CX.—*Strychnine and Brucine. Part X. The Degradation of Dinitrostrycholcarboxylic Acid: its Recognition as a Derivative of Quinoline and the Consequent Modifications of the Constitutional Formulæ for the Strychnos Bases proposed in Part VII.*

By KOTTIAZATH NARAYANA MENON, (the late) WILLIAM HENRY PERKIN, jun., and ROBERT ROBINSON.

UNEXPECTEDLY, the esterification of dinitrostrycholcarboxylic acid (Tafel, *Annalen*, 1898, **301**, 336; compare Part IX, this vol., p. 382) with ethyl alcohol and a mineral acid catalyst affected two hydroxyl groups and afforded *ethyl dinitro-*O*-ethylstrycholcarboxylate*, $C_9NH_2(NO_2)_2(OH)(OEt)\cdot CO_2Et$ (I). This ester reacted with hydrazine in the normal manner, yielding the *hydrazide*, $C_9NH_2(NO_2)_2(OH)(OEt)\cdot CO\cdot NH\cdot NH_2$ (II), and the further stages of the Curtius reactions also gave good results, the *urethane*, $C_9NH_2(NO_2)_2(OH)(OEt)\cdot NH\cdot CO_2Et$ (III), being the final product.

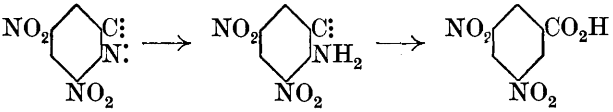
It will be recalled that dinitrostrycholcarboxylic acid cannot be degraded by boiling with nitric acid; this urethane, however, in which $\cdot NH\cdot CO_2Et$ replaces $\cdot CO_2H$, is readily attacked by the reagent and yields picric acid.

This result is inconsistent with the suggestion that strychol is a dihydroxy*iso*quinoline, because derivatives of this series would undoubtedly yield trinitro-*m*-hydroxybenzoic acid and not picric acid.

We have examined the behaviour of *m*-hydroxybenzaldehyde and *m*-hydroxybenzoic acid with boiling nitric acid, and no trace of picric acid could be detected by the sensitive potassium salt method of isolation.

Further, if strychol is thus to be recognised as a dihydroxyquinoline, the formation of picric acid proves that both hydroxyl groups are in the pyridine nucleus, in view of the fact established in Part IX (*loc. cit.*) that the quinoline nitrogen always furnishes a hydroxyl group in the oxidation–nitration process.

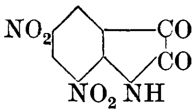
Furthermore, Mr. J. Resuggan, to whom we are greatly indebted for undertaking the preparation of large quantities of dinitrostrycholcarboxylic acid, has isolated a by-product of the oxidation of strychnine with nitric acid. This we have identified as 3 : 5-dinitrobenzoic acid, and its formation is evidently due to elimination of an amino-group in accordance with the scheme :



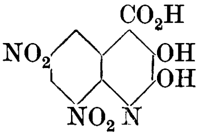
An analogous reaction is that involved in the production of nitroanisic acid from harmaline by oxidation with nitric acid (O. Fischer and Boesler, *Ber.*, 1912, **45**, 1934) :

Confirmation was obtained in the transformation of the urethane (III) into 5 : 7-*dinitroisatin* (IV), which was accomplished by hydrolysis with sulphuric acid and subsequent oxidation by permanganate in acid solution. This dinitroisatin does not appear to have been previously prepared and has been obtained in good yield by the nitration of isatin in sulphuric acid solution.

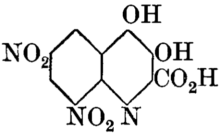
In Part IX, it was clearly proved that strychol is not 2 : 4-dihydroxyquinoline, and therefore dinitrostrycholcarboxylic acid must be represented by one of the formulæ V and VI (or a pyridone tautomeride). Either of these structures serves to accommodate



(IV.)



(V.)



(VI.)

the fact established by Tafel that dinitrostrychol behaves as a monobasic acid towards potash but as a dibasic acid towards baryta.

Having found that dinitrostrycholcarboxylic acid yielded a diethyl ester, we were led to attempt the direct esterification of dinitrostrychol, and, using methyl alcohol, we obtained with greater ease than formerly the known dinitrostrychol monomethyl ether, $C_9NH_3(NO_2)_2(OH)\cdot OMe$. This substance reacts with hydrazine in boiling methyl-alcoholic solution with formation of *dinitrohydrazinodeoxystrychol*, $C_9NH_3(NO_2)_2(OH)\cdot NH\cdot NH_2$ (VII), a base which forms very sparingly soluble salts and a sparingly soluble, pale yellow iso*propylidene* derivative, $C_9NH_3(NO_2)_2(OH)\cdot N_2H{:}CMe_2$. Unfortunately, the oxidation of this hydrazine with ferric chloride regenerates dinitrostrychol: other conditions, however, are in course of investigation. We are of the opinion that the acidic hydroxyl of dinitrostrychol is that in position 3, but we have not yet been able to get decisive experimental evidence on the point. Synthetical work in the 2 : 3- and 3 : 4-dihydroxyquinoline groups is in progress.

Irrespective of the outcome of these further researches, certain conclusions in regard to the constitutions of strychnine and brucine now appear to be fully justified.

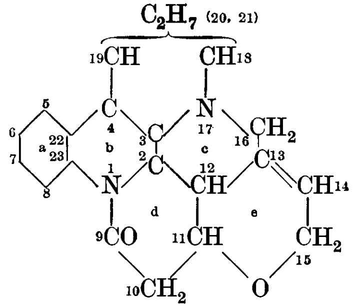
The *iso*quinoline structure (Fawcett, Perkin, and Robinson, Part VII, J., 1928, 3082) was advanced mainly in order to illustrate a mode of symbolisation of the reactions of strychnine which had been developed since 1912; especially, it was desired to emphasise the ether nature of the bases, the possession of one ethylenic double bond, and a theory (*loc. cit.*, p. 3086) of the course of the degradations to strychninolone and curbine brought to light by Leuchs and his collaborators (for references, see Part VII, *loc. cit.*, p. 3085). It is unfortunate that these ideas, which we consider to be fundamentally sound, were linked with a view of the nature of dinitrostrycholcarboxylic acid, the inherent improbability of which was almost immediately disclosed by the investigations of Leuchs and of Wieland on the products obtained by breaking down the aromatic nucleus of the alkaloids.

The new conception which we now bring into the discussion is that the hydroxyl in position 3 in the quinoline ring of dinitrostrycholcarboxylic acid marks the position of the b-N of strychnine; it appears to us that this hypothesis is the only one that can explain the appearance of the hydroxyl in this position.

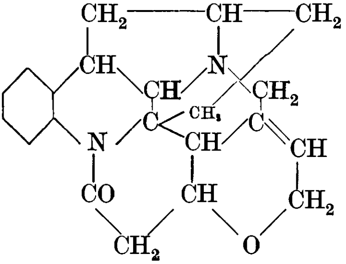
In this connexion, we have prepared 6 : 8-dinitrohydrocarbostyril, and have not yet succeeded in attempts to oxidise this substance in position 3 either by means of nitric acid or in other ways.

Embodying, now, the views advanced in Part VII, apart from those connected with dinitrostrycholcarboxylic acid, we find that strychnine must be represented by the expression (VIII).

All the many possibilities based on (VIII) must have a bridged ring, shown in one plausible example (IX); the conceivable variations are obvious.



(VIII.)



(IX.)

The new structure (VIII) has many advantages over earlier suggestions, and can be justified experimentally in every detail; the main points are the following :—

(1) The quinoline skeleton with b-N at 17, as already explained, gives naturally dinitrostrycholcarboxylic acid (V or VI).

(2) The N–CO group cannot be at 1, 2, because it must be expanded to $-N\cdot CO\cdot CH_2-$ in view of the formation of benzylidene-strychnine (Part VIII, J., 1929, 967).

(3) The properties of strychnidine and most clearly of the dihydrostrychnidines (A) and (B) prove that the second oxygen atom of the bases has ether function. The attachment of the ether oxygen atom at 11 has already been discussed (Part VIII, *loc. cit.*).

(4) The new formula allows the permanganate oxidation of strychnine (Leuchs) to proceed entirely in one section of the molecule: the $:N-CH_2-\underset{|}{C}:CH\cdot CH_2\cdot O-$ becomes $:N\cdot CO\cdot \underset{|}{C}(OH)\cdot CO\cdot CH_2\cdot O-$, and this, being an amide of a β-ketonic acid, can yield

$$:N\cdot CO\cdot \underset{|}{C}H(OH)\ CO_2H\cdot CH_2\cdot O-$$

by hydrolysis. The position chosen for b-N thus gives an excellent explanation of the formation of dihydrostrychninonic acid (and of dihydrobrucinonic acid), which is a difficulty for other formulations. Further oxidation gives strychninonic acid, $:N\cdot CO\cdot \underset{|}{C}O\ CO_2H\cdot CH_2\cdot O-$.

(5) Leuchs has recently examined many strychnine (brucine) derivatives in which nucleus (a) has been broken down; almost all of these substances absorb two oxygen atoms on oxidation with bromine and water, a third oxygen atom being taken up on treatment of the product with mercuric oxide. These changes are clearly represented by the scheme :

$$:C{=}CH- \longrightarrow :CO\ CHO- \longrightarrow :CO\ CO_2H-$$

The double bond at 13, 14 is affected in every case. This gives important support to the view that strychnine contains the group figured at 13, 14 and, indirectly, to our theory of the course of the permanganate oxidation.

(6) The hydrogen atom at C_{12} is requisite for the transference of the double bond in the strychninolone series from 11—10 to 11—12.

(7) Some considerations respecting the reduced strychnine derivatives will be discussed in a later communication.

For the above and other reasons, we consider that the structure (VIII) is almost certainly correct; it can with some show of probability be concluded that C_4 bears a hydrogen atom and that C_{20} is attached to C_2; analogy with quinine then allows us provisionally to adopt (IX) as a working hypothesis.

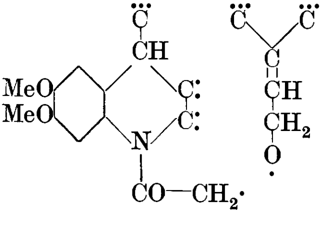
The attachment of a hydrogen atom to C_4 seems to be required in order to explain the nature and formation of a base $C_{17}H_{20}O_3N_2Br_2$ which H. Leuchs, Mildbrand, and R. Leuchs (*Ber.*, 1922, **55**, 2703) obtained along with Hanssen's acid, $C_{19}H_{22}O_6N_2$, by treating cacotheline (nitrate of nitrobruciquinone hydrate) with bromine (Hanssen, *Ber.*, 1887, **20**, 452; Ciusa and Scagliarini, *Roy. Accad. Lincei*, 1910, **19**, 504). On treatment with baryta, the bromo-compound yields a base, $C_{17}H_{22}O_5N_2$ (Leuchs, *Ber.*, 1929, **62**, 1929), which can be oxidised by means of chromic acid, yielding Wieland's acid, $C_{17}H_{22}O_6N_2$, also obtainable by the direct oxidation of brucine (Wieland and Münster, *Annalen*, 1929, **469**, 216) or mono-amino- or diamino-strychnine (Leuchs and Kröhnke, *Ber.*, 1929, **62**, 2176) or strychnine (Cortese, *Annalen*, 1929, **476**, 280) by means of chromic acid.

Wieland's acid appears to be a dibasic keto-acid in which the amide group is hydrolysed, and the following partial formulæ will serve best to illustrate the manner in which we envisage these complex relationships: Brucine (X) (compare Part III, J., 1925, **127**, 1158), cacotheline (XI), Hanssen's acid (XII), $C_{17}H_{20}O_3N_2Br_2$ (XIII), $C_{17}H_{22}O_5N_2$ (XIV), Wieland's acid, $C_{17}H_{22}O_6N_2$ (XV), $C_{17}H_{20}O_7N_2$ by the action of bromine on XV (XVI) (Leuchs and Hoffmann, *Ber.*, 1929, **62**, 2307), $C_{17}H_{20}O_8N_2$ by the action of mercuric oxide on XVI (XVII) (Leuchs and Hoffmann, *Ber.*, 1930, **63**, 440).

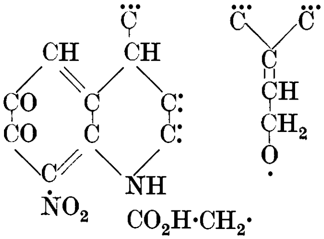
Even the substance (XIV), which is considered to contain an aldehyde group immobilised by internal condensation with an ·NH·CO· group, can be oxidised at the double bond in the usual way, yielding successively $C_{17}H_{22}O_7N_2$ and $C_{17}H_{22}O_8N_2$ (Leuchs, *Ber.*, 1929, **62**, 1935).

The compound $C_{17}H_{20}O_8N_2$ (XVII) can also be obtained from Hanssen's acid (XII), for example, by conversion by means of bromine into $C_{19}H_{22}O_8N_2$, then by mercuric oxide into $C_{19}H_{22}O_9N_2$

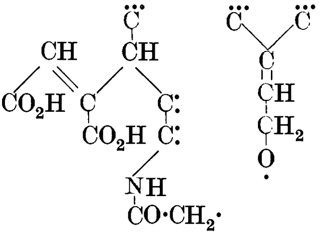
and finally by permanganate into $C_{17}H_{20}O_8N_2$ and oxalic acid; or $C_{19}H_{22}O_8N_2$ can be directly oxidised by permanganate (Leuchs, *Ber.*, 1925, **58**, 1730; Leuchs, Bender, and Wegener, *Ber.*, 1928, **61**, 2353; Leuchs and Hoffmann, *Ber.*, 1929, **62**, 1253; 1930, **63**, 440). The interpretation of these changes along the lines already laid down offers no difficulties. Another important series of substances is



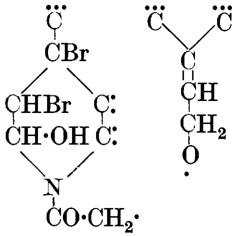
(X.)



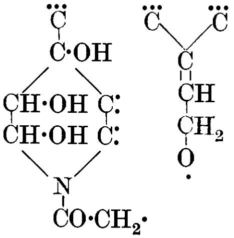
(XI.)



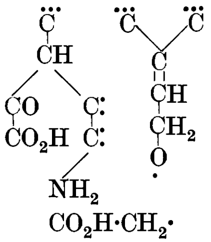
(XII.)



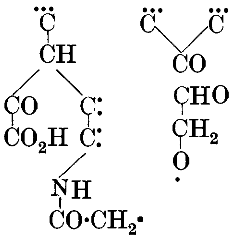
(XIII.)



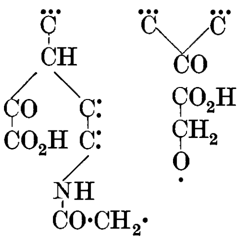
(XIV.)



(XV.)

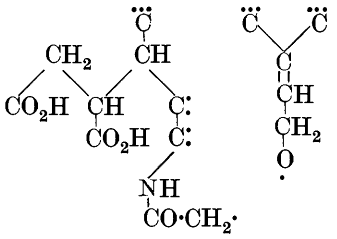


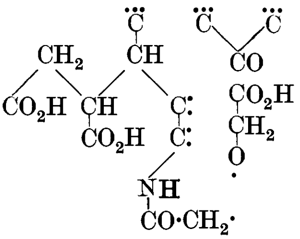
(XVI.)



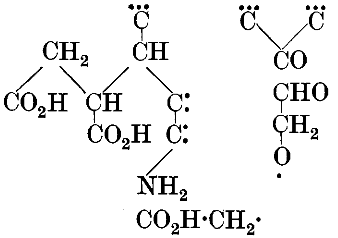
(XVII.)

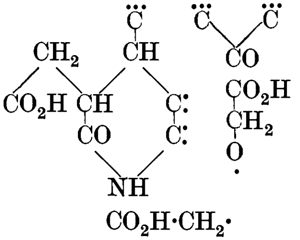
obtained by reducing Hanssen's acid (XII) to $C_{19}H_{24}O_6N_2$ (XVIII) by means of sodium amalgam (Leuchs, *Ber.*, 1929, **62**, 1929).


(XVIII.)


(XIX.)

Permanganate changes the reduced Hanssen's acid to $C_{19}H_{24}O_9N_2$ (XIX) (Leuchs and Kröhnke, *Ber.*, 1929, **62**, 2599), and it is very interesting that an isomeride has been obtained from (XVIII) by using bromine and then either mercuric oxide or permanganate. The explanation seems to be that the amide ring opens and closes again in a new position; the intermediate is then $C_{19}H_{26}O_9N_2$ (XX) and the isomeric $C_{19}H_{24}O_9N_2$ would be (XXI) (Leuchs, Mildbrand, and Leuchs, *Ber.*, 1922, **55**, 2412; Leuchs and Kröhnke, *Ber.*, 1929, **62**, 2599).


(XX.)


(XXI.)

Again, the Hanssen C_{16}-acid, $C_{16}H_{20}O_4N_2$, which Wieland and Münster (*loc. cit.*) obtained along with the Wieland acid by the oxidation of brucine with chromic acid also takes up two oxygen atoms on oxidation with bromine and a third on subsequent treatment with mercuric oxide (Leuchs and Hoffmann, *Ber.*, 1930, **63**, 446).

On the basis of these formulæ, we are able to predict that the substances (XVII), (XIX), (XXI) and the acid $C_{16}H_{20}O_7N_2$ from the Hanssen C_{16}-acid should contain a $-CH_2{\cdot}CO_2H$ fragment detachable in the form of glycollic acid or a derivative under the appropriate conditions.

The above formulæ require in some cases that the molecule should contain more carbonyl groups than have been experimentally recognised, but this is not unusual and in our experience strychnidone

(Clemo, Perkin, and Robinson, J., 1927, 1589) gave a disemicarbazone, but the analogous brucidone (Gulland, Perkin, and Robinson, *ibid.*, p. 1627) gave only a monosemicarbazone. Similar remarks apply to the number of carboxyl groups, but, broadly, the agreement between theory and experiment is remarkable.

Returning to a consideration of (VIII), the attachment of one of the carbons of the bridge ring to carbon at position 2 seems reasonable in view of the stability of Wieland's acid (XV) to chromic acid, and because there are reasons for attributing blocked hydroaromatic character to both ring B and ring D and (2) is the common position. It is hoped that experimental evidence bearing on this aspect of the problem will shortly be submitted to the Society.

The provisional formula (IX) contains the whole of the cinchonine skeleton of carbon and nitrogen atoms and, of course, two carbon atoms more. This is probably going too far in the search for analogies, but there is evidently some underlying relation between the two alkaloids.

It must be clearly stated that the formulæ (XI—XXI) given above are based on relations established by Leuchs in a series of brilliant investigations. For example, he has described in words the precise connexion between Hanssen's acid and Wieland's acid which is illustrated in our formulæ. It has, however, never been previously suggested that the whole series can be correlated by means of definite constitutional formulæ, and, having developed expressions for the alkaloids, it was necessary for us to show that such correlation is feasible.

EXPERIMENTAL.

*Ethyl Dinitro-*O*-ethylstrycholcarboxylate* (I).—Dinitrostrycholcarboxylic acid was refluxed for 7 hours with a large excess of 5% alcoholic sulphuric acid, and the product collected after the addition of water. It was washed with aqueous sodium carbonate and then with water, and crystallised from alcohol in almost colourless, soft needles, m. p. 111—112° (Found: C, 48·0; H, 3·9; EtO, 25·5. $C_{14}H_{13}O_8N_3$ requires C, 47·9; H, 3·7; 2EtO, 25·6%). The *ester* is insoluble in aqueous sodium carbonate; on heating with aqueous sodium sulphite, yellow, orange and blood-red solutions are successively obtained.

O-*Ethyldinitrostrycholcarbohydrazide* (II).—Ethyl *O*-ethyldinitrostrycholcarboxylate (1 g.) was dissolved in the minimum quantity of boiling alcohol, and 95% hydrazine hydrate (1·6 g.) added; a yellow solid separated within a few minutes from the deep red solution and, after heating on the steam-bath for 15 minutes, the product was collected and thoroughly washed with alcohol (yield, 1·0 g.). The *hydrazide* crystallised from alcohol in pale yellow, woolly needles, m. p. 218—219° (decomp.) (Found: C, 43·1; H, 3·4; N, 20·5. $C_{12}H_{11}O_7N_5$ requires C, 42·7; H, 3·3; N, 20·8%). This derivative is moderately readily soluble in alcohol; addition of water to its solution in acetic acid gives a precipitate of the free base. The hydrochloride is sparingly soluble in dilute hydrochloric acid, but dissolves on heating, and addition of acetone causes a rapid separation of the *iso*propylidene derivative in colourless needles. The hydrazide is insoluble in aqueous sodium carbonate.

Dinitrostrychylurethane (III).—*O*-Ethyldinitrostrycholcarbohydrazide (0·5 g.) was dissolved in acetic acid (60 c.c.), and powdered sodium nitrite (0·5 g.) added to the cooled solution; shortly afterwards, the whole was poured into water (250 c.c.) and the precipitated azide was collected and dried in a vacuum. This substance melted with decomposition at 110° and dissolved slowly in aqueous sodium carbonate, doubtless as the result of hydrolysis.

The azide was added to excess of alcohol, and the mixture boiled until evolution of nitrogen ceased. The product crystallised from acetic acid in clusters of yellow needles, m. p. 199—200° (yield, 2·1 g. of the pure substance from 4 g. of the hydrazide) (Found: C, 45·9; H, 3·9; N, 15·7. $C_{14}H_{14}O_8N_4$ requires C, 45·8; H, 3·8; N, 15·3%). This *urethane* is sparingly soluble in most organic solvents and is insoluble in aqueous sodium carbonate. It is unaffected by bromine in boiling acetic acid solution. Dilute aqueous sodium hydroxide causes the crystals to become orange and, on heating, an orange solution is obtained from which hydrochloric acid precipitates an orange-brown substance.

Degradation of dinitrostrychylurethane. (A) Nitric acid (40 c.c., *d* 1·42) was heated to about 60° and the urethane (1 g.) added; the mixture was then gently heated until a vigorous reaction set in, accompanied by evolution of nitrous fumes. When this ceased, the solution was boiled and concentrated to a small bulk. The picric acid formed was isolated as its sodium salt, regenerated, and identified after crystallisation by its properties and by its m. p. and mixed m. p. 122°.

(B) The urethane (1 g.) was dissolved in concentrated sulphuric acid (25 c.c.), and the yellow solution heated over a free flame until a rapid evolution of gas occurred and slackened. The yellow colour disappeared simultaneously and a dull purplish-brown colour replaced it. Water was then added drop by drop to the hot solution until the liquid was diluted to 200 c.c. *N*/10-Potassium permanganate was rapidly added to the hot solution until an excess appeared, and then a further volume (100 c.c.) was added and the mixture heated until the oxidising agent was reduced. The solution was filtered from an insoluble orange-brown substance, cooled, and thoroughly extracted with ether.

The extract was dried with sodium sulphate and the solvent removed, leaving a yellow residue which crystallised from pure benzene and then from acetic acid in bright yellow plates, m. p. 209—210°, and at the same temperature when mixed with 5 : 7-dinitroisatin prepared by the method described below. The characteristic properties of the dinitroisatin were all exhibited by this specimen.

By means of the sodium sulphite and indophenine colour reactions, the formation of dinitroisatin from dinitrostrychol derivatives by many different methods was indicated. For example, it is produced by the direct oxidation of dinitrostrychol, but the yield in this case is very unsatisfactory.

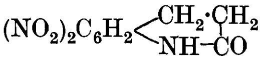
If the dilute sulphuric acid solution obtained by the hydrolysis of the urethane is neutralised with ammonia, an orange base is precipitated, and this can be redissolved in dilute hydrochloric acid to a yellow solution. Addition of nitrite slightly intensifies the colour, and the diazonium salt produced couples with β-naphthol to give a crimson azo-compound. It is very remarkable that this base can itself be coupled with diazo-salts to give quite intensely coloured substances, the nature of which is obscure. For example, *p*-nitrobenzenediazonium acetate yields a brick-red substance which behaves like an azo-compound. The anomaly arises from the circumstance that, according to our views, there is no free position in the nucleus containing the amino-group. Addition of a little nitrite to a weakly acid solution of the amine produces a violet precipitate which is due to the diazotisation of a part of the base and coupling with the remainder; this can be proved by separating the reactions. Oxidation of acid solutions of the amine from the urethane by ferric chloride and other mild reagents gives quantitatively a reddish-brown, sparingly soluble substance, apparently of indigoid or indirubinoid nature.

5 : 7-*Dinitroisatin* (IV).—A solution of isatin (5 g.) in sulphuric acid (50 c.c.) was cooled to 0°, and potassium nitrate (10 g., yield poor; 25 g., yield 56%; 50 g., yield almost quantitative) added in small portions so that the temperature did not rise above 15°. The mixture was then heated at 50—55°, until a sample diluted with water gave no precipitate (about 3 hours), cooled, and poured on ice. The solution was extracted five times with ether (200 c.c. on each occasion), the combined extracts were washed free of mineral acid by means of aqueous sodium bicarbonate and dried by means of magnesium sulphate, and the ether was distilled, leaving a yellow solid residue. This substance is sparingly soluble in benzene and

crystallises therefrom in yellow prisms, or from acetic acid in bright canary-yellow, microscopic plates, m. p. 209—210° (Found : C, 40·7; H, 1·4; N, 17·7. $C_8H_3O_6N_3$ requires C, 40·5; H, 1·3; N, 17·7%). This isatin *derivative* exhibits a very strong indophenine reaction and, when treated with aqueous sodium sulphite, it develops a characteristic, stable, bluish-red coloration.

It dissolved in aqueous sodium carbonate to an orange solution, the colour of which quickly faded and a colourless crystalline sodium salt separated. On boiling with aqueous sodium hydroxide, ammonia was evolved and the solution doubtless then contained a dinitrohydroxyphenylglyoxylate. Dinitroisatin (0·5 g.) was boiled with nitric acid (25 c.c., *d* 1·42), and the liquid concentrated to a small bulk : picric acid, m. p. 122°, undepressed by admixture with an authentic specimen, was isolated from the product.

6 : 8-*Dinitrohydrocarbostyril*,



$(NO_2)_2C_6H_2<\begin{matrix}CH_2\cdot CH_2\\ NH - CO\end{matrix}$.—A mixture of *o*-nitrobenzaldehyde (10 g.), malonic acid (15 g.), pyridine (100 c.c.), and piperidine (2 c.c.) was heated on the steam-bath for 30 minutes and then boiled for 30 minutes. On the addition of water and hydrochloric acid, pure *o*-nitrocinnamic acid was precipitated in almost theoretical yield.

The process of Friedländer and Weinberg (*Ber.*, 1882, **15**, 1423) for the preparation of hydrocarbostyril from ethyl *o*-nitrocinnamate works equally well with the acid, and hydrocarbostyril is readily accessible in this way.

The nitration (of 1 mol.) was accomplished by adding sodium nitrate (5 mols.) to a solution in sulphuric acid, and completing the reaction by heating on the steam-bath. The substance crystallised from acetic acid in stout colourless needles, m. p. 175° (Found : C, 45·7; H, 3·1; N, 17·6. Calc. for $C_9H_7O_5N_3$: C, 45·6; H, 2·9; N, 17·7%).

The dinitrohydrocarbostyril, m. p. 177°, obtained by van Dorp (*Rec. trav. chim.*, 1904, **23**, 304) by the action of boiling dilute hydrochloric acid on a β-(dinitroaminophenyl)propionic acid is doubtless identical with our compound; van Dorp records that the m. p. was about 165°, raised to 177° by many recrystallisations.

Aqueous sodium carbonate does not dissolve this substance, but the solution in aqueous sodium hydroxide is yellow and, on boiling, ammonia is evolved; the orange-yellow solution must then contain dinitrohydroxyphenylpropionic acid.

Boiling with nitric acid did not change this very stable substance, and it was also unaffected by bromine in hot acetic acid solution. The demeanour of dinitrohydrocarbostyril towards alkalis suggests that the acidic hydroxyl of dinitrostrychol is that in the β-position.

O-*Methyldinitrostrychol.*—This monomethyl ether has been obtained by the variation of Tafel's procedure (*Annalen*, 1898, **301**, 345) described in Part IX (*loc. cit.*), and also in good yield by methylation with methyl sulphate and potassium hydroxide in methyl-alcoholic solution, but the most convenient method is by direct esterification with boiling 8% methyl-alcoholic sulphuric acid, the yield being quantitative. The derivative crystallised from the hot solution, and, after recrystallisation from xylene, had m. p. 195—196°.

Attempts to prepare a dimethyldinitrostrychol have been fruitless.

Dinitrohydrazinodeoxystrychol (VII).—Hydrazine hydrate (20 c.c. of 95%) was added to a suspension of *O*-methyldinitrostrychol (5 g.) in boiling methyl alcohol (250 c.c.). The methyl ether rapidly passed into the orange solution, but, before this process was completed, a new substance separated in voluminous yellow needles. The mixture was boiled for 10 minutes and filtered hot; the yellow crystalline residue (2·9 g.) had m. p. 202—204° (decomp.) (Found in material dried at 120° in a vacuum over phosphoric oxide: C, 41·1; H, 2·7; N, 21·3; MeO, 9·5%). This substance is a base exhibiting the reactions of a hydrazine, but the analyses, which have been confirmed, do not fit a simple formula.

The filtrate deposited a sandy, orange, crystalline powder (2·3 g.) which could be recrystallised by solution in warm acetic acid and addition of water; the pale yellow needles had m. p. 253° (decomp.) (Found in air-dried material from two different preparations: C, 38·5, 38·4; H, 3·1, 3·1; N, 25·0, 25·1; MeO, trace. $C_9H_7O_5N_5,H_2O$ requires C, 38·2; H, 3·2; N, 24·7%). This *hydrazine* is very sparingly soluble in most organic solvents; when covered with acetic acid, it gives a colourless acetate which dissolves on heating. The hydrochloride crystallises in colourless needles, and the sulphate, which is very sparingly soluble in dilute sulphuric acid, crystallises in pearly leaflets. Solution in 2% hydrochloric acid occurred readily on gentle heating, and, on the addition of ferric chloride, a clear solution was obtained which soon clouded with evolution of nitrogen on boiling. The precipitate was collected, crystallised from acetic acid, and identified with dinitrostrychol by its properties and m. p. (284°), undepressed by admixture with a specimen prepared from dinitrostrycholcarboxylic acid. Similarly, dinitrostrychol was obtained by addition of *N*/10-potassium permanganate to a solution in 2% hydrochloric acid, although the amount of the reagent consumed was only about 30% in excess of the quantity required to supply one oxygen atom to one molecule of the base.

These experiments gave rise to the suspicion that the substance is the hydrazine salt of dinitrostrychol, although the behaviour towards acids was not in harmony with such a view and the preparation of anhydrous derivatives disproved it.

The *acetyl* derivative separated in flocculent colourless needles from a hot solution of the base in acetic acid, to which a few drops of acetic anhydride were added. The substance was very sparingly soluble and devoid of basic properties; it had m. p. 311—313° (decomp.) (Found in material dried at 100°: C, 42·9; H, 3·2; N, 22·7. $C_{11}H_9O_6N_5$ requires C, 43·0; H, 2·9; N, 22·8%). The iso*propylidene* derivative, $C_9NH_3(NO_2)_2(OH)\cdot NH\cdot N{:}CMe_2$, crystallised from a boiling solution of the base in acetone or when acetone was added to a hot solution in dilute hydrochloric acid: recrystallised from much acetone, it formed slender, very pale yellow, microscopic needles, m. p. 279—281° (decomp.) (Found in material dried at 100°: C, 47·3; H, 3·5; N, 22·8. $C_{12}H_{11}O_5N_5$ requires C, 47·2; H, 3·6; N, 23·0%). This very sparingly soluble derivative is insoluble in boiling dilute hydrochloric acid, but, when suspended in boiling acetone, it dissolves immediately on the addition of a drop of concentrated hydrochloric acid.

Isolation of 3 : 5-*Dinitrobenzoic Acid from the Products of the Oxidation of Strychnine by Means of Nitric Acid.*—Strychnine (100 g.) was dissolved in 20% nitric acid (4000 c.c.) and heated on the steam-bath for 120 hours, the volume being maintained by addition of 20% nitric acid as found necessary. The liquid was then concentrated to about 200 c.c., cooled, and kept for 36 hours. The solid was collected and washed with nitric acid; it then afforded, after boiling with nitric acid (75 c.c., *d* 1·42), about 10 g. of dinitrostrycholcarboxylic acid of m. p. 295—300°. The filtrate was added to water (1500 c.c.); a red gum was then deposited and a yellow solid remained in suspension. This was extracted with ether: the residue obtained from the washed and dried extract was an orange gum (about 10 g.), which was carefully heated on the steam-bath with nitric acid (90 c.c., *d* 1·42) and water (60 c.c.). The cooled solution deposited some picric acid, the filtrate from which was concentrated to half its volume; the glistening plates which then separated were recrystallised from alcohol. This product (3—4 g.) was analysed and, although the results showed it to be a mixture, a clue to its nature was obtained. A wasteful crystallisation from ethyl acetate gave the pure substance in colourless needles, m. p. 204°, alone or mixed with a specimen of 3 : 5-dinitrobenzoic acid.

Addition of aqueous sodium hydroxide to a solution of this acid in acetone produces an intense pure blue coloration, which becomes reddish-violet on the addition of water.

The authors wish to thank Mr. F. Hall for assistance in connexion with the analyses.

THE UNIVERSITY OF OXFORD.
UNIVERSITY COLLEGE, LONDON.

[*Received, March 7th,* 1930.]