[CONTRIBUTION FROM THE NOYES CHEMICAL LABORATORY, UNIVERSITY OF ILLINOIS]

Quinone Diimides. XVI. Diphenoquinonediimides

BY ROGER ADAMS AND RICHARD R. HOLMES

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o-Tolidinedibenzenesulfonamide is oxidized by lead tetraacetate in glacial acetic acid to 3,3′-dimethyldiphenoquinonedibenzenesulfonimide. Addition of hydrogen chloride to this compound gives a single product, the dibenzenesulfonamide of 5-chloro-*o*-tolidine. The monochloro diamide is oxidized similarly to 3,3′-dimethyl-5-chlorodiphenoquinonedibenzenesulfonimide, and action of hydrogen chloride on the diimide gives a single adduct, the dibenzenesulfonamide of 5,5′-dichloro-*o*-tolidine. This substance was also prepared by benzenesulfonation of 5,5′-dichloro-*o*-tolidine, obtained by direct chlorination of *o*-tolidine hydrochloride. The structure of this dichloro-*o*-tolidine has been established for the first time by an unequivocal method. Addition of hydrogen chloride to quinonedibenzenesulfonimides derived from *o*-tolidine, like the addition of this reagent to diimides derived from benzidine, appears to have occurred by a 1,8-process, for products are formed in which the chlorines are attached exclusively to positions ortho to the sulfonamido groups. A discussion of factors which may determine the mode of addition of hydrogen chloride to diphenoquinonediimides is presented.

The preparation of diphenoquinonedibenzenesulfonimides by oxidation of dibenzenesulfonamides of benzidine and certain of its chlorinated derivatives has been described in the preceding paper.[1] A study of the mode of addition of hydrogen chloride to these substances showed that it added 1,8- with the formation of chlorinated benzidine dibenzenesulfonamides in which the chlorines had entered exclusively the positions ortho to the sulfonamido groups. The present paper is an extension of this investigation to the derivatives of *o*-tolidine.

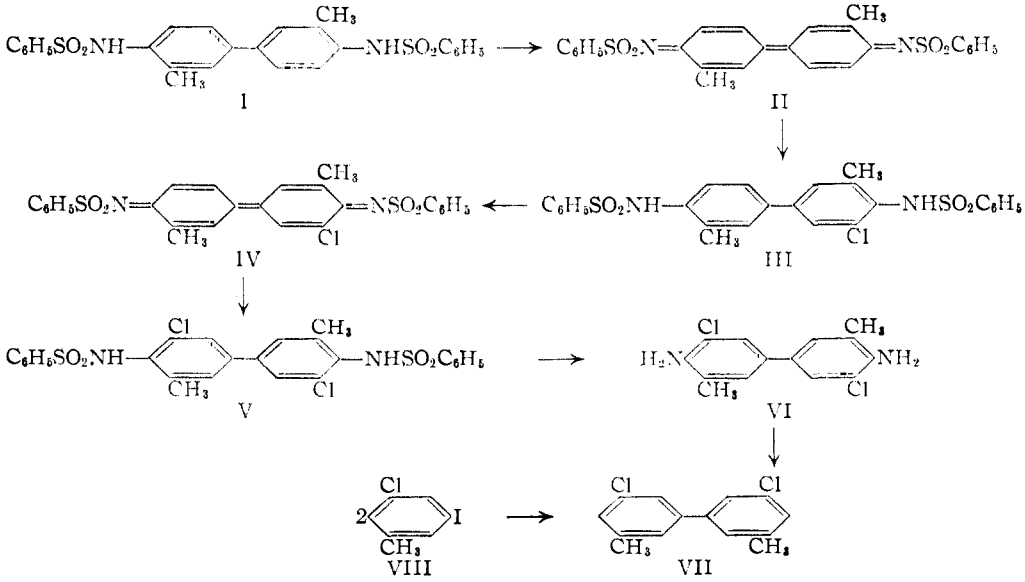
When the dibenzenesulfonamide (I) of *o*-tolidine was warmed and stirred with a solution of lead tetraacetate in glacial acetic acid, a deep red solution resulted, from which black platelets of 3,3′-dimethyldiphenoquinonedibenzenesulfonimide (II) separated. Stannous chloride or zinc dust in acetic acid reduced the diimide to diamide (I). Moreover, the action of hydrogen bromide or thiophenol also caused reduction. This diimide, like the other diphenoquinonediimides,[1] is too strong an oxidizing agent to permit addition of these latter reagents. Cold aqueous alkali destroyed the diimide rapidly.

sulfonamide (III) in high yield. That III was the only product formed was established by careful fractional crystallization of the crude adduct.

The monochloro dibenzenesulfonamide (III) was oxidized to the corresponding diimide (IV) with lead tetraacetate in acetic acid. This oxidation was somewhat more difficult to carry out than the oxidation of the unchlorinated analog (I) but by careful control of the conditions monochlorodiimide (IV) could be obtained. Too high a temperature or too long a reaction time resulted in a colorless compound which appeared to have been formed by the addition of acetic acid to the diimide desired.

The diimide (IV), in the solid state, was not as deeply colored as the unchlorinated analog (II), but formed similar, deep wine-red solutions. The infrared spectrum showed the expected absence of –NH– bands. By the action of stannous chloride in acetic acid on compound IV the disulfonamide (III) was regenerated. The diimide (IV) was destroyed by prolonged boiling with most solvents.

Dry hydrogen chloride decolorized (almost instantly) a suspension of IV in chloroform with formation of a white, crystalline dichloro-*o*-tolidinedibenzenesulfonamide (V) in high yield. Fractional crystallization of the crude adduct failed to reveal the presence of any by-product or isomer.



Addition of dry hydrogen chloride to the diimide (II) produced a monochloro *o*-tolidinedibenzene-

(1) R. Adams and R. R. Holmes, THIS JOURNAL, 74, 3033 (1952).

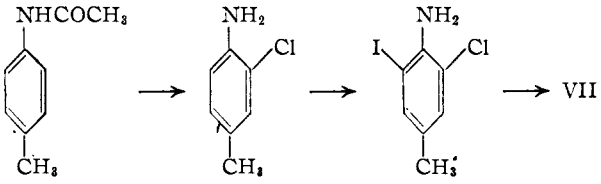
Attempts to oxidize the dichloro-*o*-tolidine derivative (V) indicated that it was much more resistant to the action of lead tetraacetate in acetic acid than were I and III.

It seemed probable, by analogy with the behavior of diimides derived from benzidine,[1] that the two chlorine atoms in V occupied the 5,5′-positions of the *o*-tolidine nucleus. Because the selective mode of addition of hydrogen chloride to these substances is of considerable theoretical interest, it was desirable to establish the structure of V with certainty. An unequivocal synthesis of the dibenzenesulfonamide of 3,3′-dimethyl-5,5′-dichlorobenzidine was achieved and the compound was shown to be identical with V.

The product of chlorination of *o*-tolidine was described by Schlenk[2] as 3,3′-dimethyl-5,5′-dichlorobenzidine (VI) but no rigorous proof of structure was offered.

In order to supply such a proof, the supposed 3,3′-dimethyl-5,5′-dichlorobenzidine was tetrazotized and deaminated with hypophosphorous acid. This led in high yield to a dichlorodimethylbiphenyl (VII) which was identical with an authentic sample of 3,3′-dimethyl-5,5′-dichlorobiphenyl. Thus the structure of the dichloro-*o*-tolidine described by Schlenk was established unequivocally.

The authentic sample of 3,3′-dimethyl-5,5′-dichlorobiphenyl (VII) was prepared from 3-chloro-5-iodotoluene (VIII) by the Ullmann reaction. A much shorter and easier route to this iodo compound than that followed by McAlister and Kenner[3] was developed. These authors used a six-step synthesis through 2-nitro-6-chloro-*p*-toluidine starting with acet-*p*-toluidide. In the present work it was found possible to prepare this compound in three steps. Acet-*p*-toluidide was converted to 2-chloro-*p*-toluidine which was iodinated to 2-chloro-6-iodotoluidine (IX), followed by deamination. When the deaminated product was condensed with copper, the same dimethyldichlorobiphenyl (VII) with the methyl groups in the 3,3′-positions was produced as that derived by deamination of the chlorination product of *o*-tolidine.



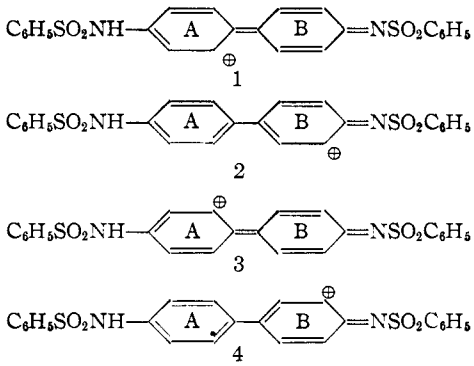
The N,N′-dibenzenesulfonyl derivative of 3,3′-dimethyl-5,5′-dichlorobenzidine was prepared by benzenesulfonation of 3,3′-dimethyl-5,5′-dichlorobenzidine (VI). Although this condensation could not be achieved by ordinary procedures, boiling VI for a short time with benzenesulfonyl chloride produced a small yield of the dibenzenesulfonamide. This substance proved to be identical with the dichloro-*o*-tolidinedibenzenesulfonamide (V) produced by addition of hydrogen chloride to the diimide (IV). This result also established III as 3,3′-dimethyl-5-chlorobenzidinedibenzenesulfonamide and IV as the corresponding diimide.

(2) W. Schlenk, *Ann.*, **363**, 317 (1908).

(3) F. B. McAlister and J. Kenner, *J. Chem. Soc.*, 1915 (1928).

Addition of hydrogen chloride to diimides (II) and (IV) appears to have been exclusively a 1,8-process, for the chlorine atoms attached themselves only to positions ortho to the sulfonamido groups. This is the same type of addition that was found to be the rule in the study of addition of hydrogen chloride to diphenoquinonedisulfonimides.[1] It is remarkable that both in the benzidine series and in the *o*-tolidine series addition of hydrogen chloride occurred exclusively in this manner. The explanation deserves consideration.

If the first step in the process is the addition of a proton to nitrogen (selecting the diimide derived from benzidine as an example), there are eight chief resonance structures for the positive ion formed. Of these only four are pertinent to this discussion.



Structures 1 and 3 contain one quinoid ring (B) and one semibenzenoid ring (A). Structures 2 and 4 contain one benzene ring (A) and one semibenzenoid ring (B). Since the resonance energy of a benzene ring is considerably greater than that of quinoid ring,[4] 2 and 4 will be at a lower energy level than 1 and 3. Thus 2 and 4 will be more important contributing structures than 1 and 3 in the above resonating ion, and attack of a chloride ion should occur preferentially at carbon atoms 3 and 5 as observed.

If this postulation is correct, the hydrogen chloride should always add to diphenoquinonediimides in such a way that chlorine becomes attached to a carbon atom ortho to one of the nitrogens. In all cases thus far studied, this has been exemplified.

Further experiments designed to test the validity of the above hypothesis are in progress.

Acknowledgment.—The authors are indebted to Miss Elizabeth Petersen for the determination and interpretation of the infrared spectra and to Miss Emily Davis, Mrs. Katherine Pih and Mrs. Jean Fortney for the microanalyses.

Experimental

***o*-Tolidinedibenzenesulfonamide (I).**—To a solution of 50 g. of *o*-tolidine in 300 ml. of pyridine, 100 g. of benzenesulfonyl chloride was added slowly with stirring. The mixture was heated at 100° for 8 hours and 25 g. of Darco added. The mixture was filtered hot and 300 ml. of water was added to the filtrate. The gray solid was crystallized twice from boiling acetic acid (10 g. per l.). The yield was 71 g. of small white prisms, m.p. 251–253° (cor.). It could also be recrystallized from dioxane.

Anal. Calcd. for $C_{26}H_{24}N_2O_4S_2$: C, 63.39; H, 4.91; N, 5.69. Found: C, 63.21; H, 4.84; N, 5.74.

(4) L. Pauling and J. Sherman, *J. Chem. Phys.*, **1**, 606 (1933).

3,3'-Dimethyldiphenoquinonedibenzenesulfonimide (II).—A mixture of 20 g. of the powdered dibenzenesulfonamide of *o*-tolidine and a hot (50–60°) solution of 26 g. of dry lead tetraacetate in 200 ml. of glacial acetic acid was stirred for two hours. The blue-black crystals were removed, boiled with 100 ml. of acetic acid for a short time and the solution was filtered hot. The product weighed 17.3 g. (86%).

The oxidation of the diamide could be carried out with equal success in six hours at room temperature or for one hour at 60–80°. The substance is recrystallized with difficulty. A suspension of 1.0 g. in 200 ml. of boiling dioxane was filtered rapidly by suction even though all the material was not dissolved. The deep red filtrate was allowed to cool and after several hours 0.2 g. of tiny gleaming black platelets separated. The diimide could also be recrystallized from ethylene dichloride. Long boiling with either of these solvents, with ethanol, methyl cellosolve, tetrachloroethane, xylene, acetic acid, nitromethane, nitrobenzene or pyridine destroyed it completely. Colorless, soluble products resulted, the character of which has not been determined. The substance had no melting point, but decomposed slowly above 200°.

Anal. Calcd. for $C_{26}H_{22}N_2O_4S_2$: C, 63.65; H, 4.52; N, 5.71. Found: C, 63.55; H, 4.41; N, 5.76.

The infrared spectrum indicated the absence of –NH– groups. There was also a strong band at 1512 cm.$^{-1}$ possibly due to the =C=N— grouping, although the =C=N— bands in the less highly conjugated quinone diimides previously studied[5] were observed at a frequency about 50 cm.$^{-1}$ higher than this.

Shaking the product with cold, aqueous alkali decolorized it rapidly with formation of a pale yellow solution. Acidification caused precipitation of a colorless gum from which no crystalline product could be isolated.

Reduction of the diimide to the diamide occurred upon treatment, as previously described for analogs,[1] with stannous chloride, hydrobromic acid, thiophenol or zinc dust and acetic acid.

Addition of Hydrogen Chloride to II: 3,3'-Dimethyl-5-chlorobenzidinedibenzenesulfonamide (III).—When dry hydrogen chloride was bubbled through a suspension of 8.0 g. of 3,3'-dimethyldiphenoquinonedibenzenesulfonimide (II) in 200 ml. of chloroform, decolorization was rapid. The white crystalline solid which separated was recrystallized from 200 ml. of boiling ethyl acetate. The product, weighing 4.6 g., formed long white needles, m.p. 182–184° (cor.). From the filtrate of the reaction mixture by evaporation an additional 3.2 g. was obtained. The total yield was 7.8 g. (89%). Fractional crystallization from ethyl acetate of the crude adduct failed to reveal the presence of any by-products or isomers.

The product retains solvent of crystallization when crystallized from a mixture of dioxane and cyclohexane or ethyl acetate and cyclohexane.

Anal. Calcd. for $C_{26}H_{23}ClN_2O_4S_2$: C, 59.25; H, 4.40; N, 5.32. Found: C, 59.52; H, 4.06; N, 5.38.

3,3'-Dimethyl-5-chlorodiphenoquinonedibenzenesulfonimide (IV).—A mixture of 13.8 g. of powdered dimethylchlorodiamide (III) was stirred with a solution of 16 g. of dry lead tetraacetate in 75 ml. of acetic acid initially at 60°. The source of heat was removed at once, and the slowly cooling mixture was stirred for one hour. Tiny maroon-red platelets separated. They were washed with hot acetic acid and dried. The yield of crystalline product was 9.4 g. (67%). It had no melting point but decomposed indistinctly starting below 200°.

This diimide was considerably more soluble than the unchlorinated analog (II). It could be recrystallized in small amounts and with great loss from hot dioxane (deep wine-red solution) from which it separated as tiny dark red platelets with a metallic luster. It was destroyed by prolonged boiling with this and most other solvents.

Anal. Calcd. for $C_{26}H_{21}ClN_2O_4S_2$: C, 59.48; H, 4.03; N, 5.34. Found: C, 59.15; H, 4.19; N, 5.32.

The infrared spectrum of IV showed the absence of –NH– groups. There were some indications of a band at 1500–1508 cm.$^{-1}$ (possibly due to the =C=N— grouping) but there were several other bands in this vicinity and a definite assignment was not possible.

When oxidized by the usual procedure different results were obtained. A mixture of 5.0 g. of the diamide with a hot (60°) solution of 6.6 g. of dry lead tetraacetate in 50 ml. of glacial acetic acid was stirred for 30 minutes. It turned a deep orange red. After an hour more the temperature had risen to 80° and a dark red crystalline solid had formed. After another hour at 80° the red solid had disappeared and on cooling the clear, pale yellow solution, 3.6 g. of long, fluffy white needles separated. These were recrystallized twice from ethyl acetate–cyclohexane, m.p. 181–184° (cor.) (dec.). Analyses indicated the product to be an adduct of a molecule of acetic acid to the diphenoquinone with a molecule of cyclohexane of crystallization. A further study was not made of this product.

Anal. Calcd. for $C_{34}H_{37}ClN_2O_4S_2$: C, 61.01; H, 5.57; N, 4.19. Found: C, 60.66; H, 5.63; N, 4.42.

Addition of Hydrogen Chloride to IV: 3,3'-Dimethyl-5,5'-dichlorobenzidinedibenzenesulfonamide (V).—When dry hydrogen chloride was bubbled through a suspension of 5 g. of the diimide in 100 ml. of chloroform, the mixture was decolorized rapidly and a white crystalline solid was formed. The crude diamide weighed 4.9 g. (90%). Fractional crystallization of the crude adduct from ethyl acetate failed to reveal the presence of any isomers or by-products. Upon crystallization from boiling ethyl acetate and twice from glacial acetic acid, white crystals, m.p. 247–248° (cor.), were obtained.

Anal. Calcd. for $C_{26}H_{22}Cl_2N_2O_4S_2$: C, 55.61; H, 3.95; N, 4.99. Found: C, 55.79; H, 4.12; N, 4.97.

Various conditions were used in attempts to oxidize this product to a diimide but all failed.

3,3'-Dimethyl-5,5'-dichlorobiphenyl (VII): **By Deamination of VI.**—A solution of 2.8 g. (0.01 mole) of 3,3'-dimethyl-5,5'-dichlorobenzidine[2] in a hot mixture of 35 ml. of water and 3 ml. of concentrated hydrochloric acid was cooled to 15° in an ice-bath with stirring. Addition was then made of 2.2 ml. of concentrated hydrochloric acid followed by a solution of 1.4 g. (0.02 mole) of sodium nitrite in 3.2 ml. of water. Stirring was continued for 30 minutes at 0–5°. Then the solution of tetrazonium salt was added with stirring to 30 ml. of ice-cold 30% hypophosphorous acid. Evolution of nitrogen was vigorous. The mixture was allowed to warm up to room temperature overnight.[6]

The yellow-white solid was first recrystallized from 50% aqueous methanol and the 2.0 g. (80%) of product was dissolved in 40 ml. of cyclohexane and the solution passed through a column (2 × 20 cm.) of alumina (ALCOA F-20). The column was eluted with 450 ml. of cyclohexane and evaporation of the solvent gave white crystals. Repetition of the above chromatography and crystallization from 30 ml. of hot ethanol gave brilliant white needles weighing 1.1 g., m.p. 100–101° (cor.).

Anal. Calcd. for $C_{14}H_{12}Cl_2$: C, 66.95; H, 4.82. Found: C, 66.83; H, 4.92.

2-Chloro-acet-*p*-toluidide.—A modification of the method of Reverdin and Crepieux[7] was used. A mixture of 200 g. of *p*-toluidine and 750 ml. of glacial acetic acid was boiled for 4 hours then cooled to 12° and 350 ml. of concentrated hydrochloric acid added. With vigorous mechanical stirring and cooling with ice, a solution of 100 g. of sodium chlorate in 450 ml. of water was added dropwise over a period of 1.5 hours. The solution was stirred for 4 hours, then allowed to stand at room temperature for 48 hours. Long white needles weighing 85 g. resulted, m.p. 109–113° (cor.). By adding water to the mother liquors and recrystallizing the solid obtained from 1:1 aqueous methanol (Darco), 65 g. of off-white needles of slightly less pure material, m.p. 107–112° (cor.) were obtained. The total yield was 150 g. (60%).

2-Chloro-6-iodo-*p*-toluidine (IX).—A mixture of 80 g. of 2-chloro-acet-*p*-toluidide, 300 ml. of ethanol and 300 ml. of concentrated hydrochloric acid was boiled for 4 hours. The hydrochloride of 2-chloro-*p*-toluidine separated as white needles from the cooled solution. The needles were suspended in a very vigorously stirred (fast stirrer plus baffle

(5) R. Adams and A. S. Nagarkatti, THIS JOURNAL, **72**, 4601 (1950); R. Adams and J. L. Anderson, *ibid.*, **72**, 5154 (1950); R. Adams and R. A. Wankel, *ibid.*, **73**, 131 (1951).

(6) N. Kornblum, "Organic Reactions," Vol. II, John Wiley and Sons, Inc., New York, N. Y., 1944, Chap. 7.

(7) F. Reverdin and P. Crepieux, *Ber.*, **33**, 2500 (1900).

plates) solution of 103 g. of sodium bicarbonate in 500 ml. of water cooled to 12–15°. In portions, 177 g. of powdered iodine was now added during the course of an hour. Stirring was continued another hour and by this time the dark oil first formed had changed to a black, lumpy solid heavier than water.

A mixture of this crude solid and 20 g. of sodium hydrosulfite was steam distilled. After 8 hours and 7 l. of distillate had collected, no more product came over. The cooled product, originally an oil, crystallized to a mass of radiating white needles. Recrystallization from a small amount of hot ethanol gave 85 g. (74%) of long white needles of product. Several recrystallizations from ethanol served to purify it, m.p. 59–60°.

Anal. Calcd. for C_7H_7ClIN: C, 31.43; H, 2.64; N, 5.31. Found: C, 31.58; H, 2.87; N, 5.40.

3-Chloro-5-iodotoluene (VIII).[3]—A mixture of 75 g. of 2-chloro-6-iodo-*p*-toluidine and 1 l. of 30% aqueous hypophosphorous acid was cooled to 0–5° and a solution of 19.5 g. of sodium nitrite in 100 ml. of water was added dropwise during one hour. Stirring was continued at 0–5° for 2 hours, then at room temperature for 2 hours. Upon addition of 1 l. of water a heavy black oil separated. It was washed with 6 100-ml. portions of warm 6 *N* hydrochloric acid. These extracts on dilution with water gave 31 g. of unreacted amine.

The black oil insoluble in 6 *N* hydrochloric acid was washed with aqueous hydrosulfite and then distilled. A tarry residue remained in the flask. The product weighed 14 g. and boiled at 238–245° (747 mm.). 3-Chloro-5-iodotoluene as prepared by treatment of diazotized 3-chloro-5-aminotoluene with potassium iodide[3] is reported to boil at 240–243° at atmospheric pressure.

3,3'-Dimethyl-5,5'-dichlorobiphenyl (VII): By the Ullman Reaction on 3-Chloro-5-iodotoluene.—The Ullman reaction on 3-chloro-5-iodotoluene as reported by McAlister and Kenner,[3] proved difficult to repeat until an active copper bronze was used.

In portions, 8 g. of active copper bronze was added to 6 g. of vigorously boiling (metal-bath at 265°) 3-chloro-5-iodotoluene. The bath temperature was raised to 300° during one-half hour, after which the reaction was complete. The cooled mixture was extracted with 50 ml. of hot benzene. By evaporation 2 g. (64%) of brownish needles resulted. Recrystallization from ethanol gave white needles, m.p. 95–97° (cor.). For further purification, they were dissolved in 20 ml. of cyclohexane and the solution was poured through a column (2 × 20 cm.) of alumina (ALCOA F-20). Elution with 500 ml. of cyclohexane and evaporation of the solvent gave white needles. These were recrystallized from 20 ml. of hot ethanol and then the chromatographic procedure was repeated. A final crystallization gave long white needles of 3,3'-dimethyl-5,5'-dichlorobiphenyl, m.p. 100–101° (cor.) (lit.[3] 101–102°).

A mixture of this material and VII (from the deamination of VI) also melted at 100–101° (cor.). The infrared spectra of the two substances were identical.

3,3'-Dimethyl-5,5'-dichlorobenzidinedibenzenesulfonamide (V): By Benzenesulfonylation of VI.—A solution of 1 g. of 3,3'-dimethyl-5,5'-dichlorobenzidine (VI) in 5 ml. of benzenesulfonyl chloride was boiled for 20 minutes, then poured into 50 ml. of pyridine. This solution was boiled for a few minutes then poured into 200 ml. of water. The product was crystallized from glacial acetic acid (Darco) to give 0.3 g. of small white prisms which after two more crystallizations from glacial acetic acid had an m.p. 247–248° (cor.). This was identical with the product obtained by addition of hydrogen chloride to the 3,3'-dimethyl-5-chlorodiphenoquinonedibenzenesulfonimide (IV) as shown by a melting point of the mixture and infrared absorption spectra.

URBANA, ILLINOIS

[CONTRIBUTION FROM THE SQUIBB INSTITUTE FOR MEDICAL RESEARCH]

Neogermitrine, a New Ester Alkaloid from Veratrum Viride[1]

BY JOSEF FRIED, PAUL NUMEROF AND NETTIE H. COY

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A new triester alkaloid, neogermitrine, possessing hypotensive activity of the order of that of germitrine has been isolated from *Veratrum viride*. This alkaloid, while present as the main active constituent in two batches of root collected during the summer seasons of 1948 and 1949, had not been encountered in a previous batch collected during 1947. Neogermitrine, $C_{36}H_{55}O_{11}N$, is a diacetate-mono-(levo)-α-methylbutyrate of the alkamine germine. On stepwise degradation with dilute methanol it yielded first the known diester alkaloid germidine and finally germine. The infrared spectra of germine and of the ester alkaloids derived from it have been recorded and found to be useful for identification purposes.

A recent investigation[2,3] having as its purpose the isolation and characterization of the hypotensive principles of *Veratrum viride* revealed that the hypotensive activity resided exclusively in an amorphous fraction,[4] from which all the previously known crystalline alkaloids had been removed. Further fractionation of this amorphous residue by chromatography and countercurrent distribution led to the isolation of the alkaloids germitrine and germidine, which were shown to be esters of the previously known alkamine germine,[5] the former with one mole each of acetic, (levo)-α-methylbutyric and (dextro)-methylethylglycolic acids,[6] and the latter with acetic and (levo)-α-methylbutyric acids. Germitrine, the more abundant and the more active of the two alkaloids, accounted for the bulk of the hypotensive activity present in the root.

More recently, with the objective of preparing larger amounts of the two active alkaloids, a 50-lb. batch of root was processed essentially as outlined previously.[2] A highly active concentrate was obtained, which could be separated by 24-plate countercurrent distribution between benzene and 2 *M* acetate buffer at *p*H 5.5 into two components with peaks at tubes 5 and 15 as shown in Fig. 1. This curve agrees in its essentials with the one reported

(1) Presented before the Division of Medicinal Chemistry of the American Chemical Society, Cleveland, Ohio, April 8 to 12, 1951.

(2) J. Fried, H. L. White and O. Wintersteiner, THIS JOURNAL, **72**, 4621 (1950).

(3) E. D. Freis, J. R. Stanton and F. C. Moister, *J. Pharmacol. Expt. Therap.*, **98**, 166 (1950).

(4) W. A. Jacobs and L. C. Craig, *J. Biol. Chem.*, **160**, 555 (1944).

(5) W. Poethke, *Arch. Pharm.*, **275**, 571 (1937).

(6) These acids, which in our previous publication had been referred to as *l*-α-methylbutyric and *d*-methylethylglycolic acid, should properly carry the designations levo- and dextro-, respectively. In a paper by Stenhagen, *et al.*, (*Arkiv Kemi*, **24B**, 1 (1947)), which came to our attention only recently, the former acid has been configurationally related to D-glyceraldehyde.