CXLII.—10-*Chloro*-5 : 10-*dihydrophenarsazine and its Derivatives. Part XII. Further Experiments in the Investigation of the* 1- *and* 3- *Methyl Derivatives.*

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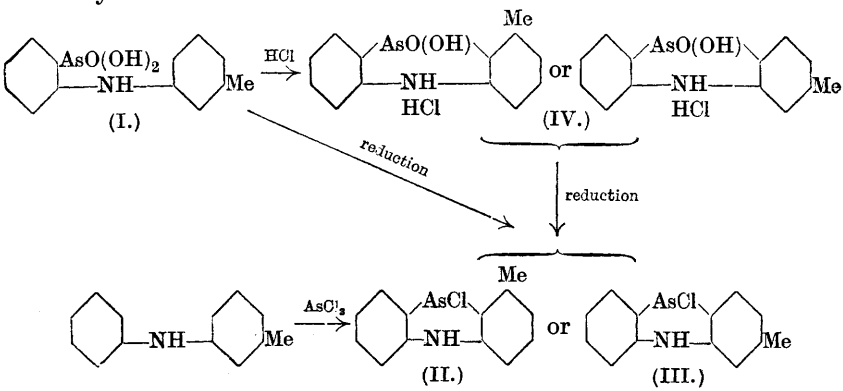
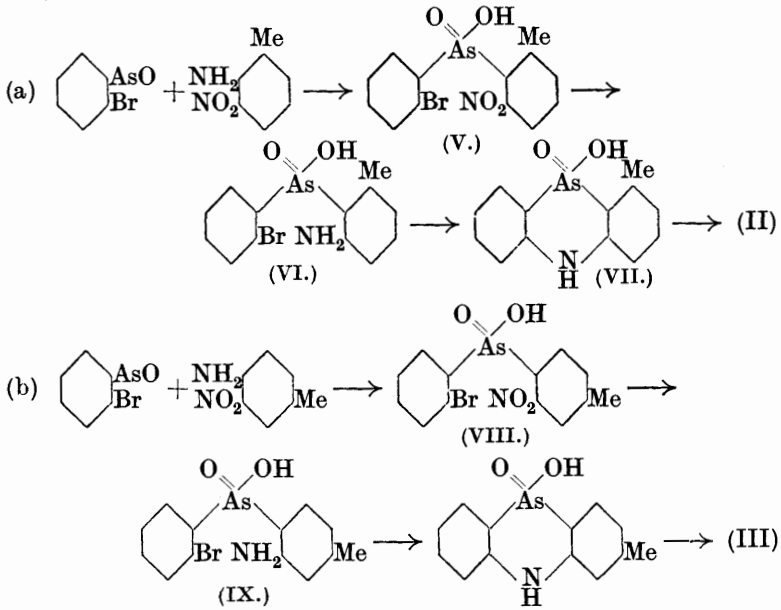
IT was shown in Part VII (J., 1929, 767) that an apparently homogeneous product, which can be either 10-chloro-1-methyl-5 : 10-dihydrophenarsazine (II) or 10-chloro-3-methyl-5 : 10-dihydrophenarsazine (III), can be obtained from 3-methyldiphenylamine-6′-arsinic acid (I) either by direct reduction or by conversion first into the homogeneous 1(or 3)-methylphenarsazinic acid hydrochloride (IV) and subsequent reduction of the latter compound. Further, in Part X (J., 1929, 1473), it was proved that the same compound (II) or (III) was the homogeneous condensation product of phenyl-*m*-tolylamine and arsenious chloride.



In order to determine the constitution of the cyclic reduction product obtained from compound (I), substances having the constitutions (II) and (III) were synthesised by methods which should leave no doubt as to their structural formulæ (Part VII, *loc. cit.*). The two substances thus synthesised were, however, indistinguishable and two explanations of this are possible: (1) the two substances may form solid solutions in each other, and (2) one of the rationally synthesised products may be transformed into the other by a rupture of the medial cyclic system, followed by cyclisation in the only other possible way (*loc. cit.*, p. 775).

The synthesis of substances (II) and (III) was attempted by the following series of reactions, which afford as little opportunity as possible of transformation of one into the other; the first stage in each case is analogous to that employed in the first synthesis of 10-chloro-5 : 10-dihydrophenarsazine (Burton and Gibson, J., 1926, 452):



The advantage of this method of synthesis appeared to be that the final cyclisation process did not involve the arsenic atom, and if the explanation (2, above) of the apparent or real identity of substances (II) and (III) is the rupture of the heterocyclic nucleus, followed by cyclisation in a different way—both of which processes involve the arsenic atom—there was a reasonable hope that the syntheses would be accomplished without intramolecular change.

The series of reactions (b) was readily accomplished, the intermediate substances, *2'-bromo-2-nitro-4-methyldiphenylarsinic acid* (VIII) and *2'-bromo-2-amino-4-methyldiphenylarsinic acid* (IX) being highly crystalline substances of undoubted purity. The 10-chloro-3-methyl-5 : 10-dihydrophenarsazine thus rationally synthesised was indistinguishable from either of the previously rationally synthesised products and from the homogeneous products obtained by the methods mentioned above.

Unfortunately, the proposed synthesis of 10-chloro-1-methyl-5 : 10-dihydrophenarsazine by the series of reactions (a) could not be accomplished. *2'-Bromo-2-nitro-6-methyldiphenylarsinic acid* (V) was prepared, but the reduction product could not be purified and an attempt to convert this crude material into (II) was unsuccessful.

Although the immediate object of this part of these investigations has not been accomplished, it may be that 10-chloro-3-methyl-5 : 10-dihydrophenarsazine has now been definitely synthesised. Before, however, the constitution of the 10-chloro-1(or 3)-methyl-5 : 10-dihydrophenarsazine obtained in the above-mentioned reactions can be definitely stated, 10-chloro-1-methyl-5 : 10-dihydrophenarsazine must be synthesised in an unequivocal manner: the balance of evidence, however, appears to be in favour of its being the 3-methyl compound.

The present work indicates that possibly false conclusions may be drawn as to the constitution of the product of a reaction which may give rise to one of two substances when this proves to be identical with one synthesised product and is not compared with the other synthesised isomeric substance. This problem is being investigated in different directions.

EXPERIMENTAL.

o-Bromophenylarsenious oxide is most conveniently prepared by passing carbon dioxide into a solution of pure *o*-bromophenyldichloroarsine (Burton and Gibson, J., 1926, 457; Kalb, *Annalen*, 1921, **423**, 39) in dilute aqueous sodium hydroxide, warmed if necessary. The colourless oxide is filtered off, washed with water, and dried over potassium hydroxide under reduced pressure; it is thus obtained as a fine colourless powder readily soluble in alkali hydroxide solutions.

2'-Bromo-2-nitro-4-methyldiphenylarsinic Acid (VIII).—Finely powdered and sieved 3-nitro-*p*-toluidine (7·6 g.) in hydrochloric acid (40 c.c.) and water (125 c.c.) was diazotised with sodium nitrite (3·8 g.) in water (9 c.c.) below 0°. A solution of *o*-bromophenylarsenious oxide (13·6 g.) in 5*N*-sodium hydroxide (87 c.c.) and water (163 c.c.) to which had been added ammoniacal cupric sulphate

(10% cupric sulphate solution treated with excess of ammonia; 5 c.c.) was then treated slowly at 20° with the diazo-solution without external cooling, the mixture being mechanically stirred. After one hour, the liquid was heated to boiling, treated with decolorising charcoal, and filtered. The filtrate was saturated with carbon dioxide to precipitate unchanged *o*-bromophenylarsenious oxide and, after filtration, carefully acidified with concentrated hydrochloric acid. The amorphous yellow acid which was precipitated could not be crystallised directly and was converted into its sodium salt by dissolving it in warm 20% aqueous sodium hydroxide and cooling the solution. The buff-yellow sodium salt was filtered off, washed with 20% aqueous sodium hydroxide and dissolved in water, and the solution acidified with hydrochloric acid. The almost colourless *acid* was recrystallised from slightly diluted acetic acid (charcoal) and obtained in colourless needles (4·33 g.), m. p. 252—254° (decomp. after slight softening) (Found : As, 19·2. $C_{13}H_{11}O_4NBrAs$ requires As, 18·7%). The ammonium salt crystallises from solution in concentrated aqueous ammonia in characteristic, colourless, rhomb-shaped plates.

2'-Bromo-2-amino-4-methyldiphenylarsinic Acid (IX).—A hot solution of the preceding acid (5·95 g.) in sodium hydroxide solution (1·5 g. in 30 c.c.) was added to a boiling suspension of ferrous hydroxide [ferrous sulphate crystals (25 g.), water (75 c.c.), and sodium hydroxide solution (25%, 30 c.c.)], and the mixture boiled for 15 minutes and filtered. The filtrate was carefully acidified with concentrated hydrochloric acid; the precipitated *acid*, recrystallised from slightly diluted acetic acid (charcoal), was obtained in colourless needles (3·9 g.), decomposing vigorously at 264—265° after previous darkening from about 240° (Found : As, 20·7. $C_{13}H_{13}O_2NBrAs$ requires As, 20·3%). This acid in contradistinction to the nitro-acid is soluble in cold concentrated hydrochloric acid.

Cyclisation of 2'-bromo-2-amino-4-methyldiphenylarsinic acid. A mixture of the preceding acid (3·08 g.), potassium carbonate (1·22 g.), amyl alcohol (22 c.c.), and a trace of copper powder was boiled for 15 hours, volatile substances then being removed by steam distillation, the aqueous solution filtered, and the filtrate acidified. The liquid filtered very slowly from the precipitated gelatinous discoloured acid. After being washed with water and dried as far as possible on the filter, the acid was dissolved in a mixture of alcohol and concentrated hydrochloric acid, to which a trace of iodine was added, and the solution was saturated with sulphur dioxide. The discoloured yellow solid was filtered off, dried over potassium hydroxide under reduced pressure, and crystallised from benzene (charcoal). After one crystallisation it had m. p. 215—216° after previous

softening from about 211°, and a further crystallisation gave 10-chloro-3-methyl-5 : 10-dihydrophenarsazine, m. p. 215—216·5°; the yield was small (Found: Cl, 12·3. Calc.: Cl, 12·2%).

2'-*Bromo*-2-*nitro*-6-*methyldiphenylarsinic Acid* (V).—This was prepared in a similar manner to that employed for the isomeric acid (VIII), 3-nitro-*o*-toluidine being used instead of 3-nitro-*p*-toluidine. The crude *acid* was purified by direct crystallisation from slightly diluted acetic acid, from which it separated in almost colourless, small plates. When recrystallised from the same medium, it was obtained in pale yellow plates, softening at 226°, darkening and finally decomposing at 237—239°; yield 29% (Found: As, 19·0. $C_{13}H_{11}O_4NBrAs$ requires As, 18·7%). The sodium salt separates from a solution of the acid in warm 20% aqueous sodium hydroxide in colourless small plates.

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