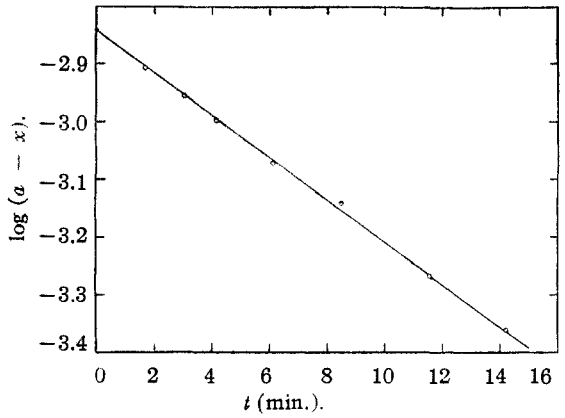

Fig. 1.—Evolution of chloride ion (x) with time at 30.3° in a solution 0.0015 M in 3(α)-chloro-6//7-cholestanedicarboxylate ion, 0.2 M in $NaHCO_3$ and containing 6% dioxane.

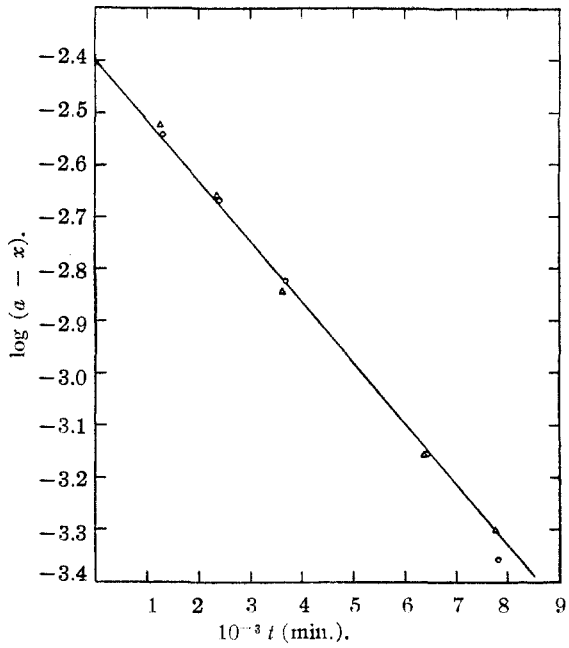

Fig. 2.—Evolution of chloride ion (x) with time at 60° in alkaline solutions 0.004 M in 3(β)-chloro-6//7-cholestanedicarboxylate ion: O, solution 0.170 M in NaOH; △, solution 0.085 M in NaOH and in $NaNO_3$.

S_N2 for (essentially) the following reasons: (a) if both I and II reacted by the (ionic) mechanism S_N1, the same mixture of epimeric 3-hydroxy-acids should result from each; (b) if intramolecular participation of carboxylate ion were operative in both hydrolyses, then the same hydroxy-acid should result in each case; (c) since, experimentally, each chloroacid gives a sterically pure hydroxyacid, formed with apparent Walden inversion at C_3, neither (a) nor (b) can provide the true explanation and the more reasonable assumption is hydrolysis by the mechanism S_N2.

Unfortunately this analysis overlooks the possibility (here demonstrated to be the fact) that the ions of both chloroacids can decompose by first-order mechanisms, but that for only one epimer (I) can participation by C_5–CO_2^- be effective.

The observed Walden inversions are of no little interest. Evidently they must be due to somewhat different influences operating for each isomer. Thus, inversion in the hydrolysis of I can probably be ascribed to initial formation of a lactonic acid (with Walden inversion) followed by alkaline cleavage of the lactone (without inversion). On the other hand, the complete inversion observed in the hydrolysis of II, which apparently proceeds by the (ionic) mechanism S_N1 is more likely connected either with shielding effects (of C_5–CO_2^- and departing Cl^-) which direct the entering hydroxide ion to the back of ring A, or with a greater thermodynamic stability for the *trans* (3(α)) hydroxy-acid.

Possible also is an intramolecular reaction involving C_3–CO_2^- in such a way as to produce (with inversion) initially a C_3–O–COC_3 lactone which subsequently cleaves (without inversion) to give the 3(α) hydroxy-acid. Inspection of molecular models shows that participation of C_3–CO_2^- in the hydrolysis of II would be possible, though attended by some strain and a very specific orientation of ring A relative to ring C. Participation by C_3–CO_2^- is sterically impossible in the hydrolysis of I.

While it is possible that some contribution by the mechanism S_N2 may have occurred under Shoppee's more alkaline conditions (4.5 N hydroxide) for the hydrolysis of II, its significance for this hydrolysis must remain questionable until experimentally verified. Certainly it is not at all necessary to assume it in accounting for the steric result.

That the mechanism S_N2 should operate under any conditions of alkalinity in the hydrolysis of I is hardly possible. The rate of such a process should be even less than that of the corresponding process for the hydrolysis of II (on account of interference by C_5–CO_2^- with a hydroxyl-ion trying to attack the face of ring A), hence should be even slower than the very sluggish first-order hydrolysis of II. Under no circumstances could it be expected to compete with the enormously rapid first-order hydrolysis of I.

A detailed study of the hydrolyses of these and other cyclic halogen acids under varying conditions of alkalinity and temperature is being undertaken in these laboratories and will be reported in subsequent papers of this series.

Acknowledgments.—The authors wish to express their thanks to the Rutgers University Research Council for a grant-in-aid in the year 1949 which assisted completion of a portion of this work and also to the White Laboratories, Inc., Newark, N. J., for supplying the cholesterol necessary for the preparation of the chloroacids.

THE SCHOOL OF CHEMISTRY
RUTGERS UNIVERSITY
NEW BRUNSWICK, N. J. RECEIVED NOVEMBER 15, 1950

NEW COMPOUNDS

α,ω-Bis-γ-hydroxyvaleramidohexane

Hexamethylenediamine (58 g.) was added to γ-valerolactone[1] (100 g.) and warmed until solution took place.

(1) Obtained from Monsanto Chemical Co.

Then, with continuous stirring, the solution was heated at 150° for two hours. The solution became dark red; and on cooling, a tan solid was formed and no liquid remained. This solid is soluble in water and insoluble in ether or benzene. Recrystallization from ethylene dichloride gave a white solid, m.p. 88°, yield 96%.

Anal. Calcd. for $C_{18}H_{32}N_2O_4$: C, 60.7; H, 10.1; N, 8.8; mol wt., 316. Found: C, 60.2; H, 9.8; N, 9.2; mol. wt. (by Rast method), 323.

RESEARCH LABORATORY
GENERAL ELECTRIC CO. MATTHEW T. GLADSTONE[2]
SCHENECTADY, N. Y.

RECEIVED JANUARY 16, 1951

(2) Technical Dept., Behr-Manning Corp., Troy, N. Y.

Phenyl-N-(1-carboxyethyl)-nitrone[1]

Hantzsch and Wild's synthesis[2] of phenyl-N-(carboxymethyl)-nitrone involved the condensation of β-benzaldoxime and chloroacetic acid. In the present work 2-bromopropionic acid was substituted for chloroacetic acid to form phenyl-N-(1-carboxyethyl)-nitrone,

$$C_6H_5CH{=}N(O){-}CH(CH_3){-}COOH$$

To an aqueous solution of 5.6 g. of potassium hydroxide was added dropwise 2-bromopropionic acid to the discharge of phenolphthalein pink (8.8 ml. of acid). This solution was added to a mixture of 12.1 g. of β-benzaldoxime and 500 ml. of water in which was dissolved 5.6 g. of potassium hydroxide. The mixture was stirred at 100° until homogeneous, then was left on the steam-bath for 13 hours. When cool, it was acidified with hydrochloric acid. The white precipitate which formed was collected and washed with ether, in which it was insoluble. The aqueous filtrate was stored overnight at −10° and a further precipitation occurred. The combined precipitates weighed 3.3 g. After two recrystallizations from methanol, the product decomposed at temperatures varying with the rate of heating: rapid heating gave a decomposition temperature of 167–170°, while an attempt to dry the nitrone in an oven at 115° resulted in decomposition, accompanied by the odor of benzaldehyde.

Anal. (by V. Hobbs and J. Sorenson). Calcd. for $C_{10}H_{11}NO_3$: C, 62.16; H, 5.75; N, 7.25. Found: C, 62.36; H, 5.63; N, 7.37.

The product was acidic. It did not reduce Fehling solution in the cold but did reduce it on brief heating. After heating the product with mineral acid, the cold reaction mixture reduced Fehling solution.

CHEMICAL LABORATORY
NORTHWESTERN UNIVERSITY CHARLES D. HURD
EVANSTON, ILLINOIS J. M. LONGFELLOW

RECEIVED DECEMBER 4, 1950

(1) Investigation supported by a research grant from Swift and Company.

(2) A. Hantzsch and W. Wild, *Ann.*, **289**, 290, 305 (1896).

Derivatives of β-Hydroxypropyl Sulfides

N,N′-Bis-(2-hydroxy-3-methylthiopropyl)-1,2-diaminoethane.—A mixture of 14.5 g. of 69% 1,2-ethanediamine hydrate and 27.2 g. of 1-methylthio-2,3-epoxypropane was heated on a steam-bath to initiate reaction. After the reaction subsided, the mixture was refluxed for one hour. Liquid impurities were removed from the cooled, solidified reaction product by pressing between clay plates. The resulting material was recrystallized from ethyl acetate to give a white crystalline solid melting at 122–123°; yield 21% based upon the starting diamine.

Anal. Calcd. for $C_{10}H_{24}N_2O_2S_2$: N, 10.43. Found: N, 10.23.

N,N′-Bis-(2-hydroxy-3-ethylthiopropyl)-1,2-diaminoethane.—This white crystalline compound, prepared by the above method, melts at 118–119°; yield 22% based upon the starting diamine.

Anal. Calcd. for $C_{12}H_{28}N_2O_2S_2$: N, 9.44. Found: N, 9.29.

ORGANIC CHEMISTRY LABORATORIES THOMAS K. TODSEN
UNIVERSITY OF FLORIDA EDWARD G. RIETZ
GAINESVILLE, FLORIDA C. B. POLLARD

COMMUNICATIONS TO THE EDITOR

THE REARRANGEMENT OF EPINOCHROME[1]

Sir:

We have reported the synthesis and isolation of crystalline epinochrome,[2] a dark-red crystalline compound of m.p. 78° by oxidative cyclization of epinine hydrochloride. This reaction is analogous to the oxidation of 3,4-dihydroxyphenylalanine to the "red pigment" in Raper's scheme of melanin formation. We now wish to report the spontaneous and the catalytic rearrangement of this crystalline compound into the colorless 5,6-dihydroxy-N-methylindole, an intramolecular oxidation–reduction which parallels the step in melanin formation where the "red pigment" is decolorized.

We have observed that this rearrangement takes place (A) spontaneously on standing of pure epinochrome at room temperature *in vacuo* in a sealed tube for several months when it has turned into a grayish white powder which essentially consists of 5,6-dihydro-N-methylindole; (B) on shaking the solution of epinochrome in water or in absolute methanol with palladium on charcoal in the presence of hydrogen or even in an atmosphere of pure nitrogen, when the solution becomes decolorized within a few minutes without the uptake of hydrogen. From the colorless solution more than 80% of the theoretical amount of 5,6-dihydroxy-N-methylindole m.p. 133° (reported 136°)[3] is isolated. *Anal.* Calcd. for $C_9H_9O_2N$: C, 66.12; H, 5.55; N, 8.57. Found: C, 66.41; H, 5.68; N, 8.85. Under the same conditions 2-carbethoxyepinochrome was decolorized without the uptake of hydrogen and with development of carbon dioxide.

The rearrangement of adrenochrome to 3,5,6-trihydroxy-*N*-methylindole ("adrenolutine")[4] bears a formal relationship to the rearrangement of

(1) This work was supported by the Life Insurance Medical Research Fund.

(2) Sobotka and Austin, THIS JOURNAL, **73**, in press (1951).

(3) Harley-Mason, *J. Chem. Soc.*, 1276 (1950).

(4) Lund, *Acta Pharm. et Tox.*, **5**, suppl. 1, 75, 121 (1949).