yield 95.3%. A solution stored in the refrigerator for one week was unchanged, while another was 17% decomposed after standing two days at room temperature.

The hydrochloride was prepared by saturating an ether solution of 4-bromopyridine with dry hydrogen chloride. The colorless, non-hygroscopic, crystalline compound melted with decomposition in a sealed capillary at 237–239°.

Isonicotinic-C^{14} Acid.—The apparatus used was that described for the preparation of nicotinic-C^{14} acid.[3] To a stirred solution of 5.12 millimoles of *n*-butyllithium in 25 ml. of ether cooled in a Dry Ice–acetone-bath was added, over a 5-minute period, 7.68 millimoles of 4-bromopyridine in 30 ml. of ether cooled to −50 to −40°. Two minutes later the reaction mixture was frozen in liquid nitrogen, evacuated, thawed in the Dry Ice–acetone-bath and carbonated with 2.56 millimoles of $C^{14}O_2$ (0.5064 g. $BaC^{14}O_3$, 14.9 millicuries). The cold reaction mixture was hydrolyzed with 10 ml. of 6 *N* hydrochloric acid. The contents of the flask was made strongly basic with sodium hydroxide and extracted with ether for 24 hours, then made strongly acidic and re-extracted for four hours. The product was isolated by adjusting the aqueous phase to *p*H 3 and continuing the extraction four to five days. The yield of colorless product was 0.303 g., 96.0%.

Four trial preparations gave 83.5–96.5% yields of material melting with decomposition within the range 301–304° (authentic purified specimen m.p. 305° dec.). A mixed m.p. with the authentic specimen showed no depression. Another preparation gave 93.2% yield when carbonated with excess carbon dioxide.

Isonicotinic-C^{14} Acid Hydrazide.—Isonicotinyl-C^{14} chloride hydrochloride was made by treating the acid with 2 ml. of purified thionyl chloride, heating under reflux for 15 minutes and distillation of the excess reagent under reduced pressure. The residual solid mass was converted to the ester hydrochloride (solid) by reaction with 4 ml. of absolute ethanol, heating under reflux for one hour and distillation of the solvent under reduced pressure. The ester was isolated by treatment with excess sodium bicarbonate solution and extraction with ether (three hours). After evaporation of the solvent, the ester was heated under reflux for 30 hours with 0.23 g. of 85% hydrazine hydrate solution in 10 ml. of absolute ethanol. Treatment with "Norit" and evaporation to dryness gave 0.328 g. of crude product (93.4% yield from the acid). Purification by vacuum sublimation (130°, 0.01 mm.) and recrystallization from *n*-butyl alcohol yielded 0.260 g. of colorless needles, m.p. 166–168° (authentic purified specimen, m.p. 168–169.5°). The specific activity was 5.80 millicuries per millimole.

Four trial preparations gave crude material, m.p. 165–168°, in yields of 91.6–99.0% from pure isonicotinic acid. Another experiment gave a quantitative yield (m.p. 166–169°) from pure isonicotinic acid ethyl ester.

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The Instability of Grignard Reagents from γ-Bromopropyl Ethers

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RECEIVED JULY 14, 1952

In an attempt to prepare γ-ethoxypropyl 11-bromohendecyl ketone, the supposed di-(γ-ethoxypropyl)-cadmium was treated with 11-bromohendecanoyl chloride. The reaction product isolated was found to be ethyl 11-bromohendecanoate. This result was unexpected in view of the fact that the Grignard reagent from γ-ethoxypropyl bromide has been employed numerous times with no apparent difficulty.

A brief investigation indicated that γ-ethoxypropylmagnesium bromide possesses a relatively low order of thermal stability. When an ether solution of this Grignard reagent was distilled to a low volume, the residue in the flask underwent a vigorous decomposition to give cyclopropane and apparently magnesium bromide ethoxide. In another experiment, benzene was added to the ether solution of the Grignard reagent and decomposition took place gradually, with the evolution of cyclopropane, as the ether was removed by distillation and the temperature of the residue approached about 75°. Anhydrous cadmium chloride was added to the reaction mixture, but only a very small additional amount of cyclopropane was obtained.

A mixture of phenyl 11-bromohendecanoate, phenol and cyclopropane was isolated when a reaction mixture, which was thought to contain di-(γ-phenoxypropyl)-cadmium was caused to react with 11-bromohendecanoyl chloride. The latter results are in agreement with the work of Paul[2] who has shown that γ-phenoxypropyl iodide is degraded by magnesium to a phenolate, 1,6-diphenoxyhexane and cyclopropane.

Experimental[3]

Reaction of 11-Bromohendecanoyl Chloride with the Supposed Di-(γ-ethoxypropyl)-cadmium.—A Grignard reagent was prepared from 10 g. (0.06 mole) of γ-ethoxypropyl bromide, 1.44 g. (0.06 gram atom) of magnesium turnings and 35 ml. of anhydrous ether. After the magnesium had disappeared, 6.4 g. (0.035 mole) of anhydrous cadmium chloride was added and the reaction mixture was heated to reflux for 45 minutes. The ether was removed by distillation and replaced with dry benzene. A solution of 15.3 g. (0.054 mole) of 11-bromohendecanoyl chloride in 25 ml. of dry benzene was added and the mixture was refluxed for 45 minutes. After cooling to room temperature, it was decomposed in the usual manner and the organic layer was washed, dried over anhydrous sodium sulfate and concentrated. The residual oil was distilled to give 6.3 g. (40% based on the acid chloride) of ethyl 11-bromohendecanoate, b.p. 144–145° (0.5 mm.), $n^{18}\text{D}$ 1.4627. Bowman[4] has recorded a boiling point of 118–119° (0.15 mm.) for this ester. We have prepared the material, in relation to other work, and have obtained the following physical constants: b.p. 157–160° (3 mm.), $n^{18}\text{D}$ 1.4610, d^{20}_4 1.120.

The ester (6.3 g.) was saponified by refluxing it for 10 hours with a 10% aqueous alcohol solution of sodium hydroxide. There was obtained 3.7 g. (85% of 11-hydroxyhendecanoic acid which melted at 65–66° after two crystallizations from benzene, lit.[5] m.p. 65.5–66°.

Decomposition Studies on γ-Ethoxypropylmagnesium Bromide.[6]—The Grignard reagent was prepared from 25.3 g. (0.15 mole) of γ-ethoxypropyl bromide, 3.72 g. (0.155 gram atom) of magnesium turnings and 80 ml. of anhydrous ether in a flask which was equipped with a condenser carrying a trap for the removal of solvents. The top of the condenser was attached to a gas trap which was cooled by means of a Dry Ice–acetone-bath.

The reaction mixture was stirred and refluxed for one hour after the bromide had been added. Then the ether was distilled slowly until 70 ml. had been collected; at this point the residue decomposed rapidly and filled the flask with a white, porous solid. A total of 13 ml. of liquid was condensed in the cooling trap. This was allowed to vaporize, at about 0°, through a water cooled condenser and 8 ml. of a low-boiling distillate was collected in a Dry Ice–acetone cooled receiver.

A sample of the porous mass was ground, suspended in ether and treated with 3,5-dinitrobenzoyl chloride. After an initial slightly exothermic reaction, the mixture was refluxed for 30 minutes. There was obtained a white crystal-

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[1] Abstracted in part from a thesis submitted by M. S. Cohen to the Graduate College of the University of Missouri, 1952, in partial fulfillment of the requirements for the degree of Doctor of Philosophy.

[2] R. Paul, *Ann. chim.*, **18**, 311 (1932).

[3] All melting points are uncorrected. The semimicro analyses were performed by Mr. P. D. Strickler.

[4] R. E. Bowman, *J. Chem. Soc.*, 177 (1950).

[5] W. H. Lycan and R. Adams, THIS JOURNAL, **51**, 625 (1929).

[6] This experiment was carried out by Mr. F. E. Martin.

line product which melted at 92–94° which corresponds to the melting point of ethyl 3,5-dinitrobenzoate.

In another run, the Grignard reagent was prepared from 33.4 g. (0.2 mole) of γ-ethoxypropyl bromide, 4.8 g. (0.2 gram atom) of magnesium turnings and 80 ml. of anhydrous ether. The reagent was refluxed for one hour, and only a trace of liquid was condensed in the cooling trap.

Forty milliliters of ether was removed by distillation from the reaction mixture and 50 ml. of dry benzene was added to give approximately the original volume. An additional 28 ml. of solvent was distilled, 50 ml. of dry benzene was added and 22 ml. more of solvent was removed. The Grignard reagent was stirred and then refluxed for one hour. At this point, 8 ml. of distillate had collected in the cooling trap; 4 ml. of this material boiled below 0° and it was removed. The mixture was refluxed for another two hours and an additional 3 ml. of a liquid was obtained which boiled below 0°. The reaction mixture was treated with 18.34 g. (0.1 mole) of anhydrous cadmium chloride and heated at reflux for one hour. Only a trace of low boiling liquid was collected.

The low boiling material (7 ml.) was allowed to distil into a mixture of 50 ml. of carbon tetrachloride, 6.1 g. of bromine and 1 ml. of water which was contained in a 100-ml. pressure bottle. After standing at room temperature for 36 hours, the mixture was poured into a sodium bisulfite solution. The organic layer was separated, washed with water, dried over calcium chloride and concentrated. The residue was distilled to give 4 g. of material which boiled at 59–63° (20 mm.), 162–164° (746 mm.), n^{19}_{D} 1.5198, d^{35}_{4} 1.97. The following physical properties are recorded for trimethylene dibromide: b.p. 165°, n^{15}_{D} 1.5249, d^{17}_{D} 1.9736.

Reaction of 11-Bromohendecanoyl Chloride with the **Supposed** Di-(γ-phenoxypropyl)-cadmium.—A mixture of 2.27 g. (0.094 gram atom) of magnesium turnings and 15 ml. of anhydrous ether was treated, under nitrogen, with a solution of 20.0 g. (0.094 mole) of γ-phenoxypropyl bromide in 50 ml. of anhydrous ether. It was observed that a gas was being evolved during this period. To the reaction mixture was added 7.25 g. (0.049 mole) of anhydrous cadmium chloride and the ether then was removed by distillation and replaced with 50 ml. of dry benzene. The mixture was refluxed for an additional hour.

A solution of 22.6 g. (0.08 mole) of 11-bromohendecanoyl chloride in 20 ml. of dry benzene was introduced over a period of 25 minutes. The reaction mixture was heated to reflux for two hours and then decomposed with dilute sulfuric acid. The benzene layer was washed with water, 5% sodium carbonate solution and dried over anhydrous sodium sulfate. The sodium carbonate extracts were acidified and yielded only a trace of an oily material.

The benzene solution was concentrated and the residual oil was distilled *in vacuo*. A fraction was obtained at approximately 50° (0.5 mm.) which solidified in the receiver and appeared to be phenol. A sample of this material was treated with bromine and 2,4,6-tribromophenol resulted, m.p. 93–94°. A higher boiling fraction (10.5 g.) was collected from the distillation at 206–207° (1 mm.). It solidified upon cooling below room temperature and was recrystallized from petroleum ether (b.p. 28–38°). The compound crystallized in the form of leaflets which melted at 23–24°.

Anal. Calcd. for $C_{17}H_{25}OBr$: C, 59.82; H, 7.38. Found: C, 60.06; H, 7.67.

This compound was shown to be phenyl 11-bromohendecanoate.

A 2-g. sample of the ester was hydrolyzed by boiling it with a 10% solution of hydrochloric acid in Cellosolve for six hours. There was obtained 0.2 g. of 11-bromohendecanoic acid, m.p. 40–42°. This was converted to the corresponding amide which melted at 83–85° and did not depress the melting point of an authentic sample of 11-bromohendecanamide.

Hydrolysis of 7.7 g. of the phenyl ester by means of aqueous alcoholic sodium hydroxide gave phenol, identified as 2,4,6-tribromophenol, and 5.1 g. of 11-phenoxyhendecanoic acid, m.p. 74.5–75.5° (from dilute alcohol), neut. equiv. 278.

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Note on the Ultraviolet Absorption Spectra of Some *p*-Substituted D-*threo*-2-Dichloroacetamido-1-phenyl-1,3-propanediols

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RECEIVED AUGUST 29, 1952

In the course of another investigation[1] the absorption spectra of two *p*-substituted D-*threo*-2-dichloroacetamido-1-phenyl-1,3-propanediols were studied in 95% ethanol, water, 0.01 *N* hydrochloric acid and 0.01 *N* sodium hydroxide solutions and compared with the spectra of chloramphenicol.[2] The effects of changing the solvent are very small, the spectra of each compound remaining essentially the same when determined in any of the above solvents (*cf.* Table I) indicating absence of prototropic rearrangements.

The spectra of the 4-nitro-,[2] 4-methylmercapto- and the 4-methylsulfonyl-substituted compounds in water are shown in Fig. 1. The less electrophilic methylmercapto group causes an expected hypsochromic shift when it is substituted for the $-NO_2$ group of chloramphenicol while the sulfone group

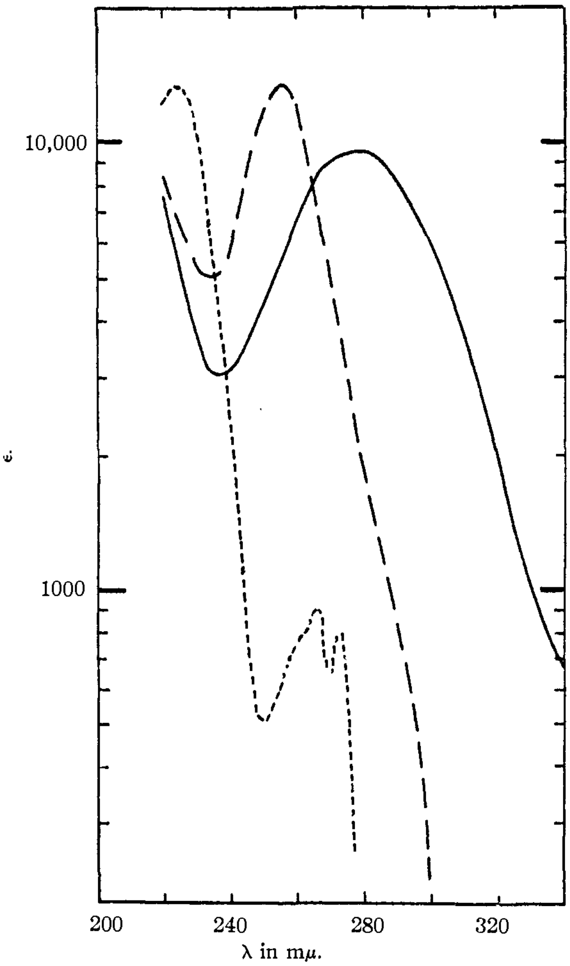

Fig. 1.—Absorption spectra of: —, *p*-NO_2-C_6H_4-R; ---, *p*-CH_3S-C_6H_4-R; ...., *p*-CH_3SO_2-C_6H_4-R in H_2O. R = D-*threo*-2-dichloroacetamido-1,3-propanediol.

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[1] R. A. Cutler, R. J. Stenger and C. M. Suter, THIS JOURNAL, **74**, 5475 (1952).

[2] M. C. Rebstock, H. M. Crooks, Jr., J. Controulis and Q. R. Bartz, *ibid.*, **71**, 2458 (1949).