have been studied chemically heretofore. Wax-like products were obtained in variable but small quantities from all of the 21 species. In none of these was the percentage found in excess of ten and some of it may have been derived from the epidermal cells rather than the secreting hairs.

Summary

Flavone was found to form at least 75% of the farina of twenty-one species of primula, by heating with 6 *N* hydrochloric acid, filtering the hot solution, cooling to 20° and separating the $C_{15}H_{10}O_2 \cdot HCl \cdot H_2O$ formed. The farina of *P. denticulata* contained about 10% of an orange-yellow compound, $C_{15}H_{10}O_4$, which melted at 228° and behaved like an undescribed dihydroxyflavone. A second yellow compound, $C_{15}H_{10}O_3$, which melted at 153° was separated from *P. verticillata*. Varying amounts of wax-like components were found in all the twenty-one species.

BERKELEY, CALIF. RECEIVED OCTOBER 25, 1944

NOTES

Bis-(trimethylenediamino)-cupric Sulfate

BY LAWRENCE H. AMUNDSEN[1] AND LENA A. MALENTACCHI

This substance was prepared for use as a germicide in the treatment of surface tissues by iontophoresis after the desired combination of properties had not been found in a number of other copper compounds, including the corresponding one from ethylenediamine. A report on these tests is expected to appear soon.[2]

Bis-(trimethylenediamino)-cupric sulfate is obtained readily from trimethylenediamine and cupric sulfate, either anhydrous (blue) or as a monohydrate (pinkish-purple). The hydrate is the stable form under ordinary conditions but loses water slowly at 56° and promptly at 100°. At room temperature it dehydrates in a desiccator over calcium sulfate (Drierite). The hydrate absorbs no more water under the atmospheric conditions prevailing in the laboratory except in the most humid summer weather, when some samples gained as much as 4–5% in weight. It is very soluble in water.

Experimental

Trimethylenediamine.—A solution was prepared from 882.4 g. (7.81 moles) of trimethylene chloride, 12636 cc. (187.4 moles) of ammonium hydroxide, and 7 liters of 95% ethanol and left standing in a stoppered bottle at room temperature (19–22°), samples being withdrawn at weekly intervals for determinations of ionizable chlorine (Table I). After five weeks the mixture was distilled to dryness under the vacuum of a water-jet pump (13 mm.).

TABLE I

YIELD OF CHLORIDE ION

Reaction period, days	% Theor.
7	33
14	63
21	82
28	88
35	92

(1) Present address: Department of Chemistry, University of Connecticut, Storrs, Conn.

(2) By Commander Armand J. Pereyra, Medical Corps, U. S. Navy.

After the addition of 1637 cc. (31.24 moles) of 50% sodium hydroxide the mixture again was distilled to dryness under vacuum. The distillate was collected in two fractions of 873 cc. and 720 cc., respectively. Water (220 cc.) was added to the residue and a third fraction was obtained by distilling to dryness again. The three fractions were saturated with sodium hydroxide. The upper layer was separated from each and dried over sodium hydroxide. The layers were separated again and more sodium hydroxide was added to the upper layers. This process was repeated until fresh sodium hydroxide remained unchanged when added to the products. Upon rectification through a 180-cm. column packed with glass helices, 161 g. of trimethylenediamine was obtained from the first fraction and 21.5 g. from the second, making a yield of 32% of the theoretical. No attempt was made to rectify the product from the third fraction because of its high viscosity and because of the low yield from even the second fraction. It presumably consisted largely of amines of higher molecular weight. The trimethylenediamine was collected at 48–50° at 20 mm. It boiled at 133° cor. at 754.5 mm.[3,4] The pressure was reduced to 5 mm. and the distillation was continued as long as any liquid would come over. When 21 cc. of material so obtained was rectified again in a semi-micro apparatus,[5] 9.4 g. of a product boiling at 128–131.5° at 20 mm. was obtained (b. p. 230.5° cor. at 760.2 mm.[2]). This compound is presumed to be bis-(γ-aminopropyl)-amine, which von Braun[4] reported that he obtained as a fraction boiling from 210–230°.

Bis-(trimethylenediamino)-cupric Sulfate.—A mixture of 15.4 g. (0.208 mole) of trimethylenediamine, 24.97 g. (0.1 mole) of C. P. cupric sulfate pentahydrate, and 15 cc. of water was boiled gently under a reflux condenser until all of the copper sulfate went into solution. The mixture then was placed in a vacuum desiccator over calcium chloride. From time to time the crust on the surface was broken up, and the drying was continued until there was no further loss in weight. The product was the monohydrate (Table II).

(3) The determination was made by the micro method described in Shriner and Fuson's, "Identification of Organic Compounds," second edition, John Wiley and Sons, Inc., New York, N. Y., 1940, p. 93.

(4) Fisher and Koch (*Ber.*, **17**, 1799 (1884)) reported 135–136° at 738 mm.; Putokhin (*Trans. Inst. Pure Chem. Reagents* (Moscow) No. 6, 10 (1927)), 135–136°; von Braun, *et al.* (*Ber.*, **70B**, 979 (1937)), 136–138°; Aspinall (THIS JOURNAL, **63**, 2843 (1941)), 131° at 760 mm.; Whitmore, *et al.* (*ibid.*, **66**, 725 (1944)), 138° at 735 mm. The higher boiling points may have been determined on samples that were not completely dry. Tests made during the present study showed that the boiling point was raised by the addition of a little water and, furthermore, that the apparent boiling point would be several degrees higher than reported above if the sample was exposed to the atmosphere of the laboratory for a few minutes during the determination.

(5) Weston, *Ind. Eng. Chem., Anal. Ed.*, **5**, 179 (1933).

TABLE II

ANALYSIS OF BIS-(TRIMETHYLENEDIAMINO)-CUPRIC SULFATE HYDRATE[6]

	% C	% H	% Cu	% N	% S
Calcd. for $C_6H_{20}CuN_4SO_4 \cdot H_2O$	22.11	6.81	19.51	17.19	9.84
Determined	21.88	6.40	19.51	16.80	9.66
Determined	21.98	6.44	19.69	16.54	9.99

When heated it changes to the blue anhydrous form and finally decomposes at 276–277° cor. with evolution of gas, leaving a brown residue. Samples of the hydrate were heated to 35, 57, 78 and 100° and kept at these temperatures, all samples being reweighed after 1, 3, 8, 10, and 14 days. At 35° there was no dehydration. At 57° dehydration progressed so slowly that it was not quite complete even after fourteen days. At both 78 and 100° the dehydration was complete after one day. At 100° the change appeared to take place instantly, but at 78° even the visible color change required about an hour. The anhydrous compound apparently is stable at 100° for no additional change in weight occurred during the fourteen-day period of heating. The product does not contain unreacted cupric sulfate because when a sample of it was treated with additional trimethylenediamine and water and dried, it went back to its original weight.

(6) All determinations were made by the Laboratory of Michrochemistry, 366 Fifth Avenue, New York, N. Y.

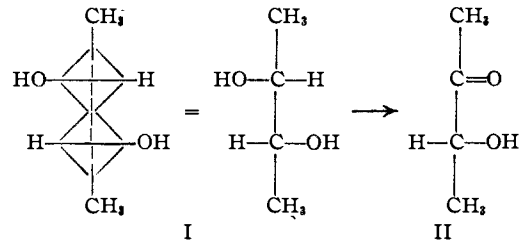
VENEREAL DISEASE RESEARCH LABORATORY
U. S. MARINE HOSPITAL
STATEN ISLAND, NEW YORK

RECEIVED SEPTEMBER 8, 1944

Configuration of Acetylmethylcarbinol

BY R. H. BLOM

The configurations of the optically active 2,3-butylene glycols have recently been correlated with the configurational system which Emil Fischer established for glucose, as D-(−) and L-(+)- for the levo- and dextro-rotatory forms, respectively.[1] The proof depends upon the established relationship of configuration between the methylethylcarbinols and the lactic acids.[2] In turn, the place of the lactic acids in the Fischer sugar system follows, for example, from the oxidation of the methyl 6-desoxy-hexopyranosides to the corresponding lactic acids.[3] In studying the vapor-phase oxidation of D-(−)-2,3-butylene glycol (I), it has been found that the acetylmethylcarbinol so formed (II) is levorotatory. Although extensive racemization occurred during the reaction, the rotation of the product was sufficient to establish the configurational relationship. Since the glycol and the carbinol can exist in only two active forms, D- or L-, racemization would form only the racemic structures in both cases. The acetylmethylcarbinols and the 2,3-butylene glycols which exhibit the same sign of rotation therefore possess the same configuration:



I D-(−)-2,3-Butylene glycol[4] II D-(−)-Acetylmethylcarbinol

A sample of D-(−)-2,3-butylene glycol,[5] $[\alpha]^{21}D$ −12.20° (C = 100%, 1-dcm. tube) was heated to 140° and vaporized by means of a stream of air. The vapors were passed through a Pyrex tube packed with copper turnings and maintained at 315°. On condensation and fractional distillation, the main products obtained were diacetyl (33% yield), b. r. 88–88.5° (uncor.) and acetylmethylcarbinol (25% yield), b. r. 142–144° (uncor.), $n^{21}D$ 1.4186, which values are in good agreement with the literature.[6] The latter was levorotatory, $[\alpha]^{21}D$ −1.39° (C = 100%, 1-dcm. tube). On standing for twenty-four hours at 4° crystals of the optically inactive dimer of acetylmethylcarbinol were deposited.[7] Since an optically pure isomer of acetylmethylcarbinol has not yet been conclusively obtained,[8] it is not possible to calculate the concentration of the active form present in the product. The acetylmethylcarbinol was identified by acetylation with acetic anhydride, acetoin acetate, b. r. 167–168°[9] being obtained.

The assistance of Dr. S. A. Morell in the preparation of this paper is gratefully acknowledged.

(4) The structural formulas used conform with the fundamental convention of Emil Fischer in that the lower edges of the tetrahedra lie in a straight line in the plane of the paper, the corners which carry (H) and (OH) groups thus being above the paper.

(5) G. E. Ward, O. G. Pettijohn, L. B. Lockwood and R. D. Coghill, THIS JOURNAL, **66**, 541 (1944).

(6) J. R. Pound and A. M. Wilson, *J. Phys. Chem.*, **39**, 1135 (1935).

(7) T. M. Lowry and W. C. G. Baldwin, *J. Chem. Soc.*, 704 (1935).

(8) W. Dirscherl and A. Schollig, *Ber.*, **71**, 418 (1938).

(9) M. Bergmann and S. Ludewig, *Ann.*, **436**, 173 (1924).

NORTHERN REGIONAL RESEARCH LABORATORY
BUREAU OF AGRICULTURAL AND INDUSTRIAL CHEMISTRY
AGRICULTURAL RESEARCH ADMINISTRATION
U. S. DEPARTMENT OF AGRICULTURE
PEORIA, ILLINOIS

RECEIVED DECEMBER 14, 1944

Carbobenzoxy Derivatives of Aromatic Amines

BY NORMAN C. BERGSTROM AND A. E. MARTELL[1]

A number of aromatic amines were treated with benzyl chlorocarbonate in order to determine the ease of acylation and the possible use of the reagent for obtaining crystalline derivatives of amines. The acylation of amines and amino acids with benzyl chlorocarbonate has been thoroughly described by Bergmann[2] and his method is essentially the one used here.

(1) Now at Clark University, Worcester, Mass.

(2) Bergmann and Zervas, *Ber.*, **65**, 1192 (1932).

The derivatives tabulated below were obtained merely by shaking the corresponding amine with slightly more than a molar equivalent of benzyl-chlorocarbonate in the presence of excess 10% sodium hydroxide solution. The product solidified in a few minutes, was filtered and then recrystallized from ethyl alcohol. The yields of recrystallized material were between 60 and 90% of the theoretical amount.

Product, carbonate	M. p., °C.	Nitrogen, % Calculated	Found
N-Phenyl-benzyl	77	6.16	6.11
N-*p*-Tolyl-benzyl	83	5.81	5.64
N-*o*-Tolyl-benzyl	83.5	5.81	5.62
N-*p*-Methoxy-phenyl-benzyl	98.0	5.83	5.65
N-*m*-Bromophenyl-benzyl	58.0	4.58	4.45

Orthoanisidine produced a liquid derivative which was not further investigated. Three of the above compounds have been prepared previously by the isocyanate method: N-phenyl-benzyl carbamate,[3] N-*o*-tolyl-benzyl carbamate,[4] and N-*p*-methoxyphenyl-benzyl carbamate.[5] The remaining two benzyl carbamates have not previously been reported. Nitrogen analyses were made by the Dumas method. Carbobenzoxy chloride was prepared by the method of Bergmann and Zervas.[2]

The low melting points and low melting point spread of these derivatives indicate that they would be of little value in the identification of the amines investigated. On the other hand they are prepared in excellent yield and seem to offer a convenient method for "masking" amino groups.

(3) Soden and Rojahn, *Ber.*, **34**, 2809 (1901).
(4) Gattermann and Cantzler, *ibid.*, **25**, 1807 (1892).
(5) Brunner and Wohol, *Monatsh.*, **63**, 374 (1930).

DEPARTMENT OF CHEMISTRY
WORCESTER POLYTECHNIC INSTITUTE
WORCESTER, MASS. RECEIVED NOVEMBER 22, 1944

Percain Analogs. The Preparation of β-Diethylaminoethoxyethyl 2-Alkoxy-cinchonates

BY CHI-CHIEK CHANG AND NENG-YÜAN WOO

Most 2-alkoxy-cinchonic acid derivatives exhibit a local anesthetic effect. In a series of β-diethylaminoethylamides of this acid prepared by Aeschlimann,[1] percain, the butoxy derivative, is the strongest, being ten times as active as cocaine, and is used in medicine.

Luré[2] showed that in a series of amino esters of these acids the anesthetic effect was to some extent dependent on the nature of the alkoxy group in the 2-position, but more on the side chain in the 4-position, the effect increasing with the increase of the number of the carbon atoms.

In a series of a different type of amides of these acids Magidson[3] proved that an increase in the number of the hydroxyl groups in the side chain in the 4-position decreases the anesthetic effect.

With these views in mind, we prepared a series of β-diethylaminoethoxyethanol esters of 2-alkoxy-cinchonic acids containing an O-atom in the side chain in the 4-position, and studied the change in the local anesthetic effect when the alkoxy group in the 2-position was varied.

β-Diethylaminoethoxyethanol was prepared by the method of Horne and Shriner.[4] 2-Chlorocinchonic acid was prepared by the method of Aeschlimann[1] or Thielepape,[5] and it was converted into a series of 2-alkoxycinchonic acids by the action of sodium alcoholate in the corresponding alcohols. From these, the acid chlorides, the esters, and finally the ester hydrochlorides were prepared.

2-Alkoxy-cinchonic Acid Chloride.—This was prepared by the action of thionyl chloride on a solution of the corresponding alkoxy-cinchonic acid[1,5] in benzene following the procedure of Gardner and Hammel.[6] In several repetitions of this procedure we found the yield to be dependent on the time of heating, as follows

Time of heating, min.	Amount of 2-alkoxy-cinchonic acid used, g.	Amount of acid recovered, g.
10	0.38	0.30
35	1.20	.25
60	1.40	.19

β-Diethylaminoethoxyethyl 2-Alkoxy-cinchonate Hydrochloride.—To a solution of the alkoxy-cinchonate chloride in about ten times its weight of benzene was added a slight excess of β-diethylaminoethoxyethanol. The mixture was heated at 60° for fifteen minutes. After cooling, the benzene solution was extracted with dilute hydrochloric acid. The ester was precipitated by neutralizing the acid solution with sodium carbonate, and was extracted with benzene. The benzene solution was dried with anhydrous sodium sulfate and treated with the calculated amount of hydrogen chloride gas. The mixture was allowed to stand for several hours and the precipitate was filtered off, washed with benzene, and dried in a desiccator. Yields and melting points are given in the table.

β-DIETHYLAMINOETHOXYETHYL 2-ALKOXY-CINCHONATE HYDROCHLORIDES

Alkoxy	Yield, %	M. p., °C.	Formula	Percentage composition Nitrogen Calcd.	Nitrogen Found	Chlorine Calcd.	Chlorine Found
-ethoxy-	64	80	$C_{20}H_{33}O_4N_2Cl$	7.02	7.10	8.94	9.03
-isopropoxy-	68	75	$C_{21}H_{35}O_4N_2Cl$	6.95	6.94	8.64	8.72
-butoxy-	66	108	$C_{22}H_{37}O_4N_2Cl$	6.72	6.77	8.35	8.50
-pentoxy-	66	78	$C_{23}H_{39}O_4N_2Cl$	6.50	6.53	8.08	8.12

These compounds, in 1% aqueous solution, produce a local anesthetic effect when tested by the tongue, but the pharmacological properties will be further investigated.

(4) Horne and Shriner, THIS JOURNAL, **54**, 2925–2930 (1932).
(5) Thielepape, *Ber.*, **55**, 133–134 (1922).
(6) Gardner and Hammel, THIS JOURNAL, **58**, 1360–1361 (1936).

DEPARTMENT OF CHEMISTRY
NATIONAL CHEKIANG UNIVERSITY
MAITAN, KWEICHOW, CHINA
RECEIVED NOVEMBER 22, 1944

Derivatives of Phenothiazine

BY STEWART E. HAZLET AND CHARLOTTE E. RODERUCK

In connection with other investigations[1] at this institution, several new derivatives of pheno-

(1) Nicholson and McCulloch, *J. Am. Vet. Med. Assoc.*, **101** (No. 786), 205 (1942).

thiazine[2] have been prepared. Methods used were similar to those which had been employed for the acylation of phenols. Acetyl derivatives were prepared by the use of acetic anhydride.[3] Other acylations were effected by permitting the materials to react in pyridine solution,[4] but no heating was required.

Phenothiazine.—"Phenothiazine (Regular) Lot 18-10402-1-769" was generously provided by E. I. du Pont de Nemours & Company. Recrystallizations from benzene yielded a product melting at 179°.

Nitro Derivatives.[5]—3-Nitrophenothiazine-5-oxide and 3,7-dinitrophenothiazine were prepared by recorded methods; 3,7-dinitrophenothiazine-5-oxide was obtained as a by-product in the preparation of the mononitro oxide.

Acyl Derivatives of Phenothiazine and Substituted Phenothiazines

(A) **10-Benzenesulfonylphenothiazine:** glistening, colorless needles from ethanol, 30% yield, m. p. 170–170.5°. *Anal.* Calcd. for $C_{18}H_{13}O_2NS_2$: S, 18.87. Found: S, 19.0.

(B) **10-Acetyl-3-nitrophenothiazine-5-oxide:** dark red irregular crystals from nitrobenzene (precipitated by the addition of 90–120° ligroin), 90% yield, sublimes *ca.* 250°, dec. above 360°. *Anal.* Calcd. for $C_{14}H_{10}O_4N_2S$: S, 10.59. Found: S, 9.6.

(C) **10-Benzoyl-3-nitrophenothiazine-5-oxide:** dark red irregular crystals from nitrobenzene (precipitated by the addition of 90–120° ligroin), crude yield nearly quantitative, sublimes *ca.* 270°, dec. above 360°. *Anal.* Calcd. for $C_{19}H_{12}O_4N_2S$: S, 9.14. Found: S, 9.12.

(D) **10-Benzenesulfonyl-3,7-dinitrophenothiazine:** as small red irregular platelets from nitrobenzene (precipitated by the addition of benzene), 40% yield, dec. above 300°. *Anal.* Calcd. for $C_{18}H_{11}O_6N_3S_2$: S, 14.94. Found: S, 14.96.

(2) In this report the nomenclature system listed recently by *Chemical Abstracts* [**37**, 7807 (1943)] and used by Gilman and Shirley [THIS JOURNAL, **66**, 888 (1944)] has been followed.

(3) Hazlet and Kornberg, THIS JOURNAL, **61**, 3037 (1939).

(4) Hazlet, *ibid.*, **59**, 287 (1937).

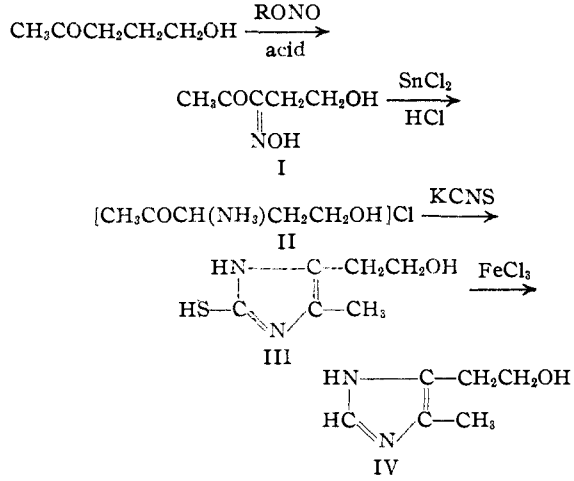
(5) Kehrmann and Nossenko, *Ber.*, **46**, 2809 (1913).

DEPARTMENT OF CHEMISTRY
STATE COLLEGE OF WASHINGTON
PULLMAN, WASHINGTON RECEIVED DECEMBER 5, 1944

Thiamin Analogs. IV.[1] 4(5)-Methyl-5(4)-(β-hydroxyethyl)-imidazole

BY SIDNEY W. FOX,[2] HERBERT SARGENT AND EDWIN R. BUCHMAN

This communication deals with the synthesis of (IV), the imidazole[3] analog of the vitamin B_1 thiazole. Its preparation was accomplished by the following steps, which are based on reactions well known in the field of imidazole chemistry.[4]



Studies carried out at this Institute by Dr. James Bonner show that (IV) is unable to function as the vitamin thiazole in supporting growth of either pea roots or *Phycomyces Blakesleeanus*.

Experimental[5]

3-Oximinopentanol-5-one-2 (I).[6]—To a mixture of 58 g. of γ-acetopropanol[7] and 1.8 cc. of concentrated hydrochloric acid, 45 g. of butyl nitrite was added over a period of fifteen minutes, with the temperature maintained at 45–50° by means of an ice-bath. After the addition the mixture was allowed to stand for an additional fifteen minutes; 50 g. of ice and 48 g. of 33% sodium hydroxide solution were then added and the mixture stirred for one-half hour. The aqueous layer was separated and extracted twice with ether, after which it was brought to *p*H 6 by addition of dilute sulfuric acid while the temperature was kept below 10° by external cooling. The resulting mixture was continuously extracted with ether and the ether extract evaporated *in vacuo;* from the residual sirup 7 g. (9% from acetopropanol) of crude (I) crystallized on standing; m. p. 91.5° after recrystallization from ethyl acetate.

Anal. Calcd. for $C_5H_9NO_3$: C, 45.79; H, 6.92; N, 10.68. Found: C, 45.97; H, 6.94; N, 10.33.

The mother liquors containing additional amounts of (I) were utilized without further purification for conversion to (IV); attempts to distill them led to extensive decomposition.

3-Aminopentanol-5-one-2 Hydrochloride (II).[8]—In a flask surrounded by a bath at −15° was placed 75 g. of stannous chloride, 100 cc. of concentrated hydrochloric acid and 180 g. of mossy tin. To this was added 14. g. of (I) at such a rate that the reaction temperature did not rise above 0° (about ten minutes). The resulting mixture was allowed to stand at room temperature for one-half hour and then heated to boiling for several minutes. The liquid was decanted, the tin was washed with water and the combined aqueous solutions, after diluting to about 1300 cc., treated with hydrogen sulfide until precipitation of tin

(1) Paper XXIV in the R. R. Williams series.

(2) Present address: Chemistry Department, Iowa State College, Ames, Iowa.

(3) Tracy and Elderfield (*Science*, **92**, 180 (1940); *J. Org. Chem.*, **6**, 54 (1941)) have prepared the pyridine analog of thiamine; see Robbins, *Proc. Natl. Acad. Sci.*, **27**, 419 (1941); also Finkelstein and Elderfield, *J. Org. Chem.*, **4**, 365 (1939); Schmelkes, *Science*, **90**, 113 (1939); Schmelkes and Joiner, THIS JOURNAL, **61**, 2562 (1939); Baumgarten and Dornow, *Ber.*, **73**, 44 (1940); Dornow, *ibid.*, **73**, 136, 353 (1940). A pyrimidine analog has been synthesized (Tota and Elderfield, *J. Org. Chem.*, **7**, 309 (1942); see Robbins, *Proc. Natl. Acad. Sci.*, **28**, 352 (1942)) and attempts to prepare a pyrazine analog have been recorded (*J. Org. Chem.*, **7**, 313 (1942)). Schultz (*Z. physiol. Chem.*, **256**, 113 (1940)) has reported on the physiological activity of the selenazole analog.

(4) Compare, for instance, Garforth and Pyman, *J. Chem. Soc.*, 489 (1935).

(5) All melting points are corrected.

(6) The structure of this compound is based on analogy; see Gabriel and Posner, *Ber.*, **27**, 1040 (1894); Fileti and Ponzio, *ibid.* **28R**, 555 (1895). Its preparation directly from α-acetobutyrolactone will be discussed in another connection.

(7) Knunyantz, Chelintzev and Osetrova, *Compt. rend. acad. sci.*, (U. R. S. S.), [N. S.] **1**, 312 (1934); *C. A.*, **28**, 4382 (1934).

(8) Compare Künne, *Ber.*, **28**, 2036 (1895); Gabriel and Pinkus, *ibid.*, **26**, 2199 (1893).

sulfide was complete. After filtration, the filtrate was evaporated *in vacuo* to yield a yellow sirup which was used directly for the next step in the synthesis.

In another similar preparation, the sirup was treated with absolute alcohol and anhydrous ether and allowed to crystallize in an icebox. The small amount of crystalline material separating was recrystallized from *n*-butanol–ether, needles m. p. 134° dec. Due to the unstable nature of (II), satisfactory analytical figures were not obtained.

2-Mercapto-4(5)-methyl-5(4)-(β-hydroxyethyl)-imidazole (III)[8] was obtained in good yield from the unstable crystalline (II). More conveniently it was prepared as follows: The crude sirup resulting from the reduction of 14 g. of (I) was taken up in 50 cc. of ethanol, 10 g. of potassium thiocyanate and 10 cc. of water were added and the mixture was heated for two hours in a bath maintained at about 60°. The reaction mixture was transferred to an evaporating dish, evaporated at about 50° and the residual dry yellow powder extracted with hot alcohol. The extracts were evaporated to a sirup which was taken up in a small amount of water and the solution allowed to stand in the icebox. After two days 9.6 g. of substantially pure (III) had crystallized out (56% from (I)), m. p. 201° from *n*-butyl alcohol, absorption maxima at 263 mμ, 209 mμ, minimum at 230 mμ (in water).[9]

Anal. Calcd. for $C_6H_{10}N_2OS$: C, 45.54; H, 6.37; N, 17.71. Found: C, 45.64; H, 6.41; N, 17.60.

Mother liquors from various preparations of (I) (60 g. of oil and crystals) were reduced essentially as given above and, after detinning and evaporation, the residue (containing large amounts of ammonium chloride) was heated for twenty-four hours with 60 g. of potassium thiocyanate and 65 cc. of water in a bath maintained at 100°. After evaporation the reaction mixture was extracted with 250 cc. of hot absolute alcohol, the extract cooled and filtered from potassium thiocyanate. After concentration to about 150 cc., an additional amount of potassium thiocyanate was filtered off and the filtrate seeded; after reworking of the mother liquors a total of 16 g. of (III) was obtained.

4(5)-Methyl-5(4)-(β-hydroxyethyl)-imidazole (IV).—To a solution of 3.2 g. of crude (III) dissolved in 100 cc. of water was added a solution of 19.6 g. of anhydrous ferric chloride[10] in 100 cc. of water. After heating the mixture at 100° for one-half hour, 300 cc. of sodium carbonate solution was added and after filtration the filtrate was concentrated *in vacuo*. The residue was extracted with two 100-cc. portions of hot absolute alcohol, the extract[11] evaporated to a small volume, 3.6 g. of picric acid added and the mixture heated and allowed to cool. The resulting picrate was recrystallized from alcohol; yield 3.0 g. (41%) m. p. 157.5°.

Anal. Calcd. for $C_{12}H_{13}N_5O_8$: C, 40.57; H, 3.69; N, 19.71. Found: C, 40.68; H, 3.61; N, 19.75.

The picrate was treated with dilute hydrochloric acid and the mixture extracted with ethyl acetate to remove picric acid. Next, excess sodium carbonate was added, the whole evaporated *in vacuo* and the residue extracted with hot absolute alcohol. After evaporation of the alcohol the residue was taken up in hot ethyl acetate and the ethyl acetate solution evaporated to a small volume. On long standing, crystals of (IV) separated, m. p. 96.5° from ethyl acetate (crystallization takes place very slowly); solution in water practically transparent above 250 mμ, $\lambda_{max.}$ 222 mμ, ε 6308,[12] character of spectrum not appreciably affected by *p*H change.

Anal. Calcd. for $C_6H_{10}N_2O$: C, 57.12; H, 7.99; N, 22.21. Found: C, 57.07; H, 7.76; N, 22.10.

(9) 2-Mercaptoimidazole exhibited $\lambda_{max.}$ 252 mμ, 208 mμ, $\lambda_{min.}$ 223 mμ (in water); 2-ethylmercapto-4-methylimidazole $\lambda_{max.}$ 251 mμ, 224 mμ, $\lambda_{min.}$ 235 mμ (in water).

(10) Compare Pyman, *J. Chem. Soc.*, **99**, 2172 (1911).

(11) In other experiments (IV) was isolated directly from such extracts without going through the picrate.

(12) A sample of 4-methylimidazole was found to have $\lambda_{max.}$ 215 mμ (in water).

The authors are indebted to Dr. J. Bonner for the results of his tests and to Dr. R. T. Major of Merck and Company, Inc., for his generous support of the investigation.

GATES AND CRELLIN LABORATORIES OF CHEMISTRY
CALIFORNIA INSTITUTE OF TECHNOLOGY
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Nicotinic Acid Esters

BY JEROME G. KAUFMAN[1]

Esters of nicotinic acid can be obtained by direct esterification of reaction mixtures that result when nicotine, quinoline or β-picoline is oxidized in the liquid phase. This direct synthesis is of interest because of the importance of these esters as intermediates in the preparation of the widely used nicotinamide. In addition, the esters, since they are capable of hydrolytic conversion to nicotinic acid in the body, can be classified as biologically active pyridine derivatives. It has been demonstrated that ethyl nicotinate, when administered orally, exhibits anti-black-tongue activity.[2]

This Laboratory[3] has shown that good yields of nicotinic acid are obtained when nicotine, quinoline or β-picoline is oxidized by concentrated sulfuric acid in the presence of mercuric sulfate or selenium. In order to isolate the nicotinic acid formed, the sulfuric acid, always used in excess, is neutralized, and the product is precipitated as copper nicotinate. The latter is then converted to nicotinic acid in the usual way. If nicotinic acid esters were desired, it was necessary to esterify by any of the known methods.[4,5,6,7]

Experimental

Methyl Nicotinate.—A mixture of 650 cc. of 95% sulfuric acid, 75 g. of selenium and 129 g. (1 mole) of quinoline was heated together for one hour. The maximum temperature attained was 300°. During this time 240 cc. of water was distilled over. To the cooled mass was added 300 cc. of methanol, after which the mixture was refluxed for six hours on the steam-bath. The reaction mixture was then poured onto three times its volume of cracked ice, made alkaline with ammonium hydroxide, and extracted with ether. The combined ether extracts were washed with water and dried over anhydrous potassium carbonate. After the ether was removed, the product was vacuum-distilled. It yielded 82.5 g. of methyl nicotinate (b. p. (3 mm.) 70–72°), which immediately crystallized to beautiful white crystals in the receiver (m. p. 38°). The yield was 60.2%.

Ethyl Nicotinate.—With essentially the same procedure as described for methyl nicotinate, 83 g. of ethyl nicotinate (b. p. (4 mm.) 72–74°) was obtained; this yield was 55%.

Propyl Nicotinate.—Substitution of *n*-propyl alcohol for the methanol and ethanol used in the preceding experi-

(1) Present address: Van Ameringen-Haebler, Inc., Elizabeth, N. J.

(2) Woolley, Strong, Madden and Elvehjem, *J. Biol. Chem.*, **124**, 715 (1938).

(3) Woodward, Badgett and Kaufman, *Ind. Eng. Chem.*, **36**, 544 (1944).

(4) Pollak, *Monatsh.*, **16**, 46 (1895).

(5) Engler, *Ber.*, **27**, 1787 (1894).

(6) Camps, *Arch. Pharm.*, **240**, 353 (1902).

(7) LaForge, THIS JOURNAL, **50**, 2477 (1928).

ments resulted in the formation of 93.5 g. of *n*-propyl nicotinate (b. p. (1 mm.) 80–82°). This represented a yield of 56.7%.

Nicotine and β-picoline behaved in a similar manner and gave yields of the esters in direct proportion to their ease of oxidation to nicotinic acid.[3]

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Dehydration of Tetrahydrofurfuryl Alcohol[1]

BY CHARLES HOWARD KLINE, JR.,[2] AND JOHN TURKEVICH

In the course of study of the catalytic synthesis of pyridine from furfural derivatives, the dehydration of tetrahydrofurfuryl alcohol was investigated. Paul[3] has found that the dehydration of tetrahydrofurfuryl alcohol over alumina results in the formation of 1,2-dihydropyrane, C_5H_8O, but did not investigate in detail the yields produced due to variation in temperature, contact body or lifetime of the catalyst.

The materials and experimental procedure were the same as those described by the authors in the publication of the catalytic synthesis of pyridine.[4]

Over alumina it was found that tetrahydrofurfuryl alcohol is unattacked at 250° but is readily dehydrated at 300 and 350°. The latter temperature is the optimum temperature for the dehydration and yields about 70% dihydropyrane. At 400° and above, high boiling material is chiefly formed and much of the feed alcohol is lost either as cracked gases (19% carbon dioxide, 57% unsaturates, 13% hydrogen and 11% saturated hydrocarbons) or catalyst deposit. Condensation of the tetrahydrofurfuryl alcohol residues appears to predominate at these temperatures. The alumina catalyst did not lose activity at 300° and at 350° the activity fell only moderately during four days of continuous operation. In all cases carbonaceous material was left on the surface of the catalyst. It is of further interest that at 300° the dehydration of tetrahydrofurfuryl alcohol poisoned the subsequent dehydration of absolute ethanol even though it did not poison *further* dehydration of the tetrahydrofurfuryl alcohol. Undoubtedly the tetrahydrofurfuryl alcohol poisons the catalyst for ethanol dehydration by being strongly adsorbed on the surface. This view is confirmed by the fact that only fifteen minutes after the start of the reaction, does the product come out of the catalyst exit tube. Further confirmation is the forty-degree rise in temperature of the catalyst bed on the introduction of the tetrahydrofurfuryl alcohol. This is to be contrasted with a nine degree rise when the ammonia is simultaneously introduced.

Over silica, tetrahydrofurfuryl alcohol is stable up to 400°, at which point some decomposition sets in. Dihydropyrane was not the only product of the reaction but there was material boiling below and above this substance. At 450° about 20% water was formed and most of the non-aqueous product appeared as high boiling still residues.

Over thoria, tetrahydrofurfuryl alcohol was stable up to 450°. The low-boiling material collected during the 550° run polymerized on standing and had a sharp odor. These facts and its boiling point suggest that it may have consisted of pentenes and pentadienes. It should be pointed out that the recovery of tetrahydrofurfuryl alcohol was high. The inactivity of the thoria for the dehydration was not due to its general lack of catalytic activity. After revivification following the 450° run, the catalyst could be used to dehydrate anhydrous ethanol. One is thus faced with the interesting fact that on alumina the efficient dehydration of tetrahydrofurfuryl alcohol poisons the alumina for the dehydration of ethanol, while on thoria the inefficient dehydration of tetrahydrofurfuryl alcohol does not poison the dehydration of ethanol.

FRICK CHEMICAL LABORATORY
PRINCETON UNIVERSITY
PRINCETON, NEW JERSEY RECEIVED JANUARY 26, 1945

(1) Original manuscript received July 19, 1944.
(2) Ensign, U. S. N. R.
(3) R. Paul, *Bull. soc. chim.*, [5] **2**, 2220-2227 (1935).
(4) Kline and Turkevich, THIS JOURNAL, **66**, 1710 (1944).

A Relation between Viscosity and Refractive Index

BY R. T. LAGEMANN

During an attempt to estimate the viscosity of higher members of some homologous series, it was noted that the viscosity and the refractive index for liquids are functionally related. A linear relation is found to hold for every homologous series if the molecular refraction R is plotted against the viscosity constant I, which is defined by Souders[1] as

$$I = \frac{M}{d}\{\log_{10}(\log_{10}\eta) + 2.9\}$$

where η is the viscosity in millipoises. For such a plot and for determining the constants of the equations, data for I may be obtained from Souders[1] and values of R from Eisenlohr,[2] Herz[3] and the Landolt–Börnstein tables.

In Table I are given the values of the constants a and b as calculated for several series by the method of least squares on the assumption that $I = aR + b$. From this table it may be seen that the slopes are very nearly identical for all the series examined, while the intercepts vary. That linear curves represent the relations very well may be deduced from the fact that use of the constants of Table I allows one to calculate values of I averaging within $^1/_3$ of one per cent. of the experimental values. As a consequence, if the density and molecular weight of a liquid belonging to any of the series of Table I are known, the viscosity

(1) M. Souders, Jr., THIS JOURNAL, **60**, 154 (1938).
(2) F. Eisenlohr, *Z. physik. Chem.*, **75**, 585 (1910).
(3) W. Herz, *Z. anorg. allgem. Chem.*, **179**, 211 (1929).

may be calculated from the refractive index or the refractive index from the viscosity. When a less

TABLE I

CONSTANTS OF THE EQUATION $I = aR + b$

Series	Number of members	a	b
Monohydric alcohols	4	12.0	16
Monocarboxylic acids	5	11.9	11
Esters of acetic acid	3	11.8	3
Aliphatic ketones	3	10.5	23
Ethyl esters	3	11.1	18
Paraffins	8	12.0	−20
Alkyl iodides	3	11.2	−47

precise result is desired and repeated calculations are necessary, one may utilize as auxiliary aids two nomographs designed by Davis.[4] With these, R and Souders' I may be found easily from the refractive index and the viscosity.

For series of related compounds such as the ethylene halides, Souders' I and the molecular refraction are also linearly related, with slopes different, however, from those of homologous series. Other liquids than those listed in Table I also yield points close to the curves represented in Table I. Therefore, for liquids in general a rough rule states that Souders' I is about twelve times the molecular refraction.

(4) D. S. Davis, *Ind. Eng. Chem.*, **33**, 1537 (1941); **34**, 258 (1942).

DEPARTMENT OF PHYSICS
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Aromatic Cyclodehydrogenation. II. A New Synthesis of Fluorene[1]

BY MILTON ORCHIN[2]

We have recently reported[3] the conversion of 2,2′-dimethylbiphenyl to 4-methylfluorene by passing the former over palladium-charcoal-asbestos at 450°. We now find that the same treatment readily converts 2-methylbiphenyl, I, to fluorene.

The steps in the synthesis of I[4] consisted of the condensation of *o*-tolylmagnesium bromide with cyclohexanone, dehydration of the resulting carbinol to 2-methyl-1′,2′,3′,4′-tetrahydrobiphenyl, II, and dehydrogenation of II to I. We have found that II can also be converted directly to fluorene, thus making synthetic fluorene available by a three-step process.

Experimental[5]

2-Methylbiphenyl, I, was synthesized by the method of Sherwood, *et al.*[4] The yield of *o*-tolylcyclohexanol was raised to 65% by refluxing the Grignard reaction mixture for twenty-four hours prior to decomposition with ice. Dehydration of the carbinol with formic acid gave II in 95% yield.

Cyclodehydrogenations to Fluorene.—The apparatus, catalyst and procedure used were the same as previously described.[3] During a period of three hours, 9.8 g. of I was passed once over the catalyst. The mixture of oil and solid in the receiver was taken up in alcohol, the mixture chilled and filtered, whereupon 2.80 g. of material, melting point 104–110°, was obtained. One recrystallization gave pure fluorene, m. p. 115.0–115.8°. The material in the original mother liquor was chromatographed on alumina and the more strongly adsorbed fraction gave 0.54 g. additional fluorene. When 9.0 g. of II was treated as above 2.06 g. of pure fluorene was obtained. In this experiment a portion of the oil which came through was recycled. There was no diminution in the activity of the catalyst, and it is apparent that the conversion to fluorene can be made quantitative by increasing the time of contact. When *o*-tolylcyclohexanol was passed over the catalyst, a small quantity of fluorene was formed, but the catalyst was rapidly poisoned and the conversion soon stopped completely.

(1) Published by permission of the Director, Bureau of Mines, U. S. Department of the Interior. Patent applied for. Article not copyrighted.

(2) Organic chemist, Central Experiment Station, Bureau of Mines, Pittsburgh, Pa.

(3) Orchin and Woolfolk, THIS JOURNAL, **67**, 212 (1945).

(4) Sherwood, Short and Stansfield, *J. Chem. Soc.*, 1832 (1932).

(5) The author wishes to thank Mr. E. O. Woolfolk for valuable assistance with a portion of the experimental work.

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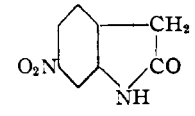
The Structure of Baeyer's Nitro-oxindole

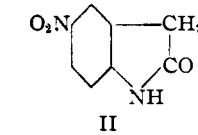
BY WARD C. SUMPTER, MARION MILLER AND MARY EDITH MAGAN

The first nitration of oxindole was carried out by Baeyer[1] through the action of potassium nitrate on a solution of oxindole in concentrated sulfuric acid. Baeyer reported that the substance did not possess a definite melting point but that it decomposed at about 175°. The position taken by the nitro group was not determined by Baeyer.

Subsequently Borsche, Weussmann and Fritzsche[2] reported that Baeyer's compound was 6-nitrooxindole (I) and while failing to present proof



I



II

for this structure did present evidence which on its face seemed to establish the fact that the compound was not the expected 5-nitro-oxindole (II) but an isomer. These workers reported that treatment of a solution of the nitro-oxindole in alcohol with nitrous acid gave a nitroisatin oxime which was not identical with the β-oxime of 5-nitroisatin. This supposed isatin oxime was called 6-nitroisatin oxime and the melting point reported as 238–239°.

In view of the fact that substitution in this series takes place normally in position 5[3,4,5] it seemed quite likely that Borsche, Weussmann and

(1) Baeyer, *Ber.*, **12**, 1312 (1879).

(2) Borsche, Weussmann and Fritzsche, *ibid.*, **57B**, 1149 (1924).

(3) Brunner, *Monatsh.*, **58**, 369 (1931).

(4) Stollé, Bergdoll, Auerhahn and Wacker, *J. prakt. Chem.*, [2] **128**, 1 (1930).

(5) Sumpter and Jones, THIS JOURNAL, **65**, 1802 (1943).

Fritzsche were incorrect in their characterization of Baeyer's product as 6-nitro-oxindole. Accordingly the nitration of oxindole by Baeyer's procedure was repeated. Instead of decomposing at about 175° as reported by Baeyer the product was found to melt at 240–241°. The same product was obtained when oxindole was nitrated through the agency of fuming nitric acid rather than potassium nitrate. Treatment of a solution of this compound in ethyl alcohol with nitrous acid in accordance with the procedure of Borsche, Weussmann and Fritzsche failed to yield an isatin oxime but resulted only in the recovery of unchanged nitro-oxindole; m. p. 240–241°.

On the other hand, treatment of a solution of the nitro-oxindole in glacial acetic acid with sodium nitrite yielded 5-nitroisatin-β-oxime, identical with an authentic sample prepared from 5-nitroisatin of known structure.[5,6] It follows from this fact that Baeyer's nitro-oxindole is 5-nitro-oxindole and not 6-nitro-oxindole[7] as stated by Borsche and his co-workers.

To further support the conclusion that the compound in question was 5-nitro-oxindole a sample was coupled with benzenediazonium chloride. The β-phenylhydrazone of 5-nitroisatin which resulted was identified by comparison with an authentic sample.[5]

5-Nitro-oxindole (II).—**A.** The nitration was accomplished as directed by Baeyer.[1] The crude product was purified by crystallization from 50% acetic acid from which it separated as nearly colorless needles; m. p. 240–241°.

B. Oxindole (0.05 mole) was dissolved in 25 ml. of concentrated sulfuric acid and the mixture maintained at 0° while 2.1 ml. of fuming nitric acid (sp. gr. 1.5) was added dropwise. After the addition of the nitric acid the reaction mixture was allowed to stand at 0° for thirty minutes and poured over cracked ice. The precipitate was collected, washed with water and crystallized from 50% acetic acid from which it separated as nearly colorless needles; m. p. 240–241°. The yield was 7.35 g. or 82% of the theoretical. The identity of the product with that obtained by Baeyer's procedure was established by melting point methods.

Anal. Calcd. for $C_8H_6N_2O_3$: N, 15.73. Found: N, 15.57.

5-Nitroisatin-β-oxime.—Nitro-oxindole (0.01 mole) was dissolved in 100 ml. of glacial acetic acid and 1.73 g. (0.025 moles) of sodium nitrite added in small portions. The yellow precipitate which soon separated was collected and purified by crystallization from ethyl alcohol from which it separated as light yellow needles; m. p. 228–229°. The melting point was unchanged when the substance was mixed with a sample of 5-nitroisatin-β-oxime (m. p. 228–229°) prepared from 5-nitroisatin.[5,6]

5-Nitroisatin-β-phenylhydrazone.—Nitro-oxindole (1.34 g.) was dissolved in 75 ml. of ethyl alcohol and a solution of 10 g. of sodium acetate in 25 ml. of water added. The mixture was cooled to 0° and a solution of benzenediazonium chloride (from 0.75 g. aniline) added. The reddish yellow precipitate which soon formed was collected and purified by crystallization from glacial acetic acid. The melting point of the substance was 295° both alone and when mixed with an authentic sample of 5-nitroisatin-β-phenylhydrazone.[5]

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(6) Calvery, Noller and Adams, THIS JOURNAL, **47**, 3059 (1925).

(7) A compound designated as 6-nitro-oxindole was employed by Parks and Aldis (*J. Chem. Soc.*, 1845 (1938)). Due to the fact that these authors gave erroneous literature references it is impossible to determine from an examination of their paper the origin of the substance they designated as 6-nitro-oxindole.

The Identification of Aldose Sugars by their Mercaptal Acetates

BY M. L. WOLFROM AND J. V. KARABINOS[1]

E. Fischer[2] has stated that the ease of crystallization of most aldose thioacetals (mercaptals) should lend itself to the preparative isolation of sugars from their solutions. Application of this principle has been made in the case of a number of aldoses, as for example, with 6-bromo-D-glucose,[3] 5-desoxy-L-arabinose,[4] D-altrose[5] and 2,3,6-O-trimethyl-D-glucose.[6]

The mercaptals of the aldoses have occasionally been employed for identification purposes.[7] It is our purpose herein to describe a general procedure of wide applicability for the identification of aldomonosaccharides as their acetylated diethyl mercaptals. The ease of isolation of these substances and their high yield of formation make them excellent characterizing derivatives. They are optically active and their rotations in chloroform solution can readily be ascertained. Furthermore, these derivatives are characteristic of one particular sugar and not of three, as is the case with the osazones. The presently known acetylated diethyl mercaptals of the aldomonosaccharides are listed in Table I. If desired, the acetylated mercaptal can readily be deacetylated to the parent mercaptal and the latter used as a confirmatory derivative.

Since concentrated acid is employed in their formation, the acetylated diethyl mercaptals of the aldoses are best limited to the characterization of the aldomonosaccharides, although the low temperature employed does keep the hydrolysis at a minimum and the acetylated diethyl mercaptal of maltose has indeed been isolated in crystalline form.[8] Ketoses[2] and 2-desoxyaldoses[9] are very sensitive to acidity and are destroyed by the high acidity employed in the mercaptalation

(1) Hoffmann-La Roche Fellow of The Ohio State University Research Foundation.

(2) E. Fischer, *Ber.*, **27**, 673 (1894).

(3) E. Fischer, B. Helferich and P. Ostmann, *ibid.*, **53**, 873 (1920).

(4) D. R. Swan and W. L. Evans, THIS JOURNAL, **57**, 200 (1935).

(5) N. K. Richtmyer and C. S. Hudson, *ibid.*, **57**, 1716 (1935). R. C. Hockett and L. B. Chandler, *ibid.*, **66**, 627 (1944).

(6) M. L. Wolfrom and L. W. Georges, *ibid.*, **59**, 601 (1937).

(7) C. Neuberg, *Ber.*, **33**, 2243 (1900); M. L. Wolfrom, W. J. Burke, K. R. Brown and R. S. Rose, Jr., THIS JOURNAL, **60**, 571 (1938); M. L. Wolfrom and T. S. Gardner, *ibid.*, **62**, 2553 (1940); *ibid.*, **65**, 750 (1943); M. L. Wolfrom and D. E. Pletcher, *ibid.*, **63**, 1050 (1941).

(8) M. L. Wolfrom, Mildred R. Newlin and E. E. Stahly, *ibid.*, **53**, 4379 (1931).

(9) Private communication from Dr. J. Compton

reaction. D-Fructose diethyl mercaptal exists and has been made by an indirect method.[10] The hexosamines are essentially insoluble in concentrated hydrochloric acid and the procedure is not applicable to them. The acetylated diethyl mercaptals of the ethyl[11] and methyl[11,12] esters of D-galacturonic acid have been recorded.

An obvious disadvantage of the method is the odor of the ethyl mercaptan but this can be minimized by the employment of small quantities of material and by the use of good fume cupboards. The purified substances are odorless.

TABLE I

CHARACTERIZING PROPERTIES OF THE KNOWN FULLY ACETYLATED DIETHYL MERCAPTALS OF ALDOMONOSACCHARIDES

Fully acetylated diethyl mercaptal of	M. p., °C.	$[\alpha]^{20-25}D$ ($c < 5$, $CHCl_3$)
D-Arabinose[a]	80	+30°
L-Arabinose[b]	79–80	−30
D-Xylose[c]	46–48	+13
D-Lyxose[d]	36–37	+40.5
D-Glucose[e]	45–47	+11
D-Galactose (trimorphous)[f]	76.5–77	+11
	80.5–81[g]	+11
	90.5–91	+11
6-Desoxy-L-galactose (L-fucose)[h]	99–100	+ 5
D-Mannose[i]	52–53	+32
6-Desoxy-L-mannose (L-rhamnose)[i]	59–61	−42
D-Gluco-D-*gulo*-heptose[j]	99–100	−12
D-Gala-L-*gluco*-heptose[k]	105	+27
D-Gala-L-*manno*-heptose[l]	145–146	+56
D-Manno-D-*gala*-heptose[m]	77	− 2.2
D-Gala-L-*gala*-octose[n]	106	+30
Methyl D-galacturonate[o,p]	112.5–113.5	+20.5
Ethyl D-galacturonate[p]	80–81	+11

[a] M. L. Wolfrom, D. I. Weisblat, W. H. Zophy and S. W. Waisbrot, THIS JOURNAL, **63**, 201 (1941). [b] M. L. Wolfrom and Mildred R. Newlin, *ibid.*, **52**, 3619 (1930). [c] Ref. 8. [d] M. L. Wolfrom and F. B. Moody, *ibid.*, **62**, 3465 (1940). [e] W. Schneider and Johanna Sepp, *Ber.*, **51**, 220 (1918); M. L. Wolfrom, THIS JOURNAL, **51**, 2188 (1929); first nuclei difficult to obtain but the deacetylated form crystallizes with ease. [f] M. L. Wolfrom, *ibid.*, **52**, 2464 (1930); L. H. Welsh and G. L. Keenan, *ibid.*, **64**, 183 (1942). [g] Stable form. [h] M. L. Wolfrom and J. A. Orsino, *ibid.*, **56**, 985 (1934). [i] N. W. Pirie, *Biochem. J.*, **30**, 374 (1936); Mildred R. Newlin, Ph.D. dissertation, The Ohio State University (1932); in the publication of Pirie, L-rhamnose diethyl mercaptal tetraacetate is recorded incorrectly as being dextrorotatory. [j] M. L. Wolfrom, M. Konigsberg, F. B. Moody (and Mildred R. Newlin), THIS JOURNAL, **62**, 2348 (1940); higher sugar nomenclature of C. S. Hudson, *ibid.*, **60**, 1537 (1938). [k] R. M. Hann and C. S. Hudson, *ibid.*, **56**, 2080 (1934). [l] R. M. Hann and C. S. Hudson, *ibid.*, **59**, 1898 (1937). [m] Edna Montgomery and C. S. Hudson, *ibid.*, **56**, 2463 (1934). [n] R. M. Hann, W. D. Maclay and C. S. Hudson, *ibid.*, **61**, 1270 (1939). [o] Ref. 12. [p] Ref. 11.

(10) M. L. Wolfrom and A. Thompson, THIS JOURNAL, **56**, 880 (1934).

(11) R. J. Dimler and K. P. Link, *ibid.*, **62**, 1216 (1940).

(12) H. A. Campbell and K. P. Link, *J. Biol. Chem.*, **120**, 471 (1937).

Experimental

Identification of D-Mannose as D-Mannose Diethyl Mercaptal Pentaacetate.—The general procedure employed was an adaptation of that reported previously[8] from this Laboratory. D-Mannose (50 mg.) was dissolved in 0.5 cc. of concentrated hydrochloric acid (*ca.* 12 *N*) in an ice-bath and 0.5 cc. of ethyl mercaptan added. The mixture was stirred or shaken mechanically for one hour and was then neutralized in the cold with concentrated ammonium hydroxide (*ca.* 15 *N*) and concentrated to dryness at 40° under reduced pressure. The salt residue was dried by adding absolute ethanol and removing this by distillation under reduced pressure at 40°, the process being repeated several times. The dried residue was treated with 3 cc. of a 2:1 (by volume) mixture of acetic anhydride and dry pyridine. After standing overnight at room temperature, the solution was poured into 10 cc. of water and extracted twice with 10-cc. portions of chloroform. The chloroform extract was washed four times with 10 cc. of a saturated aqueous sodium bicarbonate solution and finally with water. The sirup obtained on solvent removal from the dried chloroform extract was crystallized from methanol solution by the gradual addition of water; yield of D-mannose diethyl mercaptal pentaacetate practically quantitative, m. p. 51–52°.

Identification of D-Galactose in a Crude Hydrolyzate.—A fraction of solid material (50 mg.) obtained by the acid hydrolysis of a galactose-containing polysaccharide and containing *ca.* 25% of D-galactose (as determined by the mucic acid assay) was treated as described above and the product isolated in the same manner; yield of D-galactose diethyl mercaptal pentaacetate 15 mg., m. p. 78–79°.

As a confirmatory derivative, the above acetate was deacetylated to D-galactose diethyl mercaptal. To 9 mg. of the D-galactose diethyl mercaptal pentaacetate dissolved in 2 cc. of anhydrous methanol was added 0.5 cc. (*ca.* 10% excess) of 0.2 *N* barium methoxide in methanol (prepared by refluxing barium oxide with anhydrous methanol) and the solution refluxed for one hour. Carbon dioxide gas was then introduced until precipitation was complete and the precipitated barium carbonate was removed by centrifugation. The residue obtained on solvent removal from the centrifugate was extracted with 2 cc. of warm ethanol (acetone is likewise useful as a solvent in which the sugar mercaptals have some solubility) and crystallized from aqueous ethanol; yield of D-galactose diethyl mercaptal 3 mg., m. p. 138–139° (micro stage).

CHEMICAL LABORATORY
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COLUMBUS, OHIO RECEIVED JANUARY 9, 1945

NEW COMPOUNDS

Esters of Mesitoic Acid

2-Mesitoyl-4-methylphenyl Mesitoate.—A mixture of 22 g. of 2-mesitoyl-4-methylphenol[1] and 20 g. of mesitoyl chloride was warmed until hydrogen chloride ceased to be evolved. The reaction mixture was dissolved in ether, and the resulting solution washed successively with water, dilute sodium hydroxide solution and water. Evaporation of the ether left the ester as a solid which, after being recrystallized from ethanol, melted at 135–136°; yield 32%.

Anal. Calcd. for $C_{27}H_{28}O_3$: C, 80.97; H, 7.05. Found: C, 81.31; H, 7.09.

Phenyl Mesitoate.—The phenyl ester was prepared in 83% yield from phenol and mesitoyl chloride. It formed colorless needles; m. p. 37–38° (cor.).

Anal. Calcd. for $C_{16}H_{16}O_2$: C, 79.97; H, 6.71. Found: C, 80.28; H, 6.75.

(1) Fuson, Scott and Speck, THIS JOURNAL, **63**, 2845 (1941).