TABLE I

$RSCH{=}CHCO_2C_2H_5$

R	B. p. (uncor.), °C.	Mm.	$n^{20}D$	Yield, %	Formula	Analyses, % Calcd.	Found
C_6H_5	145–150	2.3	1.5808	87	$C_{11}H_{12}O_2S$	S, 15.4	15.8
p-$CH_3C_6H_4$	137–138	0.5	1.5752	86	$C_{12}H_{14}O_2S$	S, 14.4	14.9
p-ClC_6H_4	147	2	1.5920	82	$C_{11}H_{11}O_2SCl$	S, 13.2	13.7
3,4-$Cl_2C_6H_3$	152–154	1	1.6018	80	$C_{11}H_{10}O_2SCl_2$	Cl, 25.5	25.0

fractionally recrystallized from a petroleum ether-ethylene dichloride mixture. There was obtained 6 g. of a tan solid, m. p. 83–86°, neut. equiv., 180.

β-(*p*-Tolylthio)-acrylic Acid.—Saponification of ethyl β-(*p*-tolylthio)-acrylate gave a 92% yield of the acid, m. p. 94–125°. Recrystallization from benzene gave a major fraction with unaltered melting point. Fractional crystallization of this material from acetone gave a fraction, m. p. 136–138; neut. equiv. 197 (calcd. 194). The filtrate from the benzene recrystallization upon evaporation yielded a solid which was collected on the filter and recrystallized from benzene, m. p. 104–107°; neut. equiv. 199. The major portion of the acid was the higher melting form.

β-(*p*-Chlorophenylthio)-acrylic Acid.—Saponification of ethyl β-(*p*-chlorophenylthio)-acrylate gave the acid in 90% yield; m. p. 98–112°. *Anal.* Calcd. for $C_9H_7O_2SCl$: S, 14.9; Cl, 16.6. Found: S, 14.9; Cl, 16.5.

β-(3,4-Dichlorophenylthio)-acrylic Acid.—This acid was obtained in an 87% yield, m. p. 98–128°. *Anal.* Calcd. for $C_9H_6O_2SCl_2$: Cl, 28.4; S, 12.9. Found: Cl, 27.6; S, 12.5.

1-Thiochromone.—This material was prepared from 75 g. (0.41 mole) of β-phenylthioacrylic acid (m. p. 75–105°) according to the method outlined in "Organic Reactions"[3] for 2-phenyltetralone-1. The yield was 39 g. (57%), b. p. 115–138° (2–3 mm. dec.); m. p. 76–78° (from benzene).[4] *Anal.* Calcd. for C_9H_6SO: S, 19.7. Found: S, 19.4.

(3) W. S. Johnson, "Organic Reactions," Vol. II, John Wiley and Sons, Inc., New York, N. Y., 1944, p. 145.

(4) F. Arndt, *et al.*, *Ber.*, **58B**, 1612 (1925).

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X-Ray Analysis of Some Antibiotic Substances

BY J. D. DUNITZ AND JOHN E. LEONARD

The determination of the chemical constitution and molecular configuration of antibiotic substances might be expected to have important consequences with respect to our knowledge of the mechanisms involved in microbiological antagonisms and perhaps to the possible synthesis of new antibiotics. Of the major antibiotics, a complete structure determination has been carried out only for penicillin,[1] although the chemical constitution of Chloromycetin has been elucidated.[2]

Recently we have carried out preliminary X-ray investigations of some antibiotic substances which appear to have somewhat similar ranges of antibacterial and antirickettsial activity. Although we have so far been unable to obtain any definite structural information, it seems worthwhile to review here those results which we have obtained at the present stage of the work.

Chloromycetin, or chloramphenicol, $C_{11}H_{12}N_2O_5Cl_2$, has been shown[2] to be the compound D-*threo*-2-dichloroacetamido-1-*p*-nitrophenyl-1,3-propanediol. We have examined crystals of both chloramphenicol and the corresponding bromine substituted derivative, bromamphenicol. Both substances may be crystallized from water in the form of small white needles or laths, which tend to form agglomerates. X-Ray examination shows that the unit cells and space groups are

Compound	Crystal system	a, Å.	b, Å.	c, Å.	Space group	Z
Chloramphenicol	Orthorhombic	17.6	7.35	22.3	$C222_1$	8
Bromamphenicol	Orthorhombic	17.9	7.4	22.1	$C222_1$	8

The observed densities, 1.49 g. cm.$^{-3}$ 1.865 g. cm.$^{-3}$, respectively, indicate the presence of eight molecules in the unit cell. Complete intensity measurements have been made for chloramphenicol and the three Patterson–Harker sections have been computed. The interpretation of these data is complicated by the very high temperature factor observed for the crystals and so far it has not been possible to locate even the chlorine atoms. It may be surmised, however, on the basis of the outstandingly strong (020) reflection (F(020) = 0.43) and the strong negative birefringence of the crystals, that most of the atoms lie in a plane parallel to (010) at either $y = 0$, $y = 1/4$. It is possible to construct a model of the chloramphenicol molecule in which most of the atoms do lie close to a single plane. Intensity measurements for bromamphenicol are not yet completed. In spite of the large temperature factor which is again observed, it is hoped that the presence of the relatively heavy bromine atoms may lead to a direct structure analysis.

The chemical constitution of aureomycin is still unknown. Crystals of the hydrochloride have been obtained from water in the form of yellow diamond shaped plates, although other forms have also been observed. The crystals are orthorhombic with space group $P2_12_12_1$ and cell constants $a = 11.22$Å., $b = 12.89$., Å$c = 15.55$Å. The observed density, 1.52 g. cm.$^{-3}$, leads to a molecular weight of 515 ± 5 for the asymmetric unit,

(1) "The Chemistry of Penicillin," Princeton University Press, Princeton, N. J., 1949.

(2) M. C. Rebstock, H. M. Crooks, J. Controulis and Q. R. Bartz, THIS JOURNAL, **71**, 2458 (1949); J. Controulis, M. C. Rebstock and H. M. Crooks, *ibid.*, **71**, 2463 (1949).

which may be assumed to consist of one molecule of aureomycin hydrochloride.[3]

We have been unable to obtain crystals of the free base in a size suitable for single crystal work. We have likewise been unsuccessful in our efforts to obtain suitable crystals of the hydrobromide, hydroiodide and chloroplatinate of aureomycin.

Crystal modifications other than those described above have been observed both for bromamphenicol and aureomycin hydrochloride but these have not been extensively studied.

We are indebted to Parke, Davis and Co. for samples of chloramphenicol and bromamphenicol, and also for much helpful information, and to the Lederle Laboratories for a sample of aureomycin hydrochloride. This investigation was aided by a grant from the National Foundation for Infantile Paralysis.

(3) Our value, 515, for the molecular weight of aureomycin hydrochloride is not in agreement with the molecular weight, 508, obtained by Broschard, *et al.*, (*Science*, **109**, 199 (1949)) for the free base. Broschard, *et al.*, also give analysis figures for the free hase and hydrochloride; those for the free base contain an ohvious error in that the oxygen percentage (by difference) should be 27.17 rather than 21.17. Taking this error into account, one may calculate $C_{33}H_{27}N_3O_8Cl$ for the free hase, and $C_{33}H_{28}N_3O_8Cl_2$ for the hydrochloride. The molecular weight corresponding to the above empirical formula for the hydrochloride is 531.

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Preferential Complexing of Iron(III) with β-Glucose[1]

BY JOSEPH C. DELANEY,[2] JACOB KLEINBERG AND W. J. ARGERSINGER, JR.

During the course of investigations concerning iron(III) complex ions with glucose, a study was made of the effect of the presence of ferric chloride solution on the mutarotation of α-glucose. It was thought that any complex formation involved might produce a change in the rate of mutarotation of the sugar.

A weighed quantity of α-glucose, prepared according to the method of Hudson and Dale,[3] was dissolved in a known volume of 0.1 *M* hydrochloric acid, and the rate of mutarotation of the solution was observed. An equal amount of the same glucose sample was dissolved in 0.1 *M* hydrochloric acid which was 0.2 *M* with respect to ferric chloride, and the rotation was again measured as a function of time. The volumes of the two solutions were approximately equal; the *p*H values were the same. The polarimeter tube and the solutions were maintained at a constant temperature, approximately 24° throughout each experiment.

The two curves obtained by plotting the observed angle of rotation against time are shown in Fig. 1. It was not thought necessary to convert the observed rotation values to specific rotation values, since the solutions contained equal concentrations of glucose and had the same final volumes.

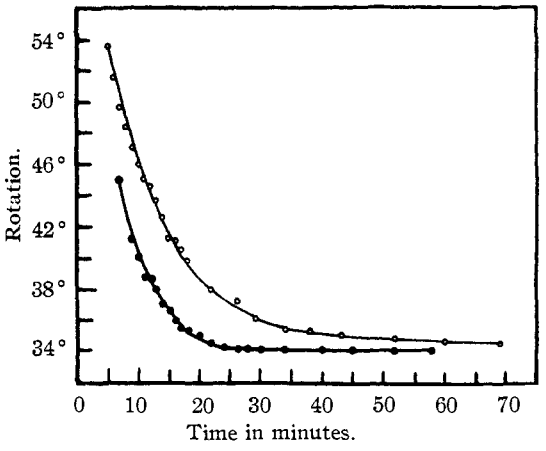

Fig. 1.—Polarimetric study of the glucose and glucose–$FeCl_3$ systems: ●, with $FeCl_3$; ○, no $FeCl_3$.

The experiments were repeated using a freshly prepared sample of α-glucose. With the exception of an increase in the concentration of the ferric chloride solution to approximately 0.4 *M*, the conditions of the former experiments were reproduced. Data obtained in this case are shown in Fig. 2.

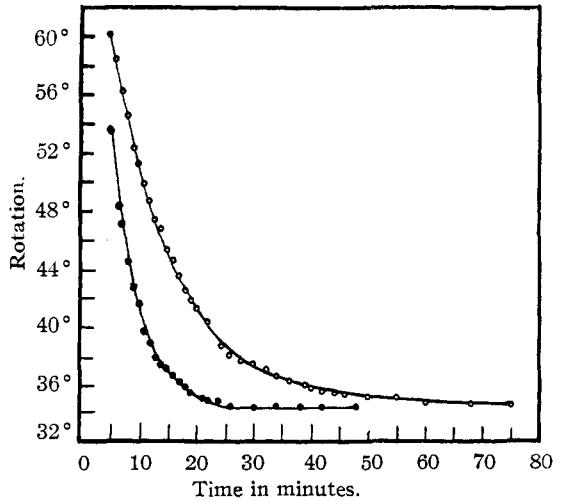

Fig. 2.—Polarimetric study of the glucose and glucose–$FeCl_3$ systems: ●, with $FeCl_3$; ○, no $FeCl_3$.

The α-glucose used to obtain both curves of Fig. 1 differed in purity from that used to obtain both curves in Fig. 2. However, the two companion curves were obtained in each case with α-glucose of the same purity.

(1) An excerpt from a thesis submitted to the department of chemistry and the faculty of the graduate school of the University of Kansas in partial fulfillment of the requirements for the degree of Master of Arts.

(2) NEPA Division, Fairchild Engine and Airplane Corporation, Oak Ridge, Tennessee.

(3) Hudson and Dale, THIS JOURNAL, **39**, 320 (1917).