indicate that in these two compounds the pyranose rings probably have the configuration II. Astbury[3] suggests that there is reason to believe that the pyranose rings can change from type I to II and *vice versa*, and suggests that such may occur in certain derivatives of cellulose. In this connection some recent results obtained in this Laboratory are of interest.

We have been making a rather extensive X-ray study of pectin and its derivatives, as well as other uronic acid-containing compounds including sodium alginate. Of interest to this discussion is the fiber identity period of 15.0 Å. obtained for sodium alginate from oriented fibers. Although fiber photographs of pectic acid are more difficult to interpret, it can be established that the fiber identity period is very close to 13.0 Å. The conclusions to be deduced from these values as well as the value 13.1 Å. for sodium pectate[2] and 8.7 Å. for alginic acid[3] are summarized in Table I.

TABLE I

	Fiber period	Symmetry of chain	Projection per unit along fiber axis	Type of pyranose ring
Alginic acid	8.7	2-fold	4.37	II
Sodium alginate	15.0	3-fold	5.0	I
Pectic acid	13.0	3-fold	4.3	II
Sodium pectate	13.1	3-fold	4.37	II
Cellulose	10.3	2-fold	5.15	I
Soda cellulose-II[4]	15.4	3-fold	5.13	I

Column 4 of Table I shows that the identity period per unit falls into two classes, the value of which agrees with the calculated value for the two *trans* configurations of the pyranose ring. In addition, two other points are of particular interest: (1) the galacturonide chain would appear less flexible than the others, since in both pectic acid and sodium pectate the screw symmetry remains three-fold; and (2) alginic acid and sodium alginate not only have chains of different screw symmetry but the pyranose rings apparently have different configurations.

[4] Gundermann, *Z. physik. Chem.*, **37B**, 387 (1937).

WESTERN REGIONAL RESEARCH LABORATORY
BUREAU OF AGRICULTURAL AND INDUSTRIAL CHEMISTRY
AGRICULTURAL RESEARCH ADMINISTRATION
U. S. DEPARTMENT OF AGRICULTURE
ALBANY 6, CALIFORNIA
K. J. PALMER
MERLE B. HARTZOG

RECEIVED SEPTEMBER 4, 1945

STREPTOMYCES ANTIBIOTICS. II. CRYSTALLINE STREPTOMYCIN TRIHYDROCHLORIDE–CALCIUM CHLORIDE DOUBLE SALT

Sir:

A crystalline double salt of streptomycin trihydrochloride and calcium chloride has been obtained. Streptomycin appears to have the composition $C_{21}H_{37}N_7O_{12}$.

Observations made during chromatographic purification of crude streptomycin concentrates led to experiments which yielded a crystalline double salt of streptomycin trihydrochloride and calcium chloride. This salt has certain advantages over the previously described non-crystalline streptomycin hydrochloride.[1] Since it can be crystallized, the double salt is obtained as a product with constant biological, chemical, and physical properties. In this respect it is more satisfactory than the hydrochloride, which is obtained by precipitation. The double salt can be prepared from streptomycin hydrochloride or from the crystalline streptomycin helianthate.[1] The latter salt is preferred for preparative work and a typical experiment follows.

Seven grams of calcium chloride in 50 ml. of methanol was acidified with 3 drops of concd. hydrochloric acid and added to 30 g. of streptomycin helianthate suspended in 900 ml. of methanol. The insoluble calcium helianthate was removed by filtration. The filtrate, concentrated *in vacuo* to 75 ml., deposited colorless crystals overnight. The crystals (9.2 g.) were dried at 100° *in vacuo*; activity, about 750 units/mg.; $[\alpha]^{25}D$ $-76°$ (c, 1% in water). They decomposed between 200–230° on the microblock.

Anal. Calcd. for $(C_{21}H_{37}N_7O_{12}\cdot 3HCl)_2\cdot CaCl_2$: C, 33.88; H, 5.42; N, 13.17; Cl, 19.05; Ca, 2.69. Found: C, 33.73; H, 5.78; N, 13.18; Cl, 18.65; Ca, 2.76.

A second crop (2.3 g.) of crystals with identical properties was obtained. Recrystallization of another sample with identical properties from methanol–ethanol gave crystals showing unchanged activity and rotation.

Anal. Found: C, 33.67; H, 5.79; N, 13.13; Cl, 19.48; Ca, 2.87.

Analytical data on streptomycin hydrochloride and helianthate,[1] which are also in agreement with the above formulation, follow:

Anal. Calcd. for $C_{21}H_{37}N_7O_{12}\cdot 3HCl$: C, 36.61; H, 5.85; N, 14.23; Cl, 15.44. Found: C, 36.80; H, 6.09; N, 14.39; Cl, 15.59.

Anal. Calcd. for $C_{21}H_{37}N_7O_{12}(C_{14}H_{15}N_3O_3S)_3$: C, 50.59; H, 5.53; N, 14.99. Found: C, 50.53; H, 5.83; N, 14.81.

At present, the formula for streptomycin appears to be $C_{21}H_{37}N_7O_{12}$. However, it is possible though improbable that the number of hydrogen atoms is 39 instead of 37. The tentative formula $(C_{10}H_{19}N_3O_{7-8})_n$, suggested by Fried and Wintersteiner,[2] is not in agreement with our present data. A cryoscopic molecular weight determination on streptomycin trihydrochloride in water gave about 800 for the free base (calcd., 580). Necessary corrections for the chloride ion and the non-ideal cryoscopic behavior of the trivalent streptomycin ion were made. The uncertainties seem sufficient to account for the observed disparity.

The extension of this work to other inorganic salts and to streptothricin will be described later

---

(1) Kuehl, Peck, Walti and Folkers, *Science*, **102**, 34-35 (1945)

(2) Fried and Wintersteiner, *ibid.*, **101**, 613-615 (1945)

We gratefully acknowledge the coöperation of Miss E. W. Peel and Messrs. L. Chaiet and C. E. Hoffhine, Jr., on experimental work, of Dr. J. B. Conn for the molecular weight determination, and of Dr. H. B. Woodruff and Mr. D. Hendlin for microbiological assays.

RESEARCH LABORATORIES
MERCK AND CO.
RAHWAY, NEW JERSEY

ROBERT L. PECK
NORMAN G. BRINK
FREDERICK A. KUEHL, JR.
EDWIN H. FLYNN
ALPHONSE WALTI
KARL FOLKERS

RECEIVED SEPTEMBER 11, 1945

S-BENZYLTHIURONIUM SALTS OF SULFOBENZOIC ACIDS

Sir:

In a paper by E. E. Campaigne and C. M. Suter [THIS JOURNAL, **64,** 3040 (1942)] which on account of the occupation of Denmark by the Germans has been unknown to me till now, where it has been reviewed in *Chem. Zentr.*, **116,** I, 529 (1945), it is stated that whereas *o*-sulfobenzoic acid forms a neutral S-benzylthiuronium salt and *p*-sulfobenzoic acid an acid salt, the *m*-sulfobenzoic acid does not form a salt with the same facility as the two other acids.

Some years ago [*Bull. soc. chim.*, [5] **5,** 1153 (1938)] I prepared a series of S-benzylthiuronium salts of different organic acids amongst which were also the *o*- and the *m*-sulfobenzoic acids. The salt with *o*-sulfobenzoic acid was neutral with m. p. 205–206°, quite in accordance with the indications of Campaigne and Suter. The salt with *m*-sulfobenzoic acid was prepared without any difficulty, using our standard method of preparation: 0.01 equivalent of the acid is dissolved in 10 ml. water, the solution is partly neutralized with 1 *N* sodium hydroxide, till the reaction is just acid against methyl red, and a solution of 2 g. of S-benzylthiuronium chloride in 10 ml. of water is added. The acid salt of *m*-sulfobenzoic acid is readily precipitated and is filtered off. Recrystallized from diluted alcohol it showed m. p. 163–164° (cor.).

LABORATORY OF ORGANIC CHEMISTRY
ROYAL TECHNICAL COLLEGE
COPENHAGEN, DENMARK

STIG VEIBEL

RECEIVED JULY 26, 1945

NEW BOOKS

Discovery of the Elements. Fifth edition. By MARY ELVIRA WEEKS, Research Associate in Scientific Literature at the Kresge-Hooker Scientific Library, Wayne University. Illustrations collected by F. B. DAINS. Published by the *Journal of Chemical Education*, 20th and Northampton Sts., Easton, Pa., 1945. xiv + 578 pp. 343 figs. 16 × 24.5 cm. Price, $4.00.

Nearly fifteen years ago, when a graduate student, this reviewer remembers reading with much pleasure Dr. Weeks' original articles in successive numbers of the *Journal of Chemical Education*, and wishing that they might be collected all in one book. The wish was granted soon thereafter, and apparently many others had the same feeling, as attested by the selling out of four editions in twelve years, each revised and amplified over its predecessor. The book now would almost serve as a history of chemistry in itself.

This new fifth edition shows an increase in text pages over the first from 363 to 578, and of pictures from 281 to 343. A comparison of the two books shows the expansion to have resulted from the normal process of adding new material, illustrations, and entries in the copious "Literature Cited." The original twenty-one chapters have been increased to twenty-seven by the addition of chapters dealing particularly with and presenting new matter concerning the lives and works of Daniel Rutherford, the de Elhuyar Brothers, Klaproth and Kitaibel (on tellurium), Charles Hatchett, Don Andrés del Rio and J. A. Arfwedson. The Author deserves a renewed and amplified vote of thanks from the profession for re-issuing this book, which should be required reading for all college teachers, and be on the reserve reading list of all other chemists.

ALLEN D. BLISS

A Manual of the Aspergilli. By CHARLES THOM, Collaborator, Northern Regional Research Laboratory, Formerly Principal Mycologist, Bureau of Plant Industry, U. S. Department of Agriculture, Washington, D. C., and KENNETH B. RAPER, Senior Microbiologist, Fermentation Division, Northern Regional Research Laboratory, Bureau of Agricultural and Industrial Chemistry, U. S. Department of Agriculture, Peoria, Illinois. The Williams and Wilkins Company, Baltimore, Md., 1945. ix + 373 pp. 15.5 × 23.5 cm. Illustrated. Price, $7.00.

This volume, the preparation of which has been based on the actual handling and culturing of the species described, is designed for the ready identification of the numerous strains of aspergilli encountered in microbiological work, either in biological research or in industrial microbiology, fermentation, and the food industry. The senior author, Dr. Thom, as a result of his studies for forty years, has long been recognized as one of the world's leading mycologists, and has previously been the principal author of what is probably the most authentic treatise on the aspergilli.

The present volume is undoubtedly of much less interest to the chemist than to the microbiologist. The latter will hail it as an exceptionally welcome addition to the literature in his field of study and practical operations. Nevertheless, the chemist who has sufficient biological background, and who wishes to broaden his knowledge of the fermentations and physiological phenomena in colorless plants, and the capacities of the fungi to produce breakdown changes in organic substances, can find great enlightenment in this book.

While avowedly written as a manual for the identifica-