were rod-like in habit with a minimum index of refraction of 1.445, which may be considered as α for the acids. The other indices of refraction were found to be very high and not measurable by the liquids available."

Rotenic Acid.—Ten grams of rotenone was intimately mixed with 40 g. of powdered potassium hydroxide and heated in an oil-bath to 180–200°. When fusion was completed, the cooled mass was dissolved in water and the solution was acidified with dilute sulfuric acid. The precipitate was filtered off and dissolved in ether; the ether solution was dried over anhydrous sodium sulfate. The ether was removed and the residue was extracted with petroleum ether, from which the rotenic acid separated on cooling. It melted at 182°. A mixture of rotenic acid and isotubaic acid had a melting point of 185°. The optical data as determined by Mr. Keenan of the Food, Drug and Insecticide Administration were the same as for isotubaic acid.

Isotubaic Acid from Tubaic Acid.—One-tenth gram of tubaic acid was added to 5 cc. of 50% sulfuric acid, and the mixture was refluxed for one hour. After cooling, the solution was exactly neutralized with dilute sodium hydroxide and then extracted with ether. After removal of the ether, the acid was recrystallized from ether–petroleum ether. It gave the characteristic blue color of isotubaic acid in alcohol solution with ferric chloride.

Summary

Isotubaic acid was prepared from isorotenone and was found to be identical with rotenic acid.

The change which occurs when rotenone is converted into isorotenone involves the same groupings as when rotenic acid is formed from tubaic acid.

WASHINGTON, D. C.

[CONTRIBUTION FROM THE DEPARTMENT OF CHEMISTRY, SYRACUSE UNIVERSITY]

THE OXIDATION OF INOSITE WITH NITRIC ACID

BY OTTO GELORMINI AND NEAL E. ARTZ

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The object of this investigation was an attempt to clear up the apparently contradictory results obtained by different investigators in the oxidation of inosite with nitric acid. Maquenne[1] oxidized inosite with three to five times its weight of fuming or concentrated nitric acid in an open dish, on a water-bath. He obtained upon evaporating to dryness, a white residue which was washed with absolute alcohol to remove the trace of oxalic acid formed, and then taken up in water and evaporated on the water-bath. The solution immediately began to turn brown, and soon a brown precipitate which he believed to be tetrahydroxyquinone separated. A solution of the oxidized material when treated with barium chloride, gave barium rhodizonate, which he identified by its red color. When the oxidized material, in water solution, was treated with sodium carbonate, a greenish-black powder separated, which he reported as a mixture of the di-sodium salts of tetrahydroxyquinone and rhodizonic acid. By acidifying he again

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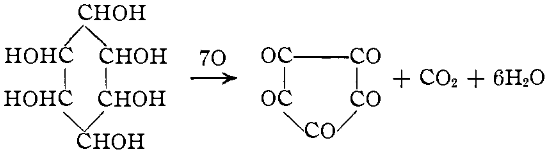
[1] Maquenne, *Compt. rend.*, **104**, 298 (1886).

obtained tetrahydroxyquinone, and on treatment with concentrated nitric acid, triquinoyl was formed. This last compound was isolated and analyzed. By warming a solution of triquinoyl in the presence of potassium hydroxide, crystals of the di-potassium salt of croconic acid were obtained.

Contardi[2] carried out the oxidation of inosite in essentially the same manner, using fuming nitric acid. However, he reported no oxalic acid, but obtained a white residue which remained white even after taking up in water and evaporating the solution to dryness. This material he claimed was pure leuconic acid. He crystallized the material from nitric acid and thereby obtained a white crystalline substance which analyzed to give the correct percentage composition for leuconic acid with five molecules of water of crystallization. The oxidized material was also treated with hydroxylamine, and a substance was obtained which was not crystalline, and which he was unable to purify because of its insolubility in all solvents except bases. This compound, when analyzed, gave the correct percentage of nitrogen to correspond with the penta-oxime of leuconic acid. On the basis of these results Contardi concluded that the oxidation of inosite with nitric acid produced only leuconic acid, and proceeded as follows



Inosite Leuconic acid

Since the percentage composition of rhodizonic acid, tetrahydroxyquinone, triquinoyl, croconic acid and leuconic acid may be almost equal, depending upon the amount of water of crystallization which each compound may contain, the results of Contardi's analysis of his crystalline compound seemed hardly sufficient ground for the conclusion that the material was only leuconic acid. The objection is increased when we consider that he had no method for establishing the purity of his product. Neither did it seem logical to place very much weight upon the fact that the material obtained by treatment with hydroxylamine gave the correct amount of nitrogen for the penta-oxime of leuconic acid, since he was unable to obtain this compound in a crystalline condition, and therefore could not be sure that he was dealing with a pure compound.

On the other hand, Maquenne's assumption of the presence of tetrahydroxyquinone and rhodizonic acid in the oxidation product on the basis of the analysis of the extraordinarily unstable triquinoyl, and of the red color of the salt produced by barium chloride, seemed hardly sufficient proof for the presence of these materials.

Because of the obviously contradictory results of these two investigators,

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[2] Contardi, *Gazz. chim. ital.*, **51**, I, 107–125 (1921).

as well as the seemingly rather doubtful basis upon which they interpreted some of their results, it seemed worth while to repeat the work on the oxidation of inosite with nitric acid.

Experimental Part

The inosite was prepared from phytin according to the method used by Contar .[2] The phytin was obtained from the Corn Products Co. We obtained from this material a nicely crystalline product melting at 218°, which exhibited all of the properties assigned in the literature to inactive inosite.

Following Contardi's directions, 50 g. of inosite was dissolved in 150 g. of nitric acid (Baker's C. P. fuming, sp. gr. 1.50), and the solution was heated on the water-bath. The reaction soon became rather violent, and large amounts of the oxides of nitrogen were given off. After some time the reaction slowed down somewhat, and the solution was evaporated to dryness. As the residue approached dryness it appeared as a greenish-white sticky mass, but on remaining on the boiling water-bath it soon changed to a light brown color. The material was extremely soluble in water, and effervesced somewhat when placed in solution. It was slightly soluble in alcohol, but insoluble in ether. It showed a very slight trace of oxalic acid.

The residue was now taken up in water and again evaporated on the water-bath. The solution began to turn brown almost immediately, and a slow but steady evolution of carbon dioxide was noted during the evaporation. After some time a brown colored precipitate began to separate, and on evaporating the solution completely to dryness, the residue was almost black, appearing much like carbon. This material was very soluble in water, giving deep brown solutions. No crystalline product was obtained from it. Cold, concentrated nitric acid decolorized it immediately, but the residue which had been decolorized in this way again turned brown when its water solution was evaporated.

The oxidation was repeated in the same way, with the exception that the temperature, neither during the reaction nor during the subsequent evaporation, was allowed to rise above 60°. When the nitric acid solution had evaporated to a thin sirup, it was removed from the water-bath and allowed to cool. Nicely crystalline colorless needles soon separated. These were filtered off with suction, washed with a mixture of half alcohol and half ether, and kept in a vacuum desiccator which contained both concentrated sulfuric acid and solid potassium hydroxide, until they no longer gave a test for nitric acid. The mother liquor from which these crystals had been obtained was concentrated somewhat, and again allowed to cool. Again needle crystals separated. These were purified in the same manner as the previously obtained fraction. In a similar manner a third fraction of crystals was obtained from the mother liquor. These fractions were analyzed separately, and the results of analysis were found to differ quite widely with the different fractions. It was apparent from these results that the three fractions were not made up of a single compound, but of a mixture. The crystalline material was unstable at temperatures around 60°. Its water solutions turned brown with the evolution of carbon dioxide when they were warmed on the water-bath.

An attempt was made to prepare the penta-oxime according to Contardi's directions.[2] A small amount of a brown amorphous material was obtained, which exploded at 170° as Contardi's oxime had done. It dissolved in alkali and was reprecipitated on addition of acid, but still in an amorphous condition. Since this material was obtained in very small amounts, and since no method of determining its purity was found, it was not investigated further.

When a solution of the material obtained by the oxidation of inosite was treated with barium chloride solution, the mixture at first became turbid; then a bright red amorphous precipitate settled out. It was upon the result of this reaction that Maquenne based his conclusion that rhodizonic acid was present in the product obtained by the oxidation of inosite with nitric acid. Since this compound could not be obtained crystalline, investigation of the substance was dropped.

Since it seemed apparent that the material obtained by oxidation in this manner was doubtless a mixture of products, we now attempted to carry out a separation of these compounds by converting them into their salts.

Isolation of the Di-potassium Salt of Croconic Acid.—A water solution of the material obtained from the oxidation of inosite with nitric acid in the manner described above, was treated with solid potassium carbonate until the solution showed an alkaline reaction. Immediately upon introduction of the carbonate the solution turned yellow and there was slight effervescence. A bright yellow precipitate soon began to settle out, and by the time the solution was neutral it had become practically solid, due to the large amount of this precipitate. More water was added, but since the material did not seem to go readily into solution, it was warmed slightly. It soon began to effervesce—the precipitate meantime going into solution, and the solution itself took on a dark brown color. It was filtered while warm and allowed to cool, whereupon a small quantity of beautiful violet colored crystals separated. This material was filtered off, and the solution was concentrated to a small volume, and again allowed to cool. A large amount of orange colored needle crystals then settled out. This material was moderately soluble in water, from which it could be easily crystallized. After several recrystallizations from water the orange crystals were dried in a water jacketed oven at 100°. On drying, the material became bright yellow in color, but upon recrystallization from water the orange needles were again obtained.

The properties of this compound agreed with those given in the literature for the di-potassium salt of croconic acid. Gmelin[3] had obtained it by the evaporation in air of a water solution of potassium carbonyl. Nietzki and Benckiser[4] obtained it from hexahydroxybenzene by evaporating a water solution of this material in the air, in the presence of potassium hydroxide. The same investigators obtained it in the same manner by evaporating a water solution of either triquinoyl, tetrahydroxyquinone or rhodizonic acid in the presence of potassium hydroxide. Their description applied in every respect to the compound which we had isolated. Consequently we proceeded to analyze the yellow salt.

Anal. Calcd. for $C_5O_5K_2$: C, 27.52; H, none; K, 35.77. Found: C, 27.31, 27.45; H, 0.18, 0.12; K, 35.7, 35.7.

There remained, therefore, little doubt but that this yellow salt was the di-potassium salt of croconic acid. Since it had been obtained by previous investigators by the evaporation of alkaline solutions of hexahydroxybenzene, tetrahydroxyquinone, rhodizonic acid and triquinoyl, it seemed possible that some of these might have been present in the original material from which potassium croconate had been obtained.

An Attempt to Isolate the Salt of Rhodizonic Acid and the Subsequent Isolation of the Di-sodium Salt of Tetrahydroxyquinone.—As already pointed out, we had obtained a violet crystalline material upon the first treatment of the oxidation product with potassium carbonate. The di-potassium salt of rhodizonic acid was obtained by several investigators[4,5]

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[3] Gmelin, *Ann. phys.*, **4**, 31 (1800).

[4] Nietzki and Benckiser, *Ber.*, **18**, 499–515 (1885); *ibid.*, **19**, 293 (1886).

[5] Heller, *Ann.*, **34**, 232–235 (1840); Will, *ibid.*, **118**, 187–206 (1861); Lerch, *ibid.*, **124**, 20–42 (1862).

and is described as a violet colored, needle crystalline material that dissolves in water to give orange colored solutions, which yield potassium croconate on evaporation. It therefore seemed probable that the violet material might be the di-potassium salt of rhodizonic acid. However, the yield of this material in the previously described treatment had been very small, and upon repeating the procedure we were seldom able to obtain any of the violet crystals. Some material usually separated, but it was not crystalline, and ranged in color from black to green, with sometimes a small amount of violet.

Since rhodizonic acid in alkaline solutions tends to change over to the salt of croconic acid, it was thought that perhaps the normal carbonate produced too alkaline a medium for the separation of the rhodizonic acid salt, if present. A solution of the oxidized material was therefore treated with solid sodium bicarbonate in small portions. It immediately turned yellow, and there was some effervescence, which continued for some time after each addition. When the solution no longer effervesced upon further addition of the bicarbonate, it was set aside and allowed to stand for some time. Soon a solid began to separate which, on filtering off, was found to be nicely crystalline, but green in color. The same green compound was obtained when sodium acetate, disodium hydrogen phosphate or trisodium phosphate was used in place of the bicarbonate, although the bicarbonate seemed to give the best results. Sodium chloride and sodium sulfate produced none of the green salt.

This green material, like the violet, could not be recrystallized from water, but, dissolved in that solvent, gave the same orange colored solution as the latter, and upon evaporation of the solution only the croconic acid salt was obtained.

Potassium bicarbonate worked in the same way as sodium bicarbonate, giving a material of a slightly darker green color, but not quite so nicely crystalline as the product obtained by the sodium bicarbonate treatment.

In no case under this treatment was there any indication of the production of the violet salt. However Nietzki and Benckiser[4] describe the disodium salt of tetrahydroxyquinone as a dark green, crystalline material, which dissolves in water to give an orange colored solution that yields sodium croconate on evaporation. We therefore believed this green material which we had obtained to be the di-sodium salt of tetrahydroxyquinone. Analysis of the compound bore out this supposition.

Anal. Calcd. for $C_6O_6H_2Na_2$: C, 33.3; H, 0.92; Na, 21.3. Found: C, 33.28, 33.76, 32.80, 32.88; H, 1.20, 1.32, 0.98; Na, 21.3, 21.3, 21.0, 21.3.

The slight variation in results may be considered as due to the fact that this compound could not be purified beyond the condition in which it separated from the original solution.

From the results of this analysis, and because of the agreement between the properties of the compound with those given in the literature for the di-sodium salt of tetrahydroxyquinone, we concluded that this green substance must be the di-sodium salt of tetrahydroxyquinone.

Isolation of the Di-potassium Salt of Rhodizonic Acid.—Since the method of procedure just described had not given a method for obtaining the violet material, we now returned to the original treatment with potassium carbonate, in the hope that by suitable adjustment of conditions we might be able to obtain the violet material consistently. After a large number of attempts we were able finally to produce the violet salt at will by the following procedure.

Inosite was oxidized with three times its weight of nitric acid, in the manner formerly described; 25 g. of the product obtained by this oxidation was dissolved in 50 cc. of water. When 2 cc. of this solution in a test-tube was treated with 3 cc. of 20% solution of potassium carbonate, the mixture became almost solid, the solid being about the color of ocher. The test-tube and contents were now placed in a beaker of water at a temperature of about 60°. Effervescence began almost immediately, the yellow precipitate began to go into solution, and the solution itself took on a much darker brown color. After about three minutes, the test-tube and contents were removed from the water. Effervescence continued for some time and when this came to an end, all of the yellow precipitate had gone into solution. The solution was dark brown in color. When it had cooled a layer of violet crystals about a centimeter deep was found on the bottom of the test-tube.

If the oxidation is carried out with different proportions of nitric acid than given, a new set of conditions for the treatment with potassium carbonate must be determined. The amount of the violet salt obtained does not appear to vary appreciably when the amount of nitric acid is varied over moderate limits.

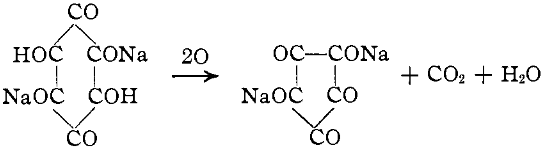
Analysis of the violet salt confirmed our belief that the violet salt was the di-potassium salt of rhodizonic acid.

Anal. Calcd. for $C_6O_6K_2$: C, 29.67; H, none; K, 31.6. Found: C, 29.15, 29.29, 29.66, 29.73, 29.40; H, 0.04, 0.16, 0.01, 0.18, 0.12; K, 31.1, 31.8, 31.2, 31.5, 31.2.

Quantitative Conversion of Six-Membered Ring Compounds to Compounds Having Five-Membered Rings.—Although it appeared certain from the results obtained thus far that some of the products in the oxidation of inosite with nitric acid were six-membered ring compounds, we deemed it advisable to try another method of investigation in order to give further proof of this fact.

As already pointed out, other investigators have shown that the salts of both rhodizonic acid and tetrahydroxyquinone in water solution change over to the corresponding salts of croconic acid. We have also pointed out that the compounds we obtained exhibited the same phenomenon. The reactions involved in this transformation would be represented as follows

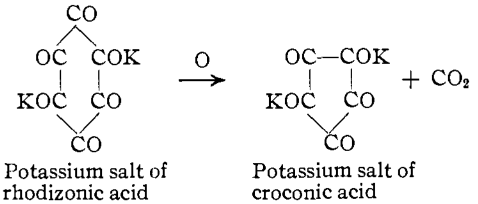
I



Sodium salt of tetra-oxyquinone

Sodium salt of croconic acid

II



Upon consideration of these equations it will be seen that they should lend themselves to a fairly simple quantitative investigation. Indeed they have the advantage that they offer three different ways in which the course of the reaction can be checked quantitatively. Taking Reaction I as an example, in the first place the amount of carbon dioxide can be absorbed and weighed. The weight of the carbon dioxide obtained should correspond to one molecule for every molecule of the di-sodium salt of tetrahydroxyquinone employed. In the second place, if the reaction takes place quantitatively according to the above equation, the weight of the tetrahydroxyquinone salt employed in the determination should be to the weight of the residue after the reaction has taken place, as the molecular weight of the di-sodium salt of tetrahydroxyquinone is to the molecular weight of the di-sodium salt of croconic acid. Finally, the amount of sodium in the residue obtained after the reaction has taken place, should correspond to the percentage of sodium in sodium croconate, while the amount present in the original material corresponds to that in the di-sodium salt of tetrahydroxyquinone.

The second reaction can lend itself to the same sort of quantitative determination, likewise offering three ways in which to obtain a quantitative check on the conversion.

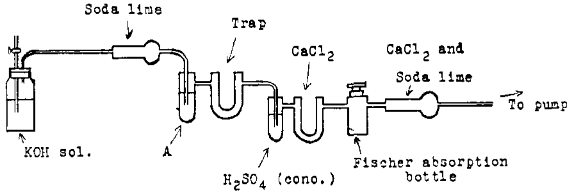


Fig. 1.—Diagram of apparatus.

In order to carry out these reactions the apparatus shown in Fig. 1 was constructed. Tube A was first filled about two-thirds full of distilled water, and was then surrounded by a beaker of water kept at about 80°. Air that had been purified from carbon dioxide by passing through the purification train shown was drawn slowly through the whole apparatus by means of a suction pump. The Fischer absorption bulb was taken off from time to time and weighed. When it no longer increased in weight, the apparatus was ready for use. Accordingly, a weighed sample of the green salt was introduced into the water in tube A, and air was drawn through the resulting solution until the absorption bulb no longer gained in weight. This required about three hours. The total increase in weight of the absorption bulb corresponded to the amount of carbon dioxide lost by the sample of the di-sodium salt of tetrahydroxyquinone in changing to the di-sodium salt of croconic acid. The solution remaining in tube A was transferred to a weighed platinum crucible and evaporated to constant weight. The difference between the weight of the original sample and the weight of the residue thus obtained corresponded to the loss in weight that the original sample of the di-sodium salt of tetrahydroxyquinone should undergo in changing to the di-sodium salt of croconic acid. The residue in the crucible was now ashed, dissolved in water and finally titrated with standard hydrochloric acid, using methyl orange as indicator, the percentage of sodium present in the residue being then calculated as the carbonate. The amount of sodium present in the residue was found to correspond to the correct percentage of the residue obtained by the evaporation of the water solution, if that residue were pure sodium croconate.

The violet salt was subjected to similar treatment, and the results were found to agree exceptionally well with the results expected if the di-potassium salt of rhodizonic acid changed quantitatively to the di-potassium salt of croconic acid, according to Equation II above. The results of the analyses are given in Tables I and II. Table I is the result of the treatment of the green salt, while Table II represents the analysis of the violet material.

TABLE I

ANALYSIS OF GREEN SALT

Sample, g.	CO_2 found, g.	CO_2 calcd., g.	Residue found, g.	Residue calcd., g.	Na found, calcd. on residue obtained, %	Na calcd. for $Na_2C_5O_5$, %
0.1216	0.0243	0.0247	0.1008	0.1047	24.1	24.7
.0930	.0188	.0189	.0725	.0800	24.5	

TABLE II

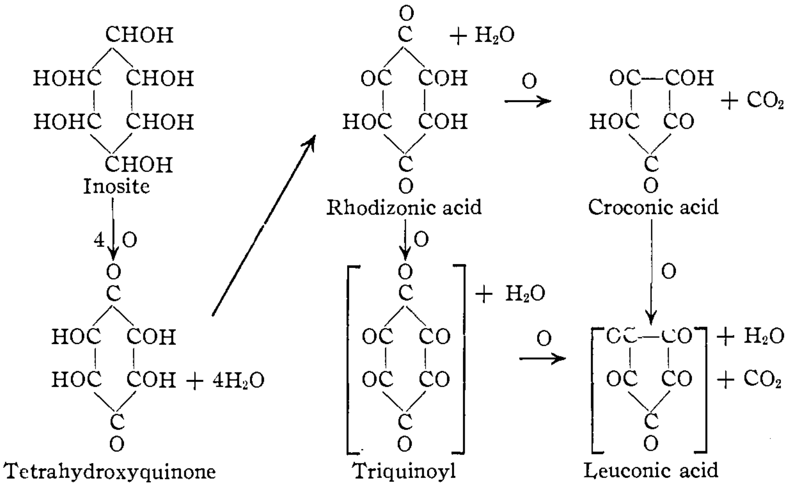
ANALYSIS OF VIOLET MATERIAL

Sample, g.	CO_2 found, g.	CO_2 calcd., g.	Residue found, g.	Residue calcd., g.	K found, calcd. on residue obtained, %	K calcd. for $K_2C_5O_5$, %
0.0987	0.0180	0.0175	0.0866	0.0867	35.4	35.7
.0902	...	...	.0846	.0843	35.3	
.1104	.0203	.0197	.0982	.0978	35.7	

(No result was obtained for the carbon dioxide in the second sample in Table II, due to the fact that a leak developed in the apparatus during this run.)

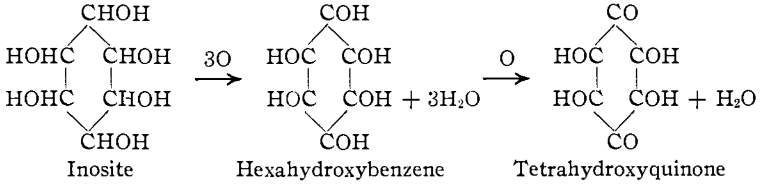
From the results thus obtained there can no longer be any doubt that six-membered products are obtained in the oxidation of inosite with nitric acid, and we can represent the reaction on the basis of the results obtained on the following page.

While direct derivatives of the products indicated in brackets (triquinoyl and leuconic acid) have not been isolated by us, we believe that it is highly probable that they are formed in the course of the reaction, since Nietzki and Benckiser[4] have shown that triquinoyl is easily produced from tetrahydroxyquinone or rhodizonic acid by oxidation with nitric acid, and Will[5] obtained leuconic acid by the oxidation of croconic acid with nitric acid. All of these are so unstable in the free condition that we feel more justified in concluding their presence on the basis of the much more stable salts



which we isolated than on the grounds of the analysis of the free compounds. At any rate, we can certainly conclude that tetrahydroxyquinone, rhodizonic acid, and croconic acid may be numbered among the compounds obtained by the oxidation of inosite with nitric acid.

Possibility of Hexahydroxybenzene as an Oxidation Product of Inosite.—On inspection of the reactions given above it will be seen that the successive reactions take place in quite an orderly manner, and that they proceed for the most part by the removal of two hydrogens from the first compound to give the second. Thus tetrahydroxyquinone is converted into rhodizonic acid by the removal of two hydrogens by oxidation. It, therefore, seemed logical that the tetrahydroxyquinone found in the mixture of oxidation products might have originated by a similar reaction from hexahydroxybenzene, which could have been formed in the reaction as follows



Indeed Lerch[6] as well as Nietzki and Benckiser[4] had obtained tetrahydroxyquinone, rhodizonic acid and triquinoyl by the oxidation of hexahydroxybenzene with nitric acid. We therefore set out to ascertain, if possible, whether hexahydroxybenzene was contained in the mixture of products which we had obtained by the oxidation of inosite.

Isolation of Hexahydroxybenzene Hexa-acetate.—Hexahydroxybenzene had been identified by Nietzki and Benckiser,[4] who first prepared the

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[6] Lerch, *Ann.*, **124,** 20–41 (1862).

compound, by the fact that upon acetylation with acetic anhydride in the presence of sodium acetate they were able to isolate a crystalline substance which showed the correct composition for the hexa-acetate of hexahydroxybenzene. This material they describe as very insoluble in most reagents, but crystallizable from boiling glacial acetic acid, in which it is slightly soluble. The material separated in colorless microscopic cubes which contained acetic acid of crystallization; this was driven off by heating at 150°. The compound melted sharply at 203°. The original material before acetylation also yielded benzene and diphenyl when distilled with zinc dust.

We believed that if hexahydroxybenzene were one of the products of oxidation, we might be able to identify it through acetylation after the method of Nietzki and Benckiser. Accordingly, 5 g. of the product obtained by the oxidation of inosite in the manner originally described, was refluxed for one hour with 100 cc. of acetic anhydride in the presence of 3 g. of fused sodium acetate. During the heating the reaction mixture became dark brown in color. It was allowed to cool and then poured into about 200 cc. of cold water. A precipitate separated, which was filtered off, washed with hot water for some time, then with hot alcohol, and finally with ether. The material remaining was of a light tan color, and was extremely insoluble in practically all ordinary solvents. It dissolved with some difficulty in boiling glacial acetic acid, from which it crystallized very quickly on slight cooling. The material obtained in this way appeared under the microscope to be made up of very small but well-formed almost colorless cubes. After several recrystallizations from glacial acetic acid the material was entirely colorless and melted sharply at 204°. It contained acetic acid of crystallization as had the compound obtained by Nietzki and Benckiser. However, after heating at 150° for some time, the weight became constant, and the material was subjected to analysis.

Anal. Calcd. for $C_6(OOCCH_3)_6$: C, 50.72; H, 4.22. Found: C, 50.48, 50.43; H, 4.43, 4.30.

From these results hexahydroxybenzene may be considered as one of the products obtained in the oxidation of inosite with nitric acid.

In order to ascertain the conditions of oxidation that were favorable to the maximum production of hexahydroxybenzene, a series of oxidations was run, using different amounts of nitric acid, and acetylating the entire oxidized product. By the amount of product obtained in the latter reaction, a relationship between the amounts of hexahydroxybenezene that were produced by varying proportions of nitric acid was obtained. The results of the treatment are given in Table III. The weight of acetylated product given is that of the crude product after being washed with hot water, hot alcohol and ether. This weight was taken, rather than the weight of the product after recrystallization from glacial acetic acid, since a considerable amount of material was always lost during this treatment, due to the tendency of the material to adhere to the crystallizing vessel.

It thus appears that the maximum amount of hexahydroxybenzene is produced when inosite and nitric acid are employed in the proportion of 5 g. of the former to 6 cc. or 9 g. of the latter. Where very small amounts

TABLE III

EXPERIMENTAL DATA

Inosite, g.	Nitric acid, cc.	Acetylated product, g.	Inosite, g.	Nitric acid, cc.	Acetylated product, g.
5	2.5	1.36	5	6.0	1.90
5	2.5	1.24	5	7.0	1.56
5	4.0	1.71	5	7.0	1.48
5	4.0	1.81	5	10.0	1.24
5	5.0	1.78	5	10.0	1.45
5	5.0	1.89	5	25.0	0.72
5	6.0	2.16	5	25.0	0.76

of nitric acid were used some inosite hexa-acetate was obtained, showing that some of the inosite originally present had not been attacked by the nitric acid.

Although from the results of previous investigators the structure of the numerous compounds which we have encountered in this investigation (hexahydroxybenzene, tetrahydroxyquinone, rhodizonic acid, etc.) seemed to be reasonably well established, in no case has a molecular weight determination been reported on any of these compounds or their derivatives. It was hoped that we might be able to give further proof of the correctness of the proposed formulas by obtaining the molecular weights of some of the derivatives that we had isolated.

Attempts to obtain the molecular weight of potassium croconate by the freezing point depression method, using water as solvent, were unsuccessful because of the high degree of dissociation of this salt in water. Attempts to obtain the molecular weight of hexahydroxybenzene hexa-acetate by the boiling point elevation method, using glacial acetic acid as solvent, and by the freezing point depression method, using nitrobenzene as solvent, were unsuccessful because of the extremely slight solubility of the compound in these solvents.

We were likewise unsuccessful in attempts to obtain methyl ethers. Attempts were made to obtain them in the hope that they might lend themselves to a determination of molecular weight. The potassium salt of croconic acid was treated with methyl sulfate and silver croconate was subjected to the action of methyl iodide, but the only evidence of methylation was a very small amount of an ether-soluble oil. The complete oxidation product was also subjected to the action of diazomethane, but here again only a very small amount of ether-soluble oil gave any indication that methylation had taken place. Attempts to methylate inosite itself by means of diazomethane were also unsuccessful.

Conclusions

From the results obtained in this investigation it is obvious that in oxidizing inosite with nitric acid, a large number of products are obtained, It is also obvious that the apparent contradiction pointed out in the literature is due to the fact that the two investigators did not succeed in isolating a sufficient number of products from the resulting mixture to establish all the intermediate steps in the progressive course of the reaction.

From the results given above, we then conclude that the products obtained in the oxidation of inosite with nitric acid, in the order formed, are hexahydroxybenzene, tetrahydroxyquinone, rhodizonic acid, croconic acid and triquinoyl, and finally leuconic acid. While neither triquinoyl nor leuconic acid has been isolated in this investigation, we include them among the products for reasons given in the text.

SYRACUSE, NEW YORK

[CONTRIBUTION FROM THE CHEMICAL LABORATORY OF MOUNT HOLYOKE COLLEGE]

SYNTHESIS OF THE POLYPEPTIDE-HYDANTOIN, N-3-METHYL-5-TYROSYL-HYDANTOIN-1-PHENYLACETIC ACID

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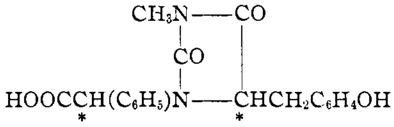
The present investigation was undertaken with a view to extending the knowledge of polypeptide-hydantoins. The particular combination was chosen in order to confirm if possible a previous observation[2] that the presence of two asymmetric carbon atoms in the polypeptide-hydantoin molecule is associated with isomerism of the meso and racemic type and at the same time to continue a study of the effect of substitutions in the N-1-position upon the mobility of the molecule as shown in its tendency to isomerize and also to split off groups in the N-1-[3] and in the C-5-positions.[4]

With these ends in view the following substance was selected for synthesis, the asymmetric carbon atoms being indicated by asterisks.[5]



A substance of the above configuration has further interest in that it may be expected to add two molecules of water on hydrolysis to give the N-phenylacetic acid derivative of tyrosine

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[2] Hahn and Gilman, THIS JOURNAL, **47**, 2944 (1925).

[3] Hahn and Renfrew, *ibid.*, **47**, 156 (1925).

[4] Hahn and Evans, *ibid.*, **49**, 2878 (1927) and **50**, 810 (1928).

[5] The system of numbering the positions of the atoms in the hydantoin ring has been changed from that used in previous papers to the one now in use by T. B. Johnson, *cf. ibid.*, **51**, 255 (1929), and in the subject index of *Chemical Abstracts*.