and the amine in benzene and were precipitated with hexane, from which they were subsequently recrystallized.

Summary

Three new dialkylaminoethyl bromide hydrobromides have been prepared by a previously known method. The corresponding dialkylaminoethylamines have been prepared by a new method in which the yield was unsatisfactory with the methyl derivative. These amines have been converted into α-naphthylureas.

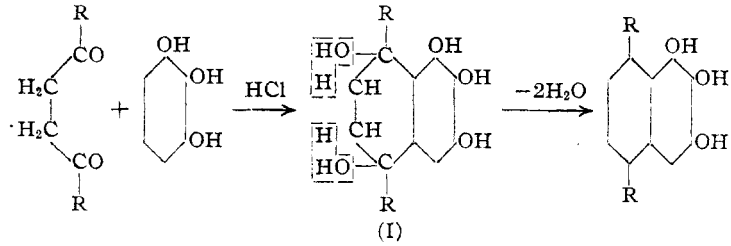
STORRS, CONNECTICUT RECEIVED OCTOBER 26, 1940

[CONTRIBUTION FROM THE CHEMICAL LABORATORIES OF NEW YORK UNIVERSITY]

Syntheses in the Naphthalene and Anthracene Series[1]

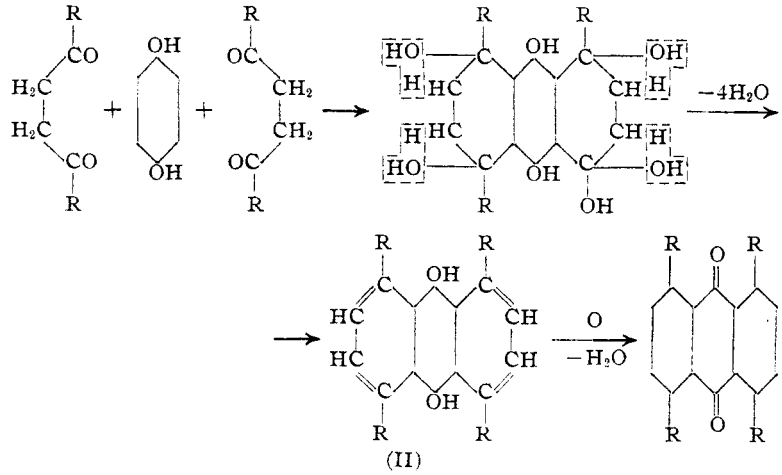
BY JOSEPH B. NIEDERL AND RICHARD H. NAGEL[2]

When the systematic investigations of the condensations of mono- and di- carbonyl compounds with phenols[3] were extended to include the condensations of γ-di-ketones with pyrogallol and hydroquinone, cyclizations followed by aromatizations were encountered. Di-acetone and pyrogallol underwent a single, but the same ketone and hydroquinone underwent double, cyclization–aromatization. In the first case (Reaction "A"), a new naphthalene compound, the 1,2,3-tri-hydroxy-5,8 - dimethylnaphthalene was produced, while in the second case (Reaction "B") an anthracene compound, the 1,4,5,8-tetramethylanthraquinone was formed, the latter involving, aside from double cyclization and aromatization of the two outer rings, de-aromatization of the center ring through oxidation.



(I)

REACTION "A"



(II)

REACTION "B"

For the formation of both types of compounds two reaction mechanisms are applicable. One would involve the conventional di-enolization of the γ-di-ketone. This reaction mechanism, which would be the simplest, has however the drawback that it would be inapplicable to condensation systems in which the same type of di-ketone and a mono-hydroxyphenol is used and where condensation products are formed which do not permit interpretation of formation through di-enolization of the reacting γ-di-ketone. The more general reaction mechanism would involve the assumption of the formation of intermediate "phenolhydrin" types of compounds[4] found thus far applicable without exception to all carbonyl compound–phenol condensations, and illustrated above

(1) Presented before the Division of Organic Chemistry at the recent Cincinnati (Naphthalene Compound Synthesis) and the Detroit (Anthracene Compound Synthesis) meetings of the American Chemical Society.

(2) Abstracted from a portion of the thesis submitted by Richard H. Nagel to the faculty of the Graduate School of New York University in partial fulfillment of the requirements for the degree of doctor of philosophy.

(3) J. B. Niederl and co workers, THIS JOURNAL, **50**, 2230 (1928); **51**, 2426 (1929); **58**, 657 (1936); **59**, 1113 (1937); **61**, 345, 348, 1005, 1785 (1939); **62**, 320, 322, 324, 1157, 3070 (1940).

(4) M. E. McGreal and J. B. Niederl, "Abstracts of Papers, 97th meeting Am. Chem. Soc.," Baltimore, Md., 1939, M, pp. 5–7.

Experimental

(I) 1,2,3-Trihydroxy-5,8-dimethylnaphthalene.—One mole of pyrogallol and one-half mole of diacetone were introduced into an Erlenmeyer flask and 70% sulfuric acid was added slowly until solution was complete. The flask with the reaction mixture was then placed in an ice-bath. In twenty-four hours the dark red liquid had solidified and was drained off on a porous tile. The crystals were then triturated with water to remove unchanged pyrogallol, dried and extracted with boiling chloroform. Upon cooling of the filtered chloroform extract the naphtho-pyrogallol crystallized out; m. p. 187° (uncor.).

Anal. Calcd. for $C_{12}H_{12}O_3$: C, 70.59; H, 5.90; mol. wt., 204. Found: C, 70.55, 70.62; H, 6.04, 6.05; mol. wt., 197.

(Ia) Acetate.—Ten grams of the above naphthopyrogallol (I) was refluxed for six hours with 50 cc. of acetic anhydride. The excess acetic anhydride was distilled off and hot alcohol was added to the residue. The resulting solution was filtered, and upon concentration the acetate crystallized out; m. p. 148–150° (uncor.).

Anal. Calcd. for $C_{16}H_{18}O_6$: C, 65.40; H, 5.40; mol. wt., 330. Found: C, 64.00; H, 5.28; mol. wt., 324.

(Ib) Phenylurethan.—One gram of the naphthopyrogallol (I) was treated with one cc. of phenyl isocyanate in a sealed test-tube and warmed for three hours on a steam-bath. The resulting semi-solid material was transferred to a porous tile and allowed to dry. The urethan was recrystallized from boiling benzene; m. p. 198° (uncor.).

Anal. Calcd. for $C_{33}H_{27}N_3O_6$: N, 7.48. Found: N, 7.43.

(II) 1,4,5,8-Tetramethylanthraquinone.—To a solution of one mole of hydroquinone and one-half of a mole of diacetone in glacial acetic acid, was added one mole equivalent of 70% aqueous sulfuric acid. After two days of standing the solidified mass was extracted exhaustively with water and crystallized from 95% boiling ethyl alcohol. The crystals, which are insoluble in alkali, were then recrystallized from diisobutylene; m. p. 235° (uncor.).

Anal. Calcd. for $C_{18}H_{18}O_2$: C, 81.20; H, 6.76. Found: C, 81.13; H, 6.78.

Summary

Further studies in the condensations of diketones with di- and trihydroxybenzenes showed that, aside from the previously reported indano-indanes ("dindanes"), known types of polycyclic compounds result. Thus diacetone with pyrogallol yielded an alkylated trihydroxynaphthalene while the same diketone with hydroquinone gave a tetraalkylated anthraquinone, thus adding a new method of synthesis for these types of compounds. A rather simple reaction mechanism was shown to be applicable to all these condensation reactions.

WASHINGTON SQUARE COLLEGE
NEW YORK, N. Y. RECEIVED SEPTEMBER 18, 1940

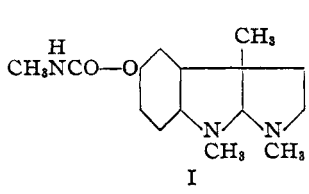
[CONTRIBUTION FROM THE RESEARCH LABORATORY OF MERCK & CO., INC.]

Physostigmine Substitutes

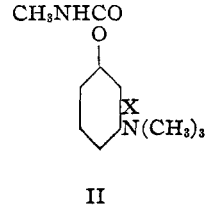
BY JOSEPH R. STEVENS AND RALPH H. BEUTEL

Stedman and co-workers have reported[1] that compounds of the types II and III showed marked physostigmine (I) activity whereas members of the corresponding ortho and para series were only slightly active.

These results seem surprising in view of the *p*-aminophenol structure of physostigmine. It occurred to us that this anomaly may be the result of activation by the alkyl residue ortho to the amino group attached to the benzene ring in physostigmine. In order to test this assumption, compounds with the formula (IV) and (V) were syn-



I



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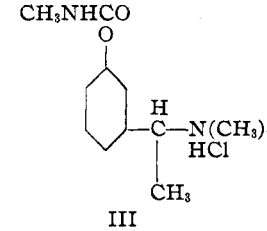
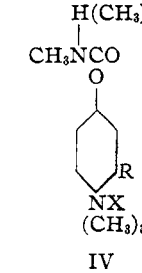
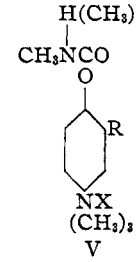


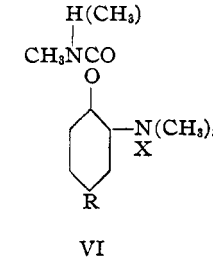
III



IV



V



VI

(1) E. Stedman, *Biochem. J.*, **20**, 719–734 (1926). E. Stedman, *ibid.*, **23**, 17–24 (1929). E. and E. Stedman, *J. Chem. Soc.*, 609–617 (1929).