

*Section X.**The epiCryptopines, A, B, and C. (Formulæ, pp. 866, 867.)*

The starting point in the investigation of this difficult and interesting section is the conversion of anhydrocryptopine into the hydrochlorides of *epicryptopine*, *A* and *B*, by the action of concentrated hydrochloric acid (compare p. 865). Anhydrocryptopine (1 gram) is mixed in a test-tube with ordinary concentrated hydrochloric acid (5 c.c.), warmed until dissolved, and then boiled vigorously for forty-five seconds in such a way that the solution becomes considerably concentrated. A pale pink colour soon develops, which rapidly becomes orange-red and ultimately deep crimson, and on the addition of two volumes of water, a chalky precipitate gradually forms and the whole sets to a thin, bright pink paste. When the mass is transferred to the pump, the slimy, chalky precipitate tends to close up the pores of the filter paper, so that filtration is a slow and tedious operation, and, when as complete as possible, the hydrochloride is ground up with dilute hydrochloric acid and again transferred to the filter, and, after a second washing of the same kind, the precipitate is left in contact with porous porcelain for a couple of days. The deep crimson filtrate deposits, on keeping for some weeks, a small crop of a crimson salt, to which the colour of the solution is due, and the examination of this salt is described on p. 1016. The almost colourless hydrochloride is now dissolved in much boiling water, mixed with excess of ammonia, and the caseous precipitate rapidly extracted with much ether. The yellowish-green ethereal solution, which exhibits a striking blue fluorescence, is dried over potassium carbonate, concentrated con-

siderably, and left for some days in the ice-chest, when a hard crust of *epicryptopine*, *A*, will have separated, but it is usually small in amount. The mother liquor is decanted, the crystalline mass washed thoroughly with ether, and is then almost pure, but it may be recrystallised from methyl alcohol if the operation is rapidly carried out with small quantities (compare p. 1011), but it is better to use benzene as the solvent. Only a small quantity of the *epicryptopine*, *A*, used in the subsequent experiments was obtained in this way; most of this substance was prepared from *epicryptopine*, *B*, by the action of dilute hydrochloric acid (p. 1012). The analysis of *epicryptopine*, *A*, gave the following results:

0.1151 gave 0.2864 CO_2 and 0.0661 H_2O . $\text{C}=67.9$; $\text{H}=6.4$.

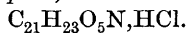
0.1538 „ 5.4 c.c. N_2 at 17° and 760 mm. $\text{N}=4.0$.

$\text{C}_{21}\text{H}_{23}\text{O}_5\text{N}$ requires $\text{C}=68.3$; $\text{H}=6.2$; $\text{N}=3.8$ per cent.

epiCryptopine, *A*, melts at $210\text{--}212^\circ$ and, like cryptopine itself, is characterised by its sparing solubility in the usual organic solvents.

It dissolves with difficulty in boiling methyl alcohol and separates, on cooling, in microscopic, glistening prisms; boiling benzene also dissolves it with difficulty, and the solution, after concentrating, deposits the substance in pale ochreous crusts. It is also sparingly soluble in boiling acetone or methyl ethyl ketone, more readily so in ethyl acetate, and dissolves freely in hot acetophenone without darkening. The solution in acetic acid gives, on the addition of sulphuric acid, an almost colourless solution, which gradually becomes very pale pink; if, however, the solution in acetic acid is boiled for a few seconds, cooled, and then mixed with sulphuric acid, a yellow solution is obtained which rapidly becomes port-wine colour, a colour change which is evidently due to the formation of *epicryptopine*, *C*, (compare p. 1012). This colour reaction is very useful, because it is so very different from the bluish-violet exhibited by cryptopine under the same conditions, and it therefore serves as a ready means for distinguishing between these substances which, in many of their properties, are so strikingly alike that they may well be easily mistaken for one another.

The Salts of epiCryptopine, A. The Hydrochloride,



—When a paste of the base with water is mixed with excess of dilute hydrochloric acid, a jelly is produced, just as in the case of cryptopine, and this breaks up on gently warming and yields a chalky precipitate, which was collected and well washed. This hydrochloride is very sparingly soluble in boiling water, but, when once dissolved, it does not readily separate again, but does so immediately on the addition of dilute hydrochloric acid. It was collected,

washed with dilute hydrochloric acid, drained on porous porcelain, and dried in the steam-oven in the dark, since it has a tendency to discolour when it is exposed to sunlight:

0.1214 gave 0.2736 CO_2 and 0.0677 H_2O . $\text{C}=61.5$; $\text{H}=6.2$.

0.2968 „ 0.1031 AgCl . $\text{Cl}=8.6$.

$\text{C}_{21}\text{H}_{23}\text{O}_5\text{N}, \text{HCl}$ requires $\text{C}=62.1$; $\text{H}=5.9$; $\text{Cl}=8.7$ per cent.

The Hydriodide, $\text{C}_{21}\text{H}_{23}\text{O}_5\text{N}, \text{HI}$.—A boiling solution of the hydrochloride yields, on the addition of a hot solution of potassium iodide, a milky liquid which almost immediately crystallises, and the chalky precipitate is seen under the microscope to consist of warty masses. It is somewhat soluble in water, and separates on cooling as a chalky, crystalline powder. The dry salt is a brittle mass like porcelain, which begins to darken at 210° and melts at 230 — 232° with much effervescence to a dark red froth:

0.1016 gave 0.1884 CO_2 and 0.0468 H_2O . $\text{C}=50.7$; $\text{H}=5.1$.

0.1434 „ 0.0685 AgI . $\text{I}=25.8$.

$\text{C}_{21}\text{H}_{23}\text{O}_5\text{N}, \text{HI}$ requires $\text{C}=50.7$; $\text{H}=4.8$; $\text{I}=25.6$ per cent.

The *platinichloride* is obtained as a very pale ochreous precipitate when platinic chloride is added to the hot aqueous solution of the hydrochloride:

0.1161 gave 0.1878 CO_2 and 0.0423 H_2O . $\text{C}=44.1$; $\text{H}=4.1$.

0.2442 „ 0.0424 Pt . $\text{Pt}=17.4$.

$(\text{C}_{21}\text{H}_{23}\text{O}_5\text{N})_2, \text{H}_2\text{PtCl}_6$ requires $\text{C}=44.0$; $\text{H}=4.2$; $\text{Pt}=17.0$ per cent.

The solution of the hydrochloride gives, with mercuric chloride, a milky liquid which, on warming, deposits a very sparingly soluble, crystalline precipitate and, with picric acid, a very sparingly soluble, chrome-yellow precipitate which softens to a resin on boiling with water.

The Acetyl Derivative, $\text{C}_{21}\text{H}_{22}\text{O}_4\text{N}(\text{O}\cdot\text{CO}\cdot\text{CH}_3)$.—The ease with which *epicryptopine*, *A*, yields the acetyl derivative is remarkable. When the finely powdered substance is mixed with acetic anhydride in the cold it dissolves, and almost immediately crystallisation commences and the acetyl derivative separates as a glistening, crystalline powder. This was collected and washed, first with acetic anhydride and then with methyl alcohol, and dried in the steam-oven:

0.1024 gave 0.2513 CO_2 and 0.0556 H_2O . $\text{C}=66.9$; $\text{H}=6.0$.

0.3500 „ 9.8 c.c. N_2 at 18° and 763 mm. $\text{N}=3.5$.

$\text{C}_{23}\text{H}_{25}\text{O}_6\text{N}$ requires $\text{C}=67.1$; $\text{H}=6.1$; $\text{N}=3.4$ per cent.

This acetyl derivative darkens at about 285° and melts at about 290° to a deep brown liquid. It is very sparingly soluble in boiling alcohol, benzene, chloroform, methyl ethyl ketone, acetic anhydride, or cold acetic acid, but it dissolves in much boiling acetic acid, appa-

rently with some change, since it does not separate again even on long keeping. It is remarkably resistant to hydrolytic agents. Thus the crystals are coloured green by concentrated hydrochloric acid and dissolve on boiling to a yellowish-brown solution, and the addition of ammonia gives a caseous precipitate, which crystallises from much ether in crusts, melts at 290° , and consists of the unchanged acetyl derivative. Again, it does not appear to be appreciably hydrolysed when boiled with concentrated methyl-alcoholic potassium hydroxide, and it does not seem to be readily affected by boiling with aniline.

Conversion of epiCryptopine, A, into epiCryptopine, B.—It has already been mentioned that *epicryptopine, A*, is very sparingly soluble in methyl alcohol, but on heating in a sealed tube with methyl alcohol at 100° , it gradually dissolves and, on cooling, nothing separates even after considerable concentration. The addition of water produces a voluminous, chalky precipitate which was extracted with ether, the ethereal solution was then thoroughly washed with water, dried over potassium carbonate, and evaporated, when an almost colourless resin remained which had all the properties of *epicryptopine, B*, (see below).

epiCryptopine (B).

When the ethereal mother liquor from the crystallisation of *epicryptopine, A*, (compare p. 1009) is concentrated and left in the ice-chest for a week it yields only a thin crust of the same substance, and the ethereal solution, on complete evaporation, leaves a large quantity of a pale brown resin which is by far the main product of the action of hydrochloric acid on anhydrocryptopine and subsequent decomposition of the mixed *epicryptopine* hydrochlorides by ammonia. The resin was dissolved in cold dilute hydrochloric acid, and the sparingly soluble hydrochloride which separated washed thoroughly and recrystallised from water; it was then dissolved in hot water, decomposed by ammonia, and the base extracted with ether. After drying over potassium carbonate, the ether was evaporated and the residue left first over sulphuric acid and then over phosphoric oxide in a vacuum desiccator, when it frothed up and ultimately became quite brittle, like flakes of almost colourless shellac:

0.1385 gave 0.3445 CO_2 and 0.0804 H_2O . $\text{C}=67.8$; $\text{H}=6.4$.

0.4012 „ 13.1 c.c. N_2 at 17° and 758 mm. $\text{N}=3.9$.

$\text{C}_{21}\text{H}_{23}\text{O}_5\text{N}$ requires $\text{C}=68.3$; $\text{H}=6.2$; $\text{N}=3.8$ per cent.

epiCryptopine, B, differs from the modifications, *A*, and *C*, in that it is very readily soluble in ether, alcohol, and most other solvents, and exhibits no tendency to assume the crystalline condition.

The *platinichloride* was obtained as a very pale salmon precipitate when platinic chloride was added to the warm solution of the hydrochloride:

0.1126 gave 0.1818 CO_2 and 0.0441 H_2O . $\text{C}=44.0$; $\text{H}=4.3$.

0.2225 „ 0.0372 Pt. $\text{Pt}=16.7$.

$(\text{C}_{21}\text{H}_{23}\text{O}_5\text{N})_2\text{H}_2\text{PtCl}_6$ requires $\text{C}=44.0$; $\text{H}=4.2$; $\text{Pt}=17.0$ per cent.

The Acetyl Derivative.—*epiCryptopine, B*, dissolves readily in acetic anhydride, yielding a brown solution, and when this is boiled and, if necessary, concentrated, a heavy, crystalline precipitate separates. This was collected, washed with acetic anhydride, and then with methyl alcohol, and the mother liquor, on mixing with twice the volume of methyl alcohol, deposited a considerable crop of the same substance. This acetyl derivative darkened at 280° and melted at about 290 — 295° to a brown mass, and had exactly the appearance and properties of the acetyl derivative of *epicryptopine A*. (Found, $\text{C}=66.9$; $\text{H}=6.0$; $\text{N}=3.4$. $\text{C}_{23}\text{H}_{25}\text{O}_6\text{N}$ requires $\text{C}=67.1$; $\text{H}=6.1$; $\text{N}=3.4$ per cent.)

Conversion of epiCryptopine, B, into epiCryptopine, A.—It has already been shown (p. 1011) that *epicryptopine, A*, is converted into the modification, *B*, when it is boiled with methyl alcohol, and the reverse change may be brought about by the action of hydrochloric acid. When *epicryptopine, B*, is mixed with excess of very dilute hydrochloric acid (1 in 10), and heated on the steam-bath, it dissolves to a clear solution, but soon the hydrochloride of *A* begins to separate in very sparingly soluble crusts. It was collected, washed well, ground up with water and excess of ammonia, and shaken with ether, when much remained undissolved. The precipitate was collected, washed with ether and then with water, and dried in the steam-oven, when it melted at 190 — 195° and, after recrystallising from benzene, at 210 — 212° , and consisted of pure *epicryptopine, A*, the yield being about 60 per cent. of the original *epicryptopine, B*. The ethereal mother liquor left, on evaporation, the remaining 40 per cent. as a resin, which apparently consisted of unchanged *epicryptopine, B*.

epiCryptopine (C).

The curious change of *epicryptopine, A*, to the acetate of *C* was discovered accidentally during the recrystallisation of *A* from ethyl acetate which had been carefully freed from acetic acid by contact with potassium carbonate. About 5 grams of *A* were boiled with much ethyl acetate, in which it is very sparingly soluble, and after about an hour the solution was concentrated, during which a pale lemon, glistening mass separated from the hot liquid, and this melted at 208 — 210° and consisted of unchanged *A*. After filtering, the filtrate was concentrated considerably and left in the ice-chest

for a fortnight, when a chalky, crystalline crust separated which, after collecting and rapidly washing with cold ethyl acetate, melted at 184—185° and consisted of the *acetate* of *epicryptopine*, *C*:

0.1049 gave 0.2464 CO₂ and 0.0609 H₂O. C=64.1; H=6.4.

0.2321 „ 6.5 c.c. N₂ at 13° and 758 mm. N=3.3.

C₂₁H₂₃O₅N, C₂H₄O₂ requires C=64.3; H=6.3; N=3.3 per cent.

This acetate is readily soluble in hot water, but is to some extent dissociated unless a little acetic acid is added, and ammonia gives, with the clear solution, a jelly which, on warming, becomes crystalline.

The precipitate was collected, washed well, and left in contact with porous porcelain; it was then extracted with ether, which readily dissolved the crude base, and left a small, black impurity. The ethereal solution was filtered, washed, dried over potassium carbonate, and concentrated when, on leaving in the ice-chest, a crust of warty groups separated and melted at 165—167° to an almost colourless syrup. The mother liquor yielded on concentration a considerable second crop of rather lower melting point. Subsequently it was discovered that heating with dilute acid readily brings about the transformation of *epicryptopine*, *A*, into the modification, *C*. If finely divided *epicryptopine*, *A*, is mixed, in the cold, with dilute acetic acid (15 per cent.) it changes in appearance, becomes colloidal, and impossible to filter. On warming, solution takes place, and if, after heating on the steam-bath for ten minutes, ammonia is added in excess, a caseous precipitate separates which, on cooling, becomes brittle and, when dried over phosphoric oxide, melts at about 115° to a syrup. It is curious that the substance in this condition gives numbers agreeing approximately with those required for *epicryptopine*. (Found, C=67.7; H=6.2. C₂₁H₂₃O₅N requires C=68.3; H=6.2 per cent.) The brittle mass was dissolved in moist ether, the ethereal solution carefully dried over potassium carbonate, and concentrated, when a thin crust separated on which nodular masses gradually formed, and these two substances could be separated mechanically. The crust melted at 205—207° and consisted of unchanged *epicryptopine* *A*, whereas the nodules melted at about 162° and, after twice recrystallising from ether, at 165—167° not quite sharply, and consisted of *epicryptopine*, *C*. In the following analyses (I) was made with material prepared from the acetate, and (II) with a specimen obtained by the acetic acid process just described:

(I) 0.1216 gave 0.3023 CO₂ and 0.0679 H₂O. C=67.8; H=6.2.

(I) 0.1705 „ 5.4 c.c. N₂ at 17° and 758 mm. N=3.7.

(II) 0.1092 „ 0.2711 CO₂ and 0.0611 H₂O. C=67.9; H=6.2.

C₂₁H₂₃O₅N requires C=68.3; H=6.2; N=3.8 per cent.

epiCryptopine, *C*, is sparingly soluble in ether, but its solution may be concentrated to a very small bulk without crystallisation commencing; it dissolves readily in alcohol, benzene, or acetone. The solution in acetic acid gives, on the addition of sulphuric acid, at first no coloration, then a deep violet gradually develops; a very different reaction from that exhibited by *epicryptopine*, *A*. It dissolves readily in dilute hydrochloric acid, but, on stirring, a sparingly soluble hydrochloride soon separates as a chalky mass. When *epicryptopine*, *C*, is warmed with phosphoryl chloride it dissolves to a brown solution, but without the formation of a scarlet salt corresponding with *epicryptopirubin* chloride (see below). It dissolves also in acetic anhydride and, on warming, the *acetyl* derivative soon begins to separate in spangles which melt at 285—290°, with decomposition, to a black mass. (Found, C=66·8; H=6·1. $C_{23}H_{25}O_6N$ requires C=67·1; H=6·1 per cent.) This *acetyl* derivative has properties which, so far as can be judged in the case of so insoluble a substance, are the same as those of the *acetyl* derivatives obtained from *epicryptopine*, *A*, and *B*, and there is little doubt that the same substance is produced in all three cases.

The epiCryptopirubin Salts. (Formulæ, p. 873).

The action of phosphoryl chloride on *epicryptopine*, *A*, is highly characteristic. When this substance (0·5 gram) is heated with phosphoryl chloride (5 c.c.), at first gently and then to boiling, it becomes salmon-coloured and dissolves to an orange solution which soon becomes intense orange-red. The boiling is continued for twenty minutes, most of the excess of phosphoryl chloride distilled off under diminished pressure, during which a red, crystalline substance separates sometimes in considerable quantity. In order to avoid decomposition due to local rise of temperature, it is a good plan to pour the residual, dark red mass in a thin stream round the sides of a small porcelain basin; ice is then added, and the whole left for some hours. On heating to boiling, all dissolves with the exception of a small quantity of an ochreous substance, which was not further examined, and, on cooling the deep crimson solution, it deposits a brilliant scarlet, crystalline precipitate of *epicryptopirubin* chloride, and this, after recrystallisation from water, was analysed with the following results:

0·1089 gave 0·2587 CO_2 and 0·0554 H_2O . C=64·8; H=5·7.

0·2941 „ 0·1048 $AgCl$. Cl=8·9.

$C_{21}H_{22}O_4NCl$ requires C=65·0; H=5·7; Cl=9·2 per cent.

epiCryptopirubin chloride, when heated in a capillary tube, does not appear to change below 210°, it becomes brownish-red at 215°

and melts at 220—223° to a blackish-brown froth. The pure salt, which closely resembles red mercuric iodide in appearance, is sparingly soluble in cold water, but dissolves readily on boiling to a solution of the colour of red ink. It also dissolves readily in hot methyl alcohol, and the deep orange-red solution deposits the salt in well-defined, orange-red prisms. The chloride dissolves in acetic acid to a bright orange salt, and the addition of sulphuric acid produces a yellow solution which exhibits a deep yellowish-green fluorescence. The colour rapidly becomes greener and soon an intense sage-green, and this persists even on the addition of a good deal of water. The aqueous solution of the chloride gives a deep greenish-brown solution on the addition of ammonia or sodium carbonate, and when this is warmed a brownish-black, amorphous precipitate separates. When a trace of the chloride, dissolved in water, is covered with a considerable layer of ether and, after the addition of ammonia, the whole rapidly shaken, the ether is coloured deep green and exhibits a blue fluorescence, but the colour soon fades to yellow and a black precipitate separates (compare p. 1016).

A trace of the chloride, mixed with concentrated nitric acid, gives an intense port-wine solution, especially on warming gently.

*epi*Cryptopirubin nitrate is precipitated, on the addition of dilute nitric acid to the hot solution of the chloride, as a crystalline, vermilion precipitate, which is sparingly soluble in hot dilute nitric acid and separates, on cooling, in irregular groups of flat, striated prisms.

The Iodide.—In preparing this salt, potassium iodide was added to the hot solution of the chloride, when the clear liquid immediately began to deposit a splendid deep vermilion precipitate, which was collected and washed with boiling water, in which it is very sparingly soluble:

0.1006 gave 0.1924 CO₂ and 0.0408 H₂O. C=52.2; H=4.5.

0.1414 „ 0.0692 AgI. I=26.4.

C₂₁H₂₂O₄NI requires C=52.6; H=4.6; I=26.5 per cent.

This iodide dissolves sparingly in boiling methyl alcohol to an orange-red solution, from which irregular prisms separate on cooling.

The *platinichloride* was obtained by adding platinic chloride to the hot solution of the hydrochloride when a brown, apparently crystalline precipitate separated which was collected, well washed, and dried in the steam-oven. The deep maroon powder decomposes with effervescence at about 205—210° to a reddish-brown mass:

0.1052 gave 0.1729 CO₂ and 0.0367 H₂O. C=44.8; H=3.9.

0.2442 „ 0.0424 Pt. Pt=17.4.

(C₂₁H₂₂O₄N)₂PtCl₆ requires C=45.3; H=4.0; Pt=17.5 per cent.

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The dilute solution of the chloride gives no precipitate with mercuric chloride, but, in concentrated solutions, a bright yellowish-red precipitate is produced, which dissolves in much boiling water to a yellow solution and separates, on cooling, in short, orange-red prisms. The addition of picric acid to the solution of the chloride produces an orange, amorphous precipitate, which becomes crystalline on boiling and is very sparingly soluble.

Examination of the Mother Liquors from the Preparation of epiCryptopine Hydrochloride.—This deep reddish-brown aqueous solution (p. 1008) was concentrated on the water-bath and allowed to remain, when a scarlet chloride separated in considerable quantity in definite crystals which were collected and dried in the steam-oven. It was then a deep, dull red powder which softened at 145° and melted at 150 – 155° with effervescence to a red froth, and it is therefore not identical with *epicryptopirubin* chloride. In all probability this salt, which on analysis gave $\text{Cl}=9.4$, is dehydro-*epicryptopirubin* chloride, $\text{C}_{21}\text{H}_{20}\text{O}_4\text{NCl}$ (p. 1017; $\text{Cl}=9.3$ per cent.), and owes its formation to the oxidising action of the air during the long evaporation on the water-bath.

The mother liquor from this salt was covered with much ether in a separating funnel, mixed with excess of sodium hydroxide, and the whole well shaken. The green, ethereal solution exhibited a striking blue fluorescence, soon became yellow, and a dark brownish-black base separated; after filtering from this, drying over potassium carbonate, and concentrating, a brown, ochreous, crystalline powder separated:

0.1102 gave 0.2671 CO_2 and 0.0502 H_2O . $\text{C}=66.0$; $\text{H}=5.4$.

$\text{C}_{21}\text{H}_{19}\text{O}_6\text{N}$ requires $\text{C}=66.1$; $\text{H}=5.0$ per cent.

This base dissolves in dilute hydrochloric acid to a brown solution, and is probably identical with the base of the same composition described in the next section.

Dehydroepicryptopirubin Hydroxide.

In order to discover the nature of the base produced by the action of dilute alkalis on *epicryptopirubin* chloride, a quantity of the very pure scarlet salt was dissolved in hot water, rapidly cooled, and stirred, when the salt separated in a very finely divided condition. It was transferred to a separating funnel, covered with much ether, mixed with potassium hydroxide, and shaken, when the deep green, ethereal solution soon became yellow and a nearly black precipitate separated. The ethereal solution was decanted, the black precipitate collected, and well washed, first with ether and then with water, and dried on porous porcelain in the water-oven. Two different specimens were analysed:

0.1200 gave 0.3020 CO_2 and 0.0596 H_2O . $\text{C}=68.6$; $\text{H}=5.5$.

0.1146 „ 0.2866 CO_2 „, 0.0572 H_2O . $\text{C}=68.2$; $\text{H}=5.5$.

$\text{C}_{21}\text{H}_{21}\text{O}_5\text{N}$ requires $\text{C}=68.6$; $\text{H}=5.7$ per cent.

Dehydroepicryptopirubin hydroxide is a reddish-black, crystalline powder which, when moistened and rubbed on a piece of porous porcelain, gives a deep reddish-brown streak. It dissolves in much boiling water to a brown solution, which dyes the fingers; it is also somewhat soluble in methyl alcohol to a yellowish-brown solution and dissolves also in acetone or chloroform. When the base is moistened with dilute hydrochloric acid it at once yields a bright red salt which is soluble in boiling water and separates, on cooling, in intense purplish-red crystals. The dry salt is a purplish-red powder almost like amorphous phosphorus in appearance; it changes colour at 140° and softens to a resin at about 155° without showing any definite melting point.

The dilute aqueous solution of the salt is the colour of dichromate and is changed to brown on the addition of dilute ammonia without precipitation; on warming, however, the base separates as a deep brown precipitate.

Potassium iodide, added to the solution of the chloride, gives an intense brick-red iodide which may be recrystallised from water.

The ethereal solution, which had been separated from the black base as described above, was dried over potassium carbonate and concentrated, when, on long keeping, a yellowish-brown, crystalline crust separated:

0.1002 gave 0.2419 CO_2 and 0.0473 H_2O . $\text{C}=65.9$; $\text{H}=5.2$.

$\text{C}_{21}\text{H}_{19}\text{O}_6\text{N}$ requires $\text{C}=66.1$; $\text{H}=5.0$ per cent.

There can be little doubt that this base is identical with the substance of the same composition described in the last section, but there is no evidence as to its constitution.

Ketoisoepticryptopirubin Hydrochloride (p. 874).

This brilliant scarlet salt is produced when ketoanhydrocryptopine reacts with phosphoryl chloride (compare p. 1008). Ketoanhydrocryptopine (1 gram) dissolves in phosphoryl chloride (2.5 c.c.) with some evolution of heat, and when the test-tube containing the orange-brown solution is placed in boiling water there is a good deal of effervescence and the colour changes to deep brown and then to dark red. After fifteen minutes the product is cooled in a freezing mixture, mixed with a little powdered ice, and, as soon as decomposition is complete, the crimson precipitate is collected and washed with concentrated hydrochloric acid. A specimen of the salt which had been left over powdered potassium hydroxide in a

vacuum desiccator until the weight was constant gave the following analytical results:

0.1015 gave 0.2351 CO_2 and 0.0455 H_2O . $\text{C}=63.2$; $\text{H}=4.9$.

0.2255 „ 0.0709 AgCl . $\text{Cl}=7.8$.

$\text{C}_{21}\text{H}_{19}\text{O}_5\text{N}_2\text{HCl}$ requires $\text{C}=62.8$; $\text{H}=4.9$; $\text{Cl}=8.8$ per cent.

This salt separates from hot dilute hydrochloric acid as a micro-crystalline, deep scarlet precipitate, but not without some hydrolysis taking place, since the salt after recrystallisation contained only 6.5 per cent. of chlorine. The dilute solution in hydrochloric acid, which has exactly the appearance of red ink, gives, on the addition of nitric acid, a deep bluish-crimson precipitate of the sparingly soluble nitrate, and when this is warmed decomposition ensues and an intense violet solution results. The *platinichloride* was obtained, on the addition of platinic chloride to the solution of the rubin chloride, in hydrochloric acid, as an intense crimson precipitate which, when dry, resembled amorphous phosphorus in appearance:

0.1312 gave 0.2145 CO_2 and 0.0423 H_2O . $\text{C}=44.6$; $\text{H}=3.5$.

0.2122 „ 0.0368 Pt . $\text{Pt}=17.3$.

$(\text{C}_{21}\text{H}_{19}\text{O}_5\text{N})_2\text{H}_2\text{PtCl}_6$ requires $\text{C}=44.2$; $\text{H}=3.5$; $\text{Pt}=17.2$ per cent.

The aurichloride separates, on the addition of gold chloride to the solution of the hydrochloride in hydrochloric acid, as a deep maroon precipitate.

Ketoisoeptcryptopirubin Base.—When finely powdered *ketoisoeptcryptopirubin* hydrochloride (from which adherent hydrochloric acid had been completely removed by exposure over potassium hydroxide in a vacuum desiccator) was boiled with water, the scarlet solution soon deposited a granular precipitate and much water, and prolonged boiling nearly decolorised the solution. The precipitated base was collected, washed with dilute hydrochloric acid and then with water, drained on porous porcelain, and recrystallised from dilute acetic acid:

0.1001 gave 0.2525 CO_2 and 0.049 H_2O . $\text{C}=68.7$; $\text{H}=5.3$.

0.2862 „ 9.6 c.c. N_2 at 10° and 746 mm. $\text{N}=4.0$.

$\text{C}_{21}\text{H}_{19}\text{O}_5\text{N}$ requires $\text{C}=69.1$; $\text{H}=5.2$; $\text{N}=3.9$ per cent.

Ketoisoeptcryptopirubin base shrinks at 210° , gradually darkens as the temperature rises, and melts, not at all sharply, at about $235\text{--}240^\circ$. It is almost insoluble in cold alcohol, but dissolves somewhat on boiling, and separates as a thin crust of almost colourless prisms; it crystallises from dilute acetic acid in brilliant, well-developed, stout, glistening prisms. The solution in glacial acetic acid develops, on the addition of sulphuric acid, a deep yellow

colour which gradually becomes brown, and a splinter of a crystal dissolves in concentrated nitric acid to an intense violet-red solution. The base is quite insoluble in dilute hydrochloric acid (1 in 6), but it is coloured red by concentrated hydrochloric acid, and dissolves on warming to an intense red solution which, on the addition of water, is largely decolorised with separation of the base.

The epiMethylcryptopines, A, and B.

It has already been stated that the methylcryptopines (β) and (γ) are readily attacked by mineral acids with the formation of intensely violet solutions, from which ammonia precipitates ochreous bases which have the same percentage composition as methylcryptopine. The difference in the behaviour of the methylcryptopines (β) and (γ) is, however, striking. When methylcryptopine (γ) is dissolved in concentrated hydrochloric acid a yellow solution is at once produced which rapidly becomes intense crimson, but methylcryptopine (β), under exactly the same conditions, dissolves to a colourless solution which soon becomes a pale greenish-pink. On remaining overnight, however, both solutions acquire the same deep permanganate colour, but on adding two volumes of water to each and leaving for a couple of days the solution of the (γ)-modification deposits a chalky hydrochloride, whereas the other remains clear. In order to obtain some clue as to the nature of these changes the action of concentrated hydrochloric acid on methylcryptopine (γ) was investigated as completely as was possible with the small amount of material available. When this substance (2 grams) is mixed with ordinary concentrated hydrochloric acid (10 c.c.) it is coloured yellow and, on heating in boiling water, it immediately dissolves and the solution soon acquires an intense reddish-violet (permanganate) colour.

After heating for twenty minutes the product was mixed with two volumes of water and allowed to remain for two days, during which a slimy, colourless hydrochloride separated, but in rather small quantity. This was collected and well washed with dilute hydrochloric acid, in which it is very sparingly soluble, and was then almost colourless (the investigation of the deep permanganate-coloured filtrate is described on p. 1022). The hydrochloride was dissolved in much boiling water and excess of ammonia added, when a chalky precipitate separated, which was collected, washed, and dried on porous porcelain. The substance was then shaken with much ether, in which it partly dissolved, leaving a chalky precipitate, which was collected, washed with ether, and recrystallised from benzene, from which the substance separated as a chalky powder:

0.1043 gave 0.2627 CO_2 and 0.0612 H_2O . $\text{C}=68.7$; $\text{H}=6.5$.

0.2351 „ 7.3 c.c. N_2 at 16° and 758 mm. $\text{N}=3.7$.

$\text{C}_{22}\text{H}_{25}\text{O}_5\text{N}$ requires $\text{C}=68.9$; $\text{H}=6.5$; $\text{N}=3.6$ per cent.

epiMethylcryptopine, *A*, melts at $222\text{--}223^\circ$ and, like *epicryptopine*, *A*, exhibits little facility for crystallising. It is readily soluble in chloroform, but sparingly so in methyl alcohol, benzene, acetone, or ethyl acetate, and is almost insoluble in light petroleum. The addition of light petroleum to the solution in boiling benzene yields a clear liquid, from which the substance separates as a chalky powder consisting of indefinitely crystalline, warty masses. It also separates as a chalky powder, but very slowly and imperfectly, when its solutions in boiling ethyl acetate or acetone are concentrated and left in the ice-chest.

The solution in acetic acid gives, on the addition of sulphuric acid, at first an almost colourless solution, but, on keeping, this gradually develops a pale salmon tint. If left overnight the solution will have become green, and the addition of a few drops of water produces an intense claret coloration. *epiMethylcryptopine*, *A*, is characterised by the fact that its salts with mineral acids are remarkably sparingly soluble. The hydrochloride is almost insoluble in cold dilute hydrochloric acid, and dissolves only very sparingly on boiling; the iodide and nitrate are colourless and also very sparingly soluble. The sulphate separates, when the finely divided base is warmed with very dilute sulphuric acid, as a chalky powder, which seems to be almost insoluble even in much boiling dilute sulphuric acid. Unlike *epicryptopine*, *A* (p. 1010), *epimethylcryptopine*, *A*, does not yield a characteristic acetyl derivative; it is sparingly soluble in acetic anhydride in the cold, but dissolves on boiling, and nothing separates even when the solution is concentrated and allowed to remain. In order to compare the behaviour of *epicryptopine*, *A*, and *epimethylcryptopine*, *A*, towards phosphoryl chloride and so to determine the influence of the extra methyl group in the latter on the possibility of yielding a scarlet chloride (compare p. 1014), the following experiment was made: Freshly distilled phosphoryl chloride (2 c.c.) was added to each of two test-tubes (*a*) and (*b*) containing respectively 1 gram of *epicryptopine*, *A*, and of *epimethylcryptopine*, *A*, and the tubes were then gradually heated side by side in a sulphuric acid-bath. At 100° the contents of (*a*) rapidly became deep salmon, a caseous precipitate separated, and, after boiling for five minutes, the colour was brick-red; after ten minutes almost the whole of the precipitate had disappeared and the solution had the colour of red ink.

The temperature was then raised and the excess of phosphoryl chloride distilled off, when a deep red, semi-solid mass remained

which, on the addition of water, yielded a large amount of a crystalline precipitate of the scarlet chloride. The mixture of *epimethylcryptopine*, *A*, and phosphoryl chloride contained in the tube (*b*) exhibited a very different behaviour. At 100° a pale green solution was first formed, but this colour rapidly disappeared and the milky liquid deposited a pale ochreous, caseous mass in considerable quantity. At the end of ten minutes there was no sign of a pink coloration and, after distilling off the excess of phosphoryl chloride, an ochreous mass was left which had the properties of a quaternary salt and was sparingly soluble in water.

It is shown on p. 1012 that *epicryptopine*, *A*, is converted into a new modification, *C*, when it is boiled with dilute acetic acid, but *epimethylcryptopine*, *A*, does not appear to be changed by this treatment. In order to demonstrate this important difference, *epimethylcryptopine A* (1 gram) was dissolved in glacial acetic acid (5 c.c.) and water (20 c.c.) and heated on the steam-bath, when the solution became first yellow, then orange, and finally orange-red. After heating for an hour, ammonia precipitated a gelatinous mass which, on warming, became crystalline, and this was collected, washed well, and crystallised from much boiling methyl alcohol, in which it was sparingly soluble and from which it separated as a chalky, crystalline mass which melted at 218–220° and consisted of unchanged *epimethylcryptopine A*.

epiMethylcryptopine, B.—The ethereal mother liquor from the purification of *epimethylcryptopine, A*, (p. 1019) was concentrated somewhat and left in the ice-chest for a month; it was then decanted from the very slight precipitate which had separated and evaporated, when a pale orange syrup remained in quantity. This was exposed over sulphuric acid in a vacuum desiccator until it was quite free from ether and the weight had become constant and the friable, ochreous powder of *epimethylcryptopine, B*, analysed :

0.1019 gave 0.2551 CO₂ and 0.0585 H₂O. C=68.3; H=6.4.

0.2327 „ 7.2 c.c. N₂ at 15° and 752 mm. N=3.6.

C₂₂H₂₅O₅N requires C=68.9; H=6.5; N=3.6 per cent.

The conversion of *epimethylcryptopine, B*, into the modification, *A*, was brought about, as in the corresponding conversion of *epicryptopine, B*, into *A* (p. 1012), by boiling with dilute hydrochloric acid.

The ochreous resin was dissolved in dilute hydrochloric acid (1 in 10) and heated on the steam-bath, when the viscid precipitate which first formed soon became chalky and very sparingly soluble. This hydrochloride was collected, washed until quite free from the pink mother liquor, dissolved in much water, and mixed with excess of ammonia, when a viscid precipitate separated which, on cooling and

stirring, became brittle. This was dried and ground with ether until the unchanged *B*, had dissolved and left a colourless, chalky powder which melted at 218° and, after recrystallisation, at $219\text{--}221^{\circ}$ and consisted of *epimethylcryptopine*, *A*.

The ethereal mother liquor yielded, on evaporation, a resin which, on again heating with dilute hydrochloric acid, gave a further small quantity of the hydrochloride of *epimethylcryptopine*, *A*. *epiMethylcryptopine*, *B*, dissolves readily in phosphoryl chloride to a deep reddish-brown solution and, on heating at 60° , the colour becomes intense brownish-violet. The whole was gently boiled for fifteen minutes, the excess of phosphoryl chloride distilled off under diminished pressure, when water precipitated a dark brown tar and there was no sign of the formation of a crystalline, scarlet salt.

isoepiMethylcryptopine.—The product of the action of hydrochloric acid on methylcryptopine (γ) is a sparingly soluble hydrochloride and a deep permanganate-coloured solution and, after filtering from the precipitate (compare p. 1019), the filtrate was rendered alkaline with ammonia, when an ochreous, gelatinous precipitate separated which, on warming, became granular and could be filtered. After washing and drying on porous porcelain, the mass was shaken with much ether, filtered from the considerable slimy residue, the ethereal extract dried over potassium carbonate, concentrated, and left in the ice-chest for several days, but nothing separated.

On evaporating the ethereal solution to dryness an orange resin remained which could be dried in the steam-oven without melting. This substance, which amounts to at least 70 per cent. of the product of the action of hydrochloric acid on methylcryptopine (γ), was dissolved in ether and precipitated by light petroleum into four fractions, of which the second and third gave the following analytical results:

II. 0.1227 gave 0.3130 CO_2 and 0.0720 H_2O . $\text{C}=69.5$; $\text{H}=6.5$.

III. 0.0989 „ 0.2521 CO_2 „ 0.0575 H_2O . $\text{C}=69.5$; $\text{H}=6.4$.

III. 0.3872 „ 12.7 c.c. N_2 at 739 mm. and 18° . $\text{N}=3.7$.

$\text{C}_{22}\text{H}_{25}\text{O}_5\text{N}$ requires $\text{C}=68.9$; $\text{H}=6.5$; $\text{N}=3.6$ per cent.

This substance, which has been provisionally named '*isoepi-methyl-cryptopine*,' dissolves in dilute mineral acids, yielding very readily soluble salts, the solutions of which are intensely permanganate-coloured.

The hydrochloride gives, with potassium iodide, a violet, gelatinous precipitate which is soluble in boiling water and separates as an apparently crystalline precipitate. The *platinichloride* is obtained as a purple, gelatinous precipitate when platinic chloride is added to the cold solution of the hydrochloride, and becomes chalky on warming. The dry salt is plum-coloured:

0.1991 gave 0.0333 Pt. Pt = 16.7.

$(C_{22}H_{25}O_5N)_2 \cdot H_2PtCl_6$ requires Pt = 16.6 per cent.

A formula, which it is suggested may represent the constitution of *isoe*pimethylcryptopine, is given on p. 871.