The Physical Constants of Pentanol-3

BY FRANK C. WHITMORE AND J. D. SURMATIS

Pure pentanol-3 was required in large quantity for work in progress in this Laboratory. Since the physical constants for the carbinol reported in the literature[1] show wide disagreement, a study was made on the purity of material synthesized in the laboratory and that obtained from Sharples Solvents Corporation.

Propionaldehyde, b. p. 48.0° at 736 mm., $n^{20}D$ 1.3636, was prepared by dehydrogenation of *n*-propyl alcohol with a copper catalyst. It was treated in four 8-mole lots with ethylmagnesium chloride in anhydrous ethyl ether. The crude product obtained in 67% yield after distillation through a column of approximately 25 theoretical plates, was refractionated through a column, 2 × 260 cm. of the total condensation partial take-off type, having approximately 85 theoretical plates. From this distillation a yield of 90% of constant boiling and constant index material resulted. The boiling point was determined in a laboratory Cottrell apparatus, with a thermometer calibrated against one checked by the Bureau of Standards; the refractive index was determined by a Valentine refractometer: b. p. 114.4° at 740 mm., $n^{20}D$ 1.4104, d^{20}_4 0.8218.

Approximately 2800 g. of Sharples pentanol-3 was distilled through a column of approximately 16 theoretical plates, and then refractionated twice through the 85-plate column described above. Of the starting material 27% was obtained with the physical constants: b. p. 114.3–114.5° at 741.5 mm., $n^{20}D$ 1.4102–1.4104, d^{20}_4 0.8203.

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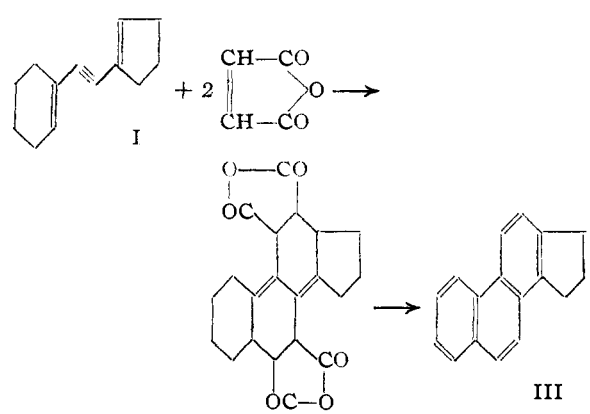
(1) Brunel, THIS JOURNAL, **45**, 1334 (1923); Lucas and Moyse, *ibid.*, **47**, 1460 (1925); Morris and Cortese, *ibid.*, **49**, 2644 (1927); Sherrill Otto and Pickett, *ibid.*, **51**, 3027 (1929); Timmermans and Hennaut-Roland, *J. chim. phys.*, **29**, 529 (1932); Clark and Hallonquist, *Trans. Roy. Soc. Can.*, [3] **24**, 115 (1930); Lauer and Stodola, THIS JOURNAL, **56**, 1216 (1934); Brooks, *ibid.*, **56**, 1998 (1934); Packendorff, *Ber.*, **67**, 905 (1934).

COMMUNICATIONS TO THE EDITOR

THE TOTAL SYNTHESIS OF A NON-BENZENOID STEROID[1]

Sir:

We reported in the last paper[2] that a derivative of hexahydronaphthalene results from the addition of maleic anhydride to 2,5-dimethyl-1,5-hexadiene-3-yne. It has now been found that an analogous reaction occurs when the hydrocarbon I[3] is heated with one mole of maleic anhydride at 130° without solvent. The crystalline product, from ethyl acetate or benzene, has m. p. 249–251° (cor.) with decomposition, and is converted in low yield to 15,16-dihydro-17-cyclopenta[a]phenanthrene (III), m. p. 132–133° (cor.), by heating with palladium–charcoal. This hydrocarbon did not depress the m. p. of an authentic specimen[4] kindly furnished by Dr. Erich Mosettig. *Anal.*[5]



15,16-Dihydro-17-cyclopenta[a]phenanthrene

Calcd. for $C_{21}H_{20}O_6$: C, 68.5; H, 5.5. Found: C, 68.7; H, 5.6. Calcd. for $C_{17}H_{14}$: C, 93.5; H, 6.5. Found: C, 93.5; H, 6.5. Structure II is tentatively assigned to the compound $C_{21}H_{20}O_6$ on the basis of analogy with the hexahydronaphthalene previously[2] described and the absorption curve of the solution in ethanol, λ max. 2555 Å., ε 19,000. It is suggested that a compound of this

(1) This work is supported by Bankhead-Jones funds. (Not subject to copyright.)

(2) Butz, Gaddis, Butz and Davis, *J. Org. Chem.* (recently submitted for publication). The present communication is the fourth paper in the series "Synthesis of Condensed Ring Compounds."

(3) Pinkney, Nesty, Wiley and Marvel, THIS JOURNAL, **58**, 972 (1936).

(4) Burger and Mosettig, *ibid.*, **59**, 1307 (1937).

(5) By Arlington Laboratories, Arlington, Virginia.

structure be called 8(14),9-steradiene-6,7,11,12-tetracarboxylic-6,7,11; 12-dianhydride.

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RECEIVED MARCH 18, 1940

FURTHER COMPOUNDS HAVING ANTI-HEMORRHAGIC ACTIVITY

Sir:

In an investigation involving the synthesis and assay of a number of additional naphthoquinones and derived or related products, considerable data have been accumulated on the problem of correlating vitamin K activity and structure which will be presented after completion of adequate assays on the entire series of compounds synthesized in the two Laboratories. In the meantime we wish to report certain observations from the synthetic work and give some indication of the potencies of the new compounds.

The method developed by one of us for the synthesis of vitamin K_1 [Fieser, THIS JOURNAL, **61**, 2559, 3467 (1939)] has been found capable of wide application. By using 1,4-naphthohydroquinone as one component 2-geranyl, 2-farnesyl, and 2-phytyl-1,4-naphthoquinone have been synthesized in good yield. The phytyl compound [yellow oil, found: C, 82.82; H, 10.31] is the most active member of the series and gives a full response in the chick assay at 50 γ. Similarly the 3-farnesyl derivative of 2-methyl-1,4-naphthoquinone [found: C, 82.97; H, 8.98] is more potent than the 2-geranyl derivative but somewhat less active than vitamin K_1. The synthesis is also applicable in the benzohydroquinone series. 2,3,5-Trimethyl-6-phytyl-1,4-benzoquinone [yellow oil, found: C, 81.04; H, 11.00, hydroquinone diacetate, m. p. 56°] shows no vitamin K activity but it provides a new route to a vitamin E factor. By treatment with stannous chloride in acetic–hydrochloric acid the quinone was converted smoothly into α-tocopherol, identified through the allophanate, m. p. 175–176°, and *p*-nitrophenylurethan, m. p. 130°. Butadiene-toluquinone condenses with phytol under the usual conditions but at the reflux temperature, giving rise to 2 - methyl - 3 - phytyl - 5,8 - dihydro - 1,4 - naphthoquinone [found: C, 82.27; H, 10.86], which is active at a level of 5–6 γ. By hydrogenating synthetic vitamin K_1 and purifying the products in the form of the solid hydroquinones, the β,γ-dihydride (active at 6 γ, hydroquinone diacetate, m. p. 57–58°) and $\beta,\gamma,5,6,7,8$-hexahydride (slight activity, diacetate derivative, m. p. 53°) have been obtained in analytically pure form. Both butadiene-toluquinone and 2-methyl-5,8-dihydro-1,4-naphthohydroquinone show marked activity, the latter at dosages as low as 8 γ.

A by-product of the vitamin K_1 synthesis, characterized as a ketonic substance of the formula $C_{31}H_{48}O_2$ [found: C, 82.38; H, 10.65; maxima at 253 and 300 mμ; 2,4-dinitrophenylhydrazone m. p. 107–108°], shows moderate vitamin K activity (50 γ). The Zerewitinoff determination indicates the presence of one active hydrogen and one carbonyl group. Aluminum isopropylate reduction gives a diol, probably $C_{31}H_{52}O_2$ [found: C, 81.52; H, 11.48], and pyrolysis of the by-product gives rise to small amounts of vitamin K_1. The isomeric naphthotocopherol [found: C, 82.30; H, 10.69; maxima at 246 and 320 mμ; *p*-nitrobenzoate, m. p. 84–85°] is active at a higher level (300 γ); on oxidation it yields a yellow hydroxyquinone [found: C, 79.19; H, 10.17].

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RECEIVED MARCH 20, 1940

THERMAL DECOMPOSITION OF ACETONE CATALYZED BY IODINE

Sir:

Several investigators[1] have shown that small amounts of iodine sensitize the thermal decomposition of various organic compounds. In the case of acetone, Bairstow and Hinshelwood[1a] have reported that the decomposition was not appreciably affected by the presence of iodine. However, Rice and Weiler[2] observed that the decomposition of acetone containing methyl iodide was appreciably faster than the rate for pure acetone. Moreover it was found that the addition of approximately 1% of ethyl iodide enormously increased the rate of decomposition of acetone at 526°.[3] When a small amount of ethyl iodide was allowed to decompose completely in the reaction vessel first and then the acetone added, a large increase in the rate also was observed. This

(1) (a) Bairstow and Hinshelwood, *J. Chem. Soc.*, 1147 (1933); (b) P. A. K. Clusius, *ibid.*, 2607 (1930); (c) Faull and Rollefson, THIS JOURNAL, **58**, 1755 (1936); Rollefson and Garrison, *ibid.*, **62**, 588 (1940).

(2) Weiler, Dissertation, Johns Hopkins University, 1930.

(3) Rice and Walters, unpublished results.

indicated that the iodine which was present in the decomposition products from ethyl iodide[4] was responsible for a large part of the promoting effect.

In the present investigation, we have found that small amounts of pure iodine actually do accelerate the decomposition of acetone in the neighborhood of 500°. The apparatus for this work is of the usual type and includes a Bodenstein valve and a click gage.

Temp., °C.	P_0, mm.	%, I_2	$(\Delta P/P_0)$ % 20–0 min.
506	168	0.00	7.5
506	178	3.60	57.6
493	215	0.00	3.3
493	207	1.55	29.5

(4) Ogg, THIS JOURNAL, **56**, 526 (1934).

From the Table it can be seen that addition of 2–3% of iodine causes the pressure change for the first twenty minutes of the reaction to increase by a factor of eight. The temperature at which Bairstow and Hinshelwood attempted the catalysis of acetone was not given, so that their failure to observe any catalysis may have been due to the fact that they were working in a different temperature range.

We are actively engaged in completing this investigation of acetone and intend to study other ketones such as diethyl and ethyl methyl ketones.

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W. D. WALTERS

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NEW BOOKS

May's Chemistry of Synthetic Drugs. By PERCY MAY, D.Sc. (Lond.), F.I.C., Consulting Chemist and Chartered Patent Agent, and G. MALCOLM DYSON, Ph.D., F.I.C., A.M.I. Chem.E., Chief Chemist, Genatosan Ltd. Fourth Edition, revised and rewritten. Longmans, Green and Company, Inc., 114 Fifth Avenue, New York, N. Y., 1939. xii + 370 pp. Illustrated. 14 × 22.5 cm. Price, $6.00.

During the past two decades there has been a steadily increasing demand for books which would adequately set forth in clear and concise fashion the salient facts dealing with the relations between the chemical constitution and physiological action of medicinal products and related substances. Despite this evident need there have been surprisingly few ventures into this field of scholarly activity.

May's "Chemistry of Synthetic Drugs," published some thirty years ago (the third edition appeared seventeen years ago), has deservedly had wide popularity. It has given readers an insight into the fundamental concepts of the field, without being handbook in nature. Indeed it was apparently never designed to serve in the role of a monograph which would point the way to new fields of research for the specialist. Rather it has been useful to young chemists who have desired a broad viewpoint of the field of medicinal products, without being compelled to delve into a maze of technical chemical and physiological information.

This, the fourth edition, has arisen from the joint efforts of Percy May and G. Malcolm Dyson. The general plan of the older editions has been followed, but a large amount of new material has been added. It has also been modernized by the inclusion of information on such subjects as hormones, vitamins, steroids, cardiac glucosides, and anthelmintics. Among the sections which have been enlarged are those dealing with hypnotics, mercurials, antiseptics, local anesthetics, analgesics, and alkaloids.

American readers, specialists in the field, will doubtless find cause for real criticism in the rather British and Continental flavor of the book, for it passes over lightly, or not at all, some of the fine developments which have come from the academic and industrial laboratories of this country. Nevertheless the authors have made a real contribution, and the book will unquestionably continue to play the important role which it has played since it was first written by Dr. May.

ARTHUR J. HILL

Plant Viruses and Virus Diseases. By F. C. BAWDEN, M. A., Virus Physiologist, Rothamsted Experimental Station. Chronica Botanica Company, P. O. Box 8, Leiden, Holland, and G. E. Stechert and Company, 31 East 10th Street, New York, N. Y., 1939. 272 pp. 37 figs. 16.5 × 25 cm. Price, Dutch guilders 7, or about $4.00.

Chemists have never been over-modest in their ideas as to the role of chemistry in the scheme of things. Bancroft, for example, has argued eloquently that all the natural sciences are mere provinces of the Chemical Empire. The developments of science in the past few years have certainly favored this *Weltanschauung*. Nevertheless, until very recently even chemists might have hesitated to designate as chemical a book on viruses, *i. e.*, living organisms defined as "obligate parasitic pathogens with at least one dimension less than 200 μ."