, that this is another polymer of the

original pyridine ; but, unfortunately, there is no means by which its molecular constitution can be determined. It is impossible to determine its vapour density, because it undergoes partial decomposition at its boiling point ; and as its salts do not crystallise, and probably, like the platinum compound, all correspond with those of the original pyridine, there is no prospect of satisfactory conclusions being drawn from them. In the absence of experimental evidence, any assumption may be made regarding the constitution of this base, and at first sight the most reasonable view of the matter is to suppose it to be the product of a further polymerisation, and to be formed by the combination of three or four molecules of the original pyridine. Its boiling point, which is certainly lower than that of dipyridine, however, appears to militate against this view ; and taking its properties and those of its compounds into consideration, I am inclined to believe it to be another dipyridine, and an example of those cases of physical isomerism of which so many are now known. As there was no means of ascertaining the constitution of this base, and the properties of its compounds were not encouraging, I have not pursued their investigation further.

LIGHT BASES.

It has been stated at the commencement of this paper that when dipyridine was prepared by the first of the processes there described, that a light basic oil was obtained at the beginning of the rectification of the crude product. This oil, which is insoluble in water, was collected, dried, and rectified when it was found to consist of several bases. The distillate was collected in several fractions, which were analysed, but the quantity was far too small to admit of any systematic attempt to separate them. The results, both of the combustion of the bases themselves and of the platinum determinations in their platinum compounds, seem to show that they are a class of bases isologous with the pyridine series. I give here the results of these analyses :—

I.	{	0.3025	gramme of base boiling between 225° and 240° F. gave
		0.8375	 carbonic acid, and
		0.2302	 water.
II.	{	0.4120	gramme of base boiling between 270° and 290° F. gave
		1.1385	 carbonic acid, and
		0.3230	 water.
III.	{	0.2711	gramme of base boiling about 291° F. gave
		0.7572	 carbonic acid, and
		0.1984	 water.
IV.	{	0.2708	gramme of base boiling between 287° and 291° F. gave
		0.7371	 carbonic acid, and
		0.2092	 water.
V.	{	0.2355	gramme of base boiling between 291° and 360° F. gave
		0.6690	 carbonic acid,
		0.1795	 water.

	I.	II.	III.	IV.	V.
Carbon, . .	75.51	75.36	76.18	74.23	77.47
Hydrogen, . .	8.46	8.71	8.13	8.58	8.47
Nitrogen, . .	16.03	15.93	15.69	17.19	14.06
	<hr/> 100.00	<hr/> 100.00	<hr/> 100.00	<hr/> 100.00	<hr/> 100.00

It must be distinctly understood that all the substances analysed were obviously mixtures, and the degrees above given do not denote true boiling points, but only that the fractions they represent were collected at these points. It will be observed that all these analyses are characterised by yielding a percentage of hydrogen far above that contained in pyridine, or any of its homologues. To render this more obvious, I place here the calculated numbers for pyridine and picoline, along with those required by bases containing two atoms of hydrogen more than these compounds:—

	C_5H_5N	C_6H_7N	C_5H_7N	C_6H_9N
Carbon, . .	75.94	77.42	74.04	75.75
Hydrogen, . .	6.33	7.53	8.64	9.47
Nitrogen, . .	17.73	15.05	17.32	14.78
	<hr/> 100.00	<hr/> 100.00	<hr/> 100.00	<hr/> 100.00

The experimental results above given are manifestly incompatible with the first two of these formula, but would agree tolerably with a mixture of substances containing more hydrogen, and this is further confirmed by several platinum determinations in platinum compounds obtained from these substances. These results appear to indicate the existence of a series of bases having the general formula $C_nH_{2n-3}N$. The further investigation of these substances would be of interest, but as they are obtained only in minute quantity, and are clearly secondary products of the action of sodium on pyridine, it is scarcely possible to obtain them in sufficient quantity for this purpose.

At the beginning of this paper, mention has been made of a black or dark-gray substance, obtained in the second process for preparing dipyridine. This compound was only obtained towards the close of the investigation, and I have not had time to examine its properties and relations minutely. It is a black amorphous powder, quite insoluble in water. When exposed to the air, it is rapidly converted into a mass of crystals of pure dipyridine. I was at first disposed to consider this substance to be a sodium compound of dipyridine, but I soon found that this was not the case, and that its properties more nearly corresponded with a hydrogen compound of that base; and it seems probable that its formula will turn out to be $C_{10}H_{12}N_2$, in which case it would be related to

dipyridine in the same manner as ammonium is to ammonia. Should this view be correct; it seems probable that, on the addition of hydrochloric acid, it should, like a metal, evolve hydrogen. An experiment was made to ascertain whether this occurred by introducing a quantity of the compound into a jar over mercury, and bringing hydrochloric acid in contact with it; but the anticipated result was not obtained,—no hydrogen was evolved, but a brownish precipitate appeared in the fluid, and the gray powder at once disappeared. I have been unable to pursue this subject further, but propose to return to it on a future occasion.

Numerous experiments have been made, in the hope of throwing light on the nature of the chemical changes occurring during the first process of preparing dipyridine; but it is obviously of a very complex kind, and some of the products must be the result of secondary decompositions. My impression is, that sodio-dipyridine must be first formed, probably $C_{10}H_8Na_2N_2$. In this case hydrogen must be given off during the action, and this is actually the case, as was established by direct experiment; but the quantity evolved is trifling compared with that of the sodium consumed, so that if the action takes place in this way, a large part of the hydrogen must be converted into some other compounds within the mixture itself. The light bases already mentioned might account for this, if it were not that they are produced in very small quantity. Altogether I am inclined to think that, in the first process, a number of secondary reactions take place, which greatly complicate matters, and that it is through some modification of the second by which an explanation will most probably be obtained. I am still engaged with the subject, and have already nearly perfected a process by which some of the products can be obtained with greater certainty and in larger quantity than by either of those described in this paper, and which I hope will enable me to subject the constitution and relations of these curious compounds to a more minute examination.