2 and 3. This conclusion is in agreement with the speculations of others regarding the structure of the copper-cellulose complex.[1] The formation of a highly levo-rotatory complex does not require that the glucosidic units be linked together in a polysaccharide.

β-Methyl glucoside dissolved in cuprammonium hydroxide solution does not show a levo rotation. However, β-methyl-4-methyl glucoside, which possesses the same free and substituted positions as cellulose, shows optical activity remarkably like that of cellulose. Similar behavior is exhibited by α- and β-methyl glucosides substituted in positions 4 and 6. In these cases only hydroxyl groups on positions 2 and 3 are available for engagement with the copper radical.

TABLE 1

THE OPTICAL ROTATION (HG BLUE LINE) IN WATER AND CUPRAMMONIUM HYDROXIDE SOLUTION OF CELLULOSE AND SOME METHYLGLUCOSIDES*

Substance	Solvent†	$[\alpha]^{25}_{436}$		$[M]^{25}_{436}$
Cellulose (Purified cotton fiber)‡	Cupra	−1200°		−194,400°
	Water-Triton B(1:1)	− 46°		− 7,500°
			Dif.	−186,900°
β-Methyl-4-methyl glucoside	Cupra	−1008°		−209,700°
	Water	− 36°		− 7,500°
			Dif.	−202,200°
β-Methyl-4,6-ethylidene glucoside	Cupra	−1058°		−234,800°
	Water	− 163°		− 36,200°
			Dif.	−198,600°
α-Methyl-4,6-benzylidene glucoside	Cupra	− 608°		−171,500°
	Water	+ 159°		+ 44,800°
			Dif.	−216,300°
β-Methylglucoside	Cupra	+ 67°		+ 13,000°
	Water	− 62°		− 12,000°
			Dif.	+ 25,000°
α-Methylglucoside	Cupra	+ 432°		+ 83,800°
	Water	+ 306°		+ 59,400°
			Dif.	+ 24,400°
α-Methyl-2,4-dimethyl glucoside	Cupra	+ 275°		+ 61,000°
	Water	+ 308°		+ 68,400°
			Dif.	− 7,400°
β-Methyl-3-methyl-4,6-ethylidene glucoside	Cupra	− 128°		− 30,200°
	Water	− 126°		− 29,700°
			Dif.	− 500°

* The Hg blue line (436 mμ) was isolated for aqueous solutions by use of Corning filters 511 and 038. For cuprammonium solutions it is only necessary to use filter 038 since the longer wave-lengths are absorbed by the solution.

† The cuprammonium hydroxide solution contained 15 gm. copper, 240 gm. ammonia, and 1 gm sucrose per liter. All observations on cuprammonium solutions were made in an 0.5 dm tube. The rotation of the solvent was +0.09° (0.5 dm).

‡ It is impossible to give a correct figure for the rotation of cellulose in water solution. The present value was obtained by dissolving acid-treated cotton fiber in Triton B and diluting with an equal volume of water. Triton B is an aqueous solution of trimethyl benzyl ammonium hydroxide supplied by Röhm and Haas Company, Inc.

When positions 2 and 4 of a methylglucoside are substituted the levo-rotating complex is not formed, indicating that a free hydroxyl group on position 2 is essential for the complex formation. Likewise when positions 3, 4 and 6 are substituted the levo-rotatory complex is not formed indicating that a free hydroxyl group on position 3 is also essential. Formation of the levo-rotatory complex in glucopyranosides appears to require that hydroxyl groups on carbon atoms 2 and 3 be free while that on 4 must be substituted. It is immaterial whether position 6 be free or substituted. Finally the possibility that the complex involves linkage of the 2 position of one glucoside molecule with the 3 position of another was investigated. A solution containing equal parts of 2,4- and 3,4,6-substituted glucosides dissolved in cuprammonium hydroxide solution showed no indication of complex formation.

All the glucose derivatives considered in this communication are believed to have the pyranoside structure. Since the magnitude of the optical rotation in cuprammonium hydroxide solution is dependent upon the relationship between concentration of copper and carbohydrate, all observations were made on approximately 0.03 Molar glucoside solutions or 0.5 per cent. cellulose solutions. Aqueous solutions of similar concentration were employed. A description of the synthesis and properties of β-methyl-3-methyl-4,6-ethylidene glucoside as well as observations on the optical rotation of other polysaccharides and substituted glucosides will be published in another communication.

RICHARD E. REEVES

SOUTHERN REGIONAL RESEARCH LABORATORY,
U. S. DEPARTMENT OF AGRICULTURE,
NEW ORLEANS, LA.

[1] "Natural and Synthetic High Polymers," p. 291. By Kurt H Meyer. Interscience Publishers, Incorporated, New York, 1942.

SCIENTIFIC APPARATUS AND LABORATORY METHODS

A STILL FOR THE CONTINUOUS PRODUCTION OF DOUBLE DISTILLED WATER

THIS apparatus has been used for the production of all-glass distilled water for over a year and has proved very efficient. The water level in the distilling flask is maintained by means of a simple float valve made from a cork and a rectangular brass rod about 1 cm wide and 2 mm thick. This is faced at one end with a piece of gum rubber about 3 mm thick. A weather-stripping cement[1] is used to fasten the rubber to the brass. This is hinged so that when the large cork is horizontal the inlet tube (a quarter inch brass tube) is closed. The box *A* for the leveling device is made from ⅛ inch brass plates. The distillation flask

[1] 3 M weatherstrip cement sold by Minnesota Mining and Manufacturing Company, St. Paul, Minn.

E is made from a Pyrex 2 liter flask which has a 24/40 ground glass joint *D* sealed into it. The tubing sealed

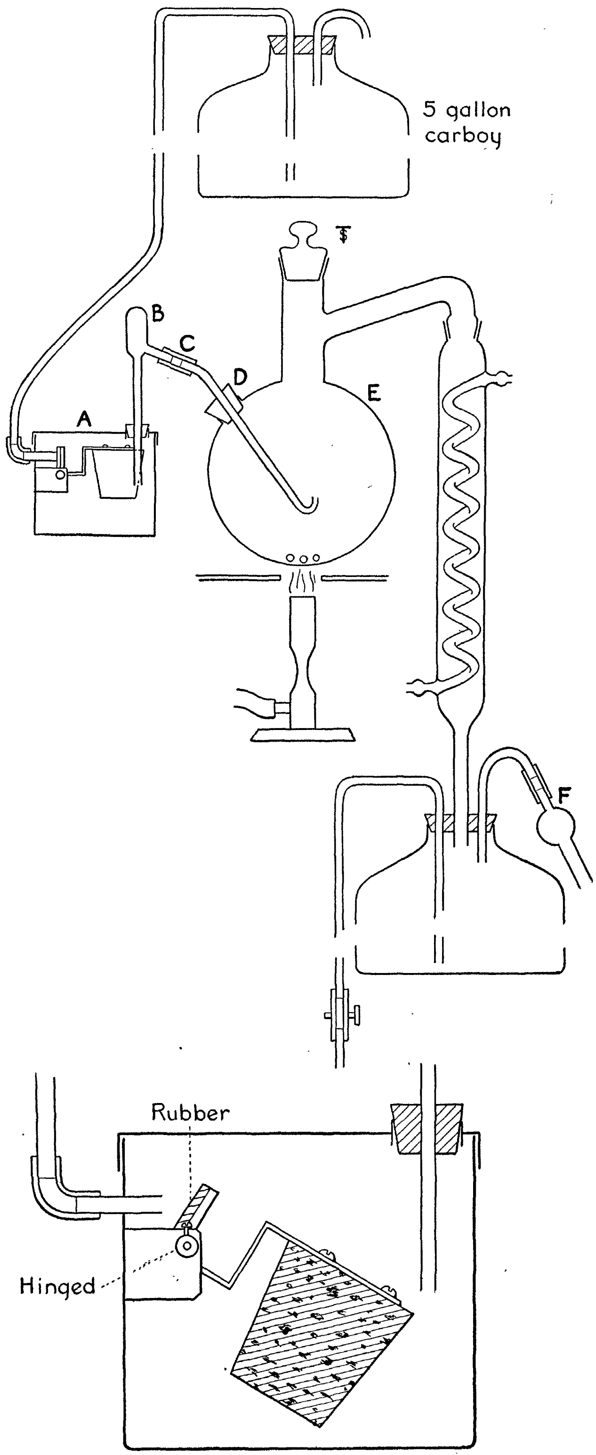

FIG. 1

into the male part of the joint should be constricted slightly at the bottom and turned up to prevent the ingress of air bubbles during boiling. The siphon is equipped with an air trap. It is made by sealing a side arm into the bulb of a broken 10 ml pipette; the upper part of the bulb is sealed. The siphon tube should be sloped from the bulb into the flask so that if any bubbles form they will collect in *B*. Over a period of months only a small amount of air collects in *B*. The rubber tubing *C* should permit the insertion of a clamp when the apparatus is not in use. The soda lime tube *F* should contain only coarse particles; otherwise it offers too much resistance to the distillation and may blow the stopper out of the flask. Sometimes it is advisable to remove the soda lime tube during the distillation.

Two mls of 85 per cent. phosphoric acid and a few glass beads are put into the flask. A Day pinch clamp is left on the rubber tubing at *C* until the water starts to boil. The siphon can be filled from the rubber tubing on the end of the delivery tube from the large carboy. When the siphon and the air trap *B* are filled, the clamp is put on at *C*. When the first distillation is started the flask *E* should be filled to a level a little below that in *A;* otherwise when the water starts to boil it will force some of the solution out of the flask into the leveling box.

The entire apparatus can be assembled in an area $24 \times 15 \times 65$ inches, which includes a 5-gallon carboy reservoir for single distilled water. Where there is a supply of running distilled water, a line can be brought over to the 5-gallon carboy and so facilitate filling the reservoir. The carboy rests on a shelf supported by wall brackets and a $\frac{5}{8}$ inch pipe which serves as a support for the rest of the equipment.

OLAF MICKELSEN
W. W. BENTON
JOHN A. PHELAN

LABORATORY OF PHYSIOLOGICAL HYGIENE AND THE CENTRAL SCIENTIFIC SHOP, UNIVERSITY OF MINNESOTA, MINNEAPOLIS

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