moved by filtration and recrystallized once from glacial acetic acid and three times from ethyl acetate to give pale yellow crystals, m. p. 170.9–172.0°.

Anal. Calcd. for $C_{14}H_{11}O_5N$: C, 61.54; H, 4.06. Found: C, 61.33, 61.60; H, 4.04, 3.99.

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Hydroxyethylmorphine

BY WARNER W. CARLSON AND L. H. CRETCHER

The typical result of alkylating the phenolic hydroxyl of morphine has been found to be the production of codeine-like effects, almost regardless of the chemical nature of the alkylating group.[1] However, since no reference could be found to the preparation of a hydroxyalkyl ether derivative of morphine, the alkaloid was hydroxyethylated by the procedure previously developed for use with nitrogenous phenols.[2]

Toxicity of the derivative was determined by the subcutaneous (abdominal) injection of graded doses of the compound in white mice (17 to 19 g. weight range). The results are given in Table I, along with the values listed by Small and Eddy[1] for the parent alkaloid and its methyl and ethyl ethers. Introduction of the hydroxyethyl group was found to produce a marked decrease both in acute toxicity and convulsant action. Hydroxyethylmorphine also failed to elicit the Straub reaction or circus movements in the animals. In its actions the hydroxyethyl derivative resembles γ-isomorphine, which has an LD 50 of 2000 mg./kg. and does not produce the Straub reaction or circus movements in mice.[1]

TABLE I

ACUTE TOXICITY OF HYDROXYETHYLMORPHINE TO WHITE MICE

Substituent at position 3	LD 50 mg./kg., as free base	Convulsant action, mg./kg.	Straub reaction
HO—	531	531	Present
CH_3O—	241	161	Present
C_2H_5O—	136	122	Present
HOC_2H_4O—	2500	2500	Absent

A preliminary estimate of analgesic potency in white mice was made by the method of Woolfe and MacDonald,[3] morphine and codeine being used as reference compounds. The results are given in Table II, from which it is estimated that codeine is approximately 1/10, and hydroxyethylmorphine 1/15, as analgesic as the parent alkaloid.

Experimental

Hydroxyethylmorphine.—A mixture of 5.7 g. of morphine, 8.3 g. of potassium carbonate, and 100 g. of ethylene carbonate[2] (in excess as solvent) was heated with stirring for seventy-five minutes at 98°, cooled, and poured into an excess of cold aqueous alkali. The solution was extracted three times with 50-cc. portions of chloroform, the extracts united and the product extracted by 20 cc. of 0.1 *N* hydrochloric acid. The solution was made alkaline and the product again extracted into chloroform; because of the marked water solubility of the derivative, it was not feasible to wash the extract. The chloroform solution was evaporated to a sirup under reduced pressure, the residue dissolved in boiling absolute alcohol, and the solution cooled, hydroxyethylmorphine crystallizing. Recrystallized from the same solvent (30 cc. of alcohol per g. of compound) the derivative was obtained as colorless crystals; m. p. 190°; yield, 4.6 g.; $[\alpha]_D$ −124.8° (methanol).

TABLE II

ANALGESIC POTENCY OF HYDROXYETHYLMORPHINE

Drug	Dose, mg./kg., as free base	Animals showing analgesia, %	Av. time to develop analgesia minutes	Average duration of analgesia minutes
Morphine	10	100	14	29
	20	100	12	80
Codeine	50	60	14	31
	100	100	14	41
Hydroxy-ethylmorphine	50	66	12	32
	100	66	12	34
	150	100	10	38
	200	100	10	58

Anal. Calcd. for $C_{19}H_{23}NO_4$: C, 69.26; H, 7.04; N, 4.26. Found: C, 69.02; H, 7.08; N, 4.36.

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[1] Small and Eddy, U. S. Public Health Reports, Supplement No. 138, U. S. Government Printing Office, Washington, D. C., 1938.

[2] Carlson and Cretcher, THIS JOURNAL, **69**, 1952 (1947).

[3] Woolfe and MacDonald, *J. Pharm. Exp. Therap.*, **80**, 300 (1944).

The Ultraviolet Absorption Spectra of 1,1'- and 2,2'-Binaphthyl

BY VERNON L. FRAMPTON, JOSEPH D. EDWARDS, JR., AND HENRY R. HENZE

In a very recent article concerning the ultraviolet absorption spectra of some naphthalene derivatives, Friedel, Orchin and Reggel[1] call attention in a footnote to differences between the spectra as determined by them for 1,1'- and 2,2'-binaphthyl and those noted previously by Adams and Kirkpatrick.[2] The significance of these data is such as to warrant this communication to confirm the location of the absorption maxima reported by Friedel, Orchin and Reggel, since, as they appear to us, the ultraviolet absorption spectra of 1,1'-binaphthyl and, especially, of 2,2'-binaphthyl were of fundamental importance in the selection by Adams, *et al.*, of a binaphthyl as the basic nucleus of gossypol.

1,1'-Binaphthyl has been resynthesized[3] by three different procedures, namely: (a) by the Wurtz–Fittig reaction[4] starting with 1-chloronaphthalene; (b) according to the method of Ull-

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[1] Friedel, Orchin and Reggel, THIS JOURNAL, **70**, 199 (1948); see footnote (10).

[2] Adams and Kirpatrick, *ibid.*, **60**, 2181 (1938).

[3] These experimental data are drawn from a thesis presented by Joseph Daniel Edwards, Jr., to the Faculty of the Graduate School of the University of Texas in partial fulfillment of the requirements for the Master of Arts degree, January, 1948.

[4] Rodd and Linch, *J. Chem. Soc.*, 2178 (1927).

mann[5] using 1-bromonaphthalene; (c) utilizing the Grignard reaction[6] with 1-bromonaphthalene. The melting points of the samples of 1,1′-binaphthyl[7] prepared by these procedures were 157.5, 157.2 and 157.5°, respectively; a mixture of the three preparations melted at 157.5°.

In Fig. 1 are presented the ultraviolet absorption spectra for these three samples, which were determined with a Beckman quartz spectrophotometer using 95% ethyl alcohol as solvent, together with the data[8] taken from the Fig. 2 published by Adams and Kirkpatrick.[2] In our Fig. 1 are included also data recorded still earlier by Pestemer and Cecelsky[9] using a hexane solution of 1,1′-binaphthyl. The low wave length absorption band which we report is at 220–224 millimicrons, which is in satisfactory agreement with the band at 226 millimicrons reported by Friedel, *et al.*,[1] but is in disagreement with the location of the absorption band at 238 millimicrons according to Adams and Kirkpatrick.

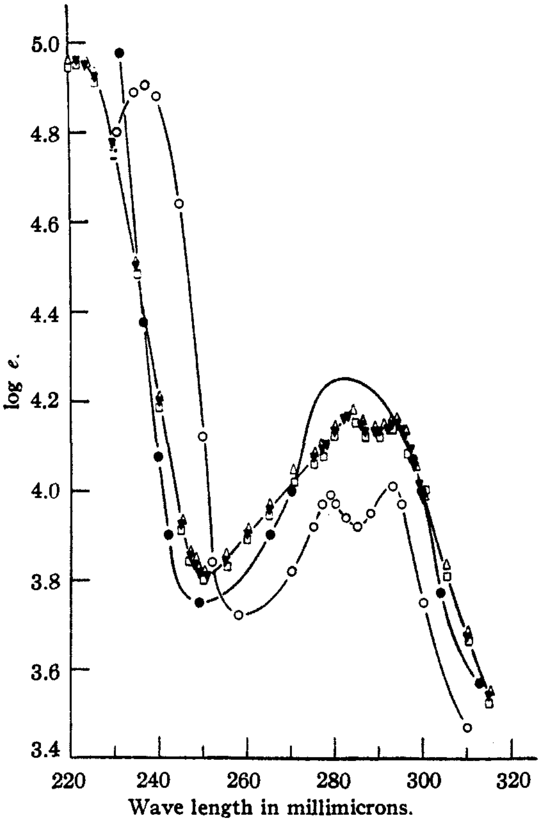

Fig. 1.—Ultraviolet absorption spectra for 1,1′-binaphthyl: ▼, 1,1′-binaphthyl prepared by the Wurtz–Fittig synthesis; △, Ullmann synthesis; □, Grignard synthesis; ○, data of Adams and Kirkpatrick; ●, data of Pestemer and Cecelsky.

2,2′-Binaphthyl,[10] melting at 187°, was synthesized through the Grignard reaction with 2-iodonaphthalene. The absorption spectrum for 2,2′-binaphthyl is presented in Fig. 2. In agreement with the findings of Friedel, *et al.*, a thorough investigation throughout the region 260–300 millimicrons did not yield evidence for the existence of an absorption maximum at 297 millimicrons, as reported by Adams and Kirkpatrick. Otherwise, the absorption spectra for 2,2′-binaphthyl are in reasonable agreement.

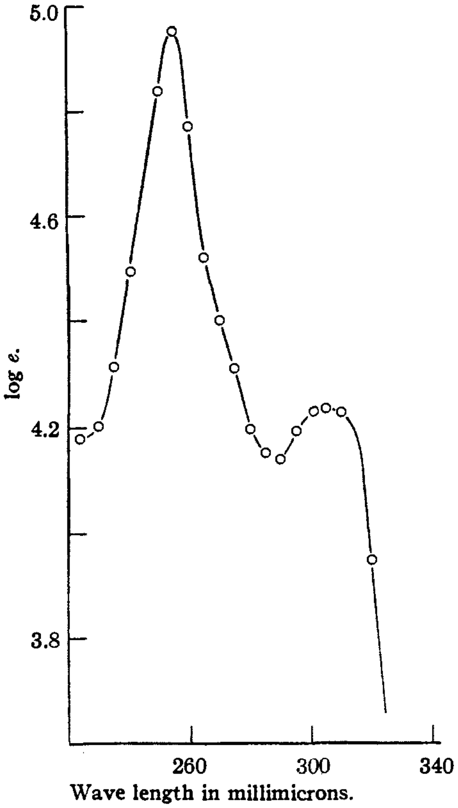

Fig. 2.—Ultraviolet absorption spectrum for 2,2′-binaphthyl.

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AUSTIN, TEXAS

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(5) Ullmann and Bielecki, *Ber.*, **34**, 2184 (1901).

(6) Sakellarios and Kyrimis, *ibid.*, **57**, 324 (1924).

(7) The melting point behavior is considerably influenced by the rate of heating. Samples can be shown to exhibit sintering at temperatures lower than the m. p. of 157.5° by very rapid heating. *Cf.* Orchin and Friedel, THIS JOURNAL, **68**, 573 (1946).

(8) These data were obtained using dioxane as solvent; however, identical data were reported utilizing ethyl alcohol as solvent.

(9) Pestemer and Cecelsky, *Monatsh.*, **59**, 119 (1932).

(10) Vesely and Stursa, *Coll. Czechoslov. Chem. Commun.*, **4**, 139 (1932), reported m. p. of 187° for a sample of 2,2′-binaphthyl obtained using lithium as the coupling agent.

The Purification of Neopentane by Mercury Photosensitization[1]

BY B. DEB. DARWENT AND E. W. R. STEACIE

In a study of the mercury photosensitized reactions of neopentane it was found necessary to