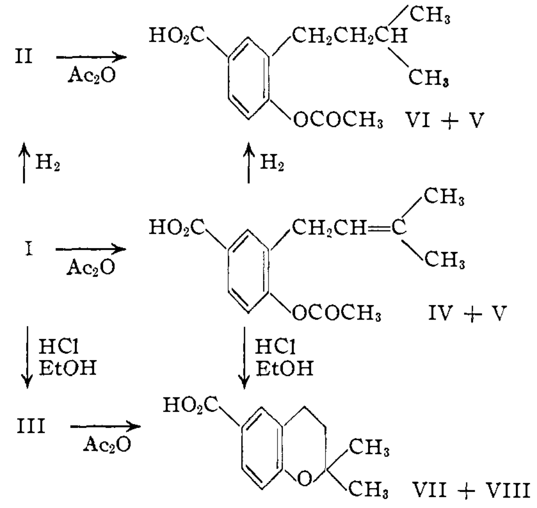
as ultraviolet spectra, show I to be a dibasic acid ($pK'_a$s 4.3 and 9.1 in water) with an equivalent weight of 636. The formation of neutral and acid salts with many bases confirms this. At least one methoxyl and two C-methyl groups are present. Catalytic hydrogenation of I with Adams ($PtO_2$) or Raney nickel catalysts yields dihydrostreptonivicin (II), m.p. 163–165° (calcd. for $C_{31}H_{44}N_2O_{11}$: C, 59.98; H, 7.15; N, 4.41. Found: C, 59.84; H, 6.44; N, 4.49). The potentiometric titration and optical activity of II are similar to those of I. The ultraviolet spectra are also similar, but the 334 mμ absorption of peak of I is found at 328 mμ for II. The infrared spectra of these compounds show similarities in the regions of carbonyl and conjugated system absorptions. The biological activity of II is very similar to that of I.

Hydrolysis of I by 4 *N* hydrochloric acid in 60% ethanol yields III, an optically inactive acid ($pK'_a$ 6.3 in 66% dimethylformamide, m.p. 288–290° (dec.)) in 95% yields (calcd. for $C_{22}H_{21}NO_6$: C, 66.82; H, 5.35; N, 3.54. Found: C, 67.18; H, 5.40; N, 3.70). Compound III has characteristic ultraviolet absorption maxima in 0.01 *N* ethanolic acid at 330 mμ ($a$ = 61.0) and in 0.01 *N* ethanolic potassium hydroxide at 251 mμ ($a$ = 84.7) and 328 mμ ($a$ = 68.2). The Kuhn–Roth determinations show the presence of at least one C-methyl group; no methoxyls are present.

Each of these three compounds is cleaved in refluxing acetic anhydride. From I is obtained an optically inactive acid (IV) (m.p. 116–120°, $pK'_a$ 5.67 in 50% ethanol) and an optically active neutral compound (V) m.p. 167–173°, $[\alpha]^{24}\text{D}$ −94.4° ($c$, 2% in dimethylformamide). Calcd. for $C_{14}H_{16}O_4$ (IV): C, 67.72; H, 6.50. Found: C, 67.75; H, 6.56. The approximate formula $C_{23-25}H_{28-34}N_2O_{10-11}$ is assigned to V (calcd. for $C_{23}H_{28}N_2O_{10}$: C, 56.09; H, 5.73; N, 5.69. Found: C, 56.65; H, 5.44; N, 5.74. The cleavage of II yields V and an optically inactive acid (VI), m.p. 138–144° (calcd. for $C_{14}H_{18}O_4$: C, 67.18; H, 7.25. Found: C, 67.45; H, 6.93). From III are obtained 2,2-dimethyl-6-carboxychroman[4] (VII) and an optically inactive neutral compound (VIII) melting at 203–206° (calcd. for $C_{12}H_{14}O_3$ (VII): C, 69.88; H, 6.84. Found: C, 69.80; H, 6.71. Calcd. for $C_{14}H_{11}NO_5$ (VIII): C, 61.54; H, 4.06; N, 5.13. Found: C, 61.59; H, 3.77; N, 5.06). The identity of VII was established by comparison of melting points of VII and of its *p*-bromophenacyl ester with the published values, as well as by infrared and ultraviolet comparison of VII with an authentic sample graciously supplied by Prof. W. M. Lauer.

Catalytic hydrogenation of IV yields VI. Treatment of IV with alcoholic sodium hydroxide deacetylates it to a dibasic acid (IX) melting at 103–106°, with $pK'_a$s of 6.2 and 11.0 in 66% ethanol (calcd. for $C_{12}H_{14}O_3$: C, 69.88; H, 6.84. Found: C, 69.89; H, 6.94). The characteristic ultraviolet absorption spectrum of IX is consistent with that of a substituted *p*-hydroxybenzoic acid, the substituent in this case would be a pentenyl side-chain in which the double bond is not conjugated with the ring. The nature and position of the pentenyl group was deduced as follows: A band at 842 cm.$^{-1}$ in the infrared spectra of IV and IX was consistent with the presence of an isopropylidene group. Successive oxidations of IV with osmium tetroxide and sodium periodate yielded acetone as a major product. Finally, IV was converted to VII upon heating in 4 *N* hydrochloric acid in 70% ethanol. The structure 4-acetoxy-3-(3-methyl-2-butenyl)-benzoic acid was assigned to IV, 4-acetoxy-3-(3-methylbutyl)-benzoic acid to VI, and 4-hydroxy-3-(3-methyl-2-butenyl)-benzoic acid to IX. The linkage of this moiety (IX) to the rest of the streptonivicin molecule is through its carboxylic acid function.



Additional structural features of I will be published at a later date.

We are grateful to William A. Struck and associates for the analytical data.

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[4] Walter M. Lauer and Owen Moe, THIS JOURNAL, **65**, 289 (1943).

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## A SYNTHESIS FOR 3,5-DIARYL-1-(5'-TETRAZOLYL)-(1H)TETRAZOLIUM BETAINES

*Sir:*

We wish to report the synthesis of a new class of tetrazolium betaines which are derived from (1H)-tetrazole.[1] All of the tetrazolium salts which have previously been reported have been prepared, directly or indirectly, by the oxidation of 1,3,5-trisubstituted formazans.[2] This oxidative ring closure affords only derivatives of (2H)tetrazole.[3]

It was demonstrated by Busch and Pfeiffer that treatment of a 1,3-diaryltetrazene with an aromatic aldehyde produces a 1,3,5-triarylformazan instead of the expected aldimine derivative of tetrazene.[4] This phenomenon was explained in terms of a facile tetrazene–formazan rearrangement. A

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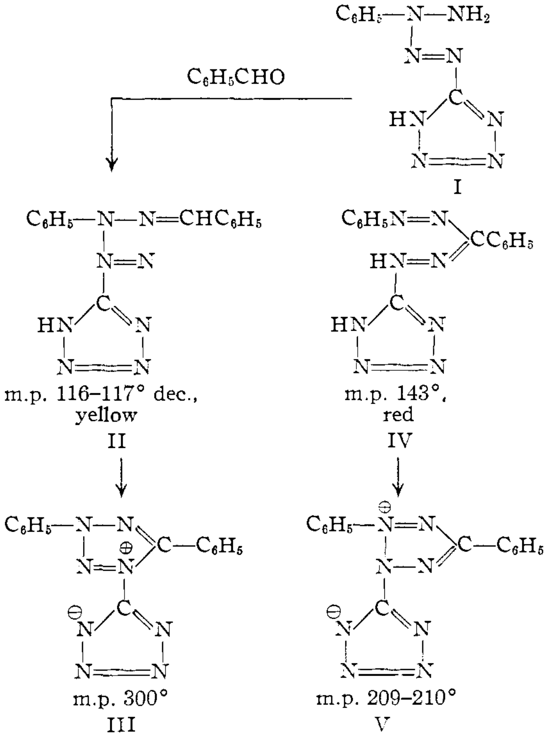
[1] The designation "(1H)" indicates that the salt is formed by the quaternation of a 1-substituted tetrazole.

[2] For an excellent discussion of this subject see A. W. Nineham, *Chem. Revs.*, **55**, 385 (1955).

[3] The preparation of a (1H)tetrazolium betaine has recently been reported by S. Hunig and O. Boes, *Ann.*, **579**, 28 (1953). However, the structure is not known with certainty.

[4] M. Busch and H. Pfeiffer, *Ber.*, **59**, 1162 (1926).

recent study confirms Busch's initial hypothesis and, furthermore, suggests that the rearrangement is probably intramolecular.[5] However, we have found that the interaction of 1-(5'-tetrazolyl)-3-phenyltetrazene (I) and benzaldehyde yields a relatively stable benzaltetrazene (II), m.p. 116–117 dec. (*Anal.* Calcd. for $C_{14}H_{12}N_8$: C, 57.52; H, 4.14; N, 38.34. Found: C, 57.30; H, 4.33; N, 38.04) instead of the corresponding formazan (IV). Oxidation of this yellow solid (II) with cold concentrated nitric acid gave 3,5-diphenyl-1-(5'-tetrazolyl)(1H)-tetrazolium betaine (III), m.p. 300° (*Anal.* Calcd. for $C_{14}H_{10}N_8$: C, 57.92; H, 3.47; N, 38.61. Found: C, 58.12; H, 3.76; N, 38.50). That the oxidation product (III) was, indeed, a tetrazolium betaine was established from the degradation of this solid with hot concentrated hydrochloric acid which gave a mixture of 5-hydroxytetrazole (60% yield) and 2,5-diphenyltetrazole (98% yield). However, the degradative evidence did not permit the unequivocal assignment of the relative positions of the tetrazolyl and N-phenyl substituents. Thus, it is conceivable that structure V might afford the same degradation products.



Quite fortunately, Kuhn and Kainer had earlier described the synthesis of 2,5-diphenyl-3-(5'-tetrazolyl)(2H)tetrazolium betaine (V), m.p. 209–210°, which was obtained by the oxidation of the corresponding formazan (IV) with N-bromosuccinimide.[6] Compound IV, m.p. 143°, possesses the red color that characterizes the formazans[2] and was obtained by the action of benzenediazonium chloride on benzal 5-tetrazolylhydrazone.

The differences noted between II and IV, and III and V preclude the possibility of a tetrazene–formazan rearrangement in the present study and hence lend credence to the (1H)-tetrazolium structure assigned to III.

We have employed the procedure described above for the preparation of a variety of 3,5-diaryl-1-(5'-tetrazolyl)(1H)tetrazolium betaines by introducing electronegative substituents in the benzene residue of I together with the use of substituted benzaldehydes. These compounds will be described in detail in a future communication.

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RECEIVED NOVEMBER 8, 1955

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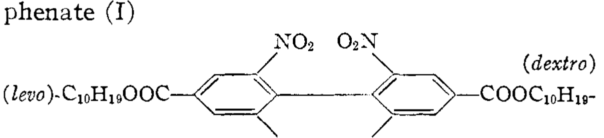
## MOLECULAR DISSYMMETRY AND OPTICAL INACTIVITY

*Sir:*

We wish to report the synthesis of (*dextro*)-menthyl (*levo*)-menthyl 2,6,2',6'-tetranitro-4,4'-diphenate (I)



I

*an optically inactive and configurationally pure compound[1] whose individual molecules are asymmetric.*

Despite the total lack of molecular reflection symmetry, *i.e.*, the absence of plane, point of 4*n*-fold alternating axis of symmetry, rotameric interconversions ensure statistically equal populations of enantiomeric conformations and thus account for the observed optical inactivity.[2]

Compound I may be variously regarded either as (1) a *meso* diastereomer for which no symmetric conformation is possible, or as (2) a non-resolvable racemic mixture of conformational type. In either case I appears unique in that its enantiomeric conformations are interconverted by rotameric changes which cannot involve passage through any symmetric conformation.[2] An adequate discussion of this and related matters requires the reexamination of certain fundamental generalizations pertaining to molecular dissymetry and optical activity, a task which we hope to approach in full publication.

The stereoisomers of I were prepared as follows. Action of copper on methyl 4-chloro-3,5-dinitrobenzoate gave methyl 2,6,2',6'-tetranitro-4,4'-diphenate, m.p. 192–192.5°[3] (Found: C, 42.9; H, 2.0; N, 12.5), acid hydrolysis of which yielded 2,6,2',6'-tetranitro-4,4'-diphenic acid (II), m.p. 338–342° (Found: C, 40.2; H, 1.8; N, 13.0). Conversion of II to the acid chloride with thionyl chloride, followed by treatment with (−)-menthol in pyridine, gave (−)-menthyl 2,6,2',6'-tetranitro-4,4'-diphenate (III), m.p. 225–226°, $[\alpha]^{28}D$ −59.4° (benzene); Found: C, 58.5; H, 5.6; N, 8.3. Similar treatment of the acid chloride of II with (+)-menthol yielded (+)-menthyl 2,6,2',6'-tetranitro-4,4'-diphenate (IV), m.p. 225–226°, $[\alpha]^{28}D$

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[5] H. Hauptmann and A. C. de M. Perisse, *Experientia*, **10**, 60 (1954).

[6] R. Kuhn and H. Kainer, *Angew. Chem.*, **65**, 442 (1953).

[1] As distinguished from a racemate or racemic mixture.

[2] K. Mislow, *Science*, **120**, 232 (1954).

[3] F. Ullmann and J. Bielecki, *Ber.*, **34**, 2174 (1901), report m.p. 173°.