it has been pointed out[8] that the discordance between the results of the several studies is as much as 0.2 to 0.5 mv. Analogous studies with the silver–silver chloride electrode[9,13] agree within 0.1 mv. Our own electromotive forces in pure hydrobromic acid solutions at 25° are 0.1185 and 0.0775 v. at 0.5 and 1 *m*, respectively, which are 0.3 to 0.6 mv. lower than results previously reported.[8] It is improbable that this discordance is due to analysis, as it corresponds to errors of the order of 0.5 to 1%. It is attributed more readily to impurities in the solution and electrode constituents, but further purification of the commercial reagents employed was shown to be without effect in this as well as in a previous study.[6] It is noteworthy in this connection that sample B of hydrobromic acid, which was protected from oxygen and exposure to light, gave the same results as the unprotected sample A. As a check on the preparation of the thermal type electrodes, the measurements on four cells were repeated with the electrolytic variety. The concordance was within 0.1 mv. In fact, the only irregularities apparent in our measurements occurred when x was less than 0.1, or when the cells had been in operation all day. In the latter case a drop in e. m. f. of about 0.1 mv. in six or eight hours undoubtedly caused the irregularity in temperature coefficient which can be observed in Fig. 1 between 20 and 25°.

At 25° we made $x = 0.063$ for sample B acids at 0.5 and 1 *m*, and obtained readings 0.44 and 0.34 mv. higher than required by the extensions of the lines in Fig. 1. Unfortunately the time available for measurements did not allow us to investigate the reproducibility of these "high" results. Accordingly we have disregarded them entirely, and *limited our conclusions to values of* x *greater then one-seventh.*

Summary

1. The silver–silver bromide electrode was studied in mixtures of hydrobromic acid and hydrochloric acid and found to give reproducible results over a sevenfold change in relative concentration.

2. Log γ for hydrobromic acid was determined in the mixtures at constant total molality from 0 to 45°. It was shown to vary linearly with relative concentration. The rate of variation decreases with rise in temperature, but is practically independent of concentration between 0.5 and 1 *m*.

3. The rate of variation of log γ for hydrochloric acid in the mixtures was estimated, and found to be of the same order of magnitude as that for hydrobromic acid, but of opposite sign. Its temperature coefficient is also negative.

NEW HAVEN, CONN. RECEIVED AUGUST 16, 1937

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[13] (a) Randall and Young, THIS JOURNAL, **50**, 989 (1928); (b) Shedlovsky and MacInnes, *ibid.*, **58**, 1970 (1936).

[CONTRIBUTION FROM THE FOREST PRODUCTS LABORATORY,[1] FOREST SERVICE, U. S. DEPARTMENT OF AGRICULTURE]

Composition of Coconut Shells[2]

BY L. C. FLECK,[3] W. G. VAN BECKUM[4] AND GEO. J. RITTER[4]

Although coconut shells have been used extensively for making a highly absorbent charcoal, little if any published information on their composition is available. In order to supply some information on the subject, the Forest Products Laboratory presents the following results of an analysis of the shells made in coöperation with the Barnebey–Cheney Engineering Company of Columbus, Ohio. The standard methods employed on woods were used in this analysis.

Analysis and Results

Coconut shells in the form of a meal (60–80 mesh) were analyzed according to the following determinations: moisture, ash, cold water soluble material, hot water soluble material, 1% sodium hydroxide soluble material, ether soluble material, pentosans, methoxyl, and acetic acid by methods described by Schorger;[5] holocellulose by the chlorine–alcohol–ethanolamine method developed by Van Beckum and Ritter;[6] Cross and Bevan cellulose by a modified Cross and Bevan method

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[1] Maintained at Madison, Wis., in coöperation with the University of Wisconsin.

[2] Presented before the American Chemical Society, Rochester, N. Y., September, 1937.

[3] Formerly with the Forest Products Laboratory.

[4] U. S. Forest Products Laboratory, Madison, Wis.

[5] A. W. Schorger, *Ind. Eng. Chem.*, **9**, 556 (1917).

[6] W. G. Van Beckum and Geo. J. Ritter, *Paper Trade J.*, **104**, 19, 49 (1937).

described by Ritter and Fleck;[7] lignin by the 72% sulfuric acid method by Ritter, Seborg, and Mitchell;[8] and the hydrolysis number by a procedure developed by Hawley and Fleck.[9] The cellulose stable to the 15% acid hydrolysis is the residue remaining from the "hydrolysis number" determination.

TABLE I

COMPOSITION OF COCONUT SHELLS

Materials determined	Based on weight of oven-dry (105°) shells, %
Moisture	6.07
Cold H_2O soluble	1.43
Hot H_2O soluble	2.67
Ether soluble	0.19
1% alkali soluble	20.53
Lignin	33.30
Total pentosan	30.28
Ash	0.23
Holocellulose	61.00
Cellulose	44.98
Pentosans in cellulose	17.67
Pentosan in cellulose	39.30[a]
Loss in cellulose due to 15% H_2SO_4 hydrolysis, "Hydrolysis No."	35.85[a]
Cellulose stable to 15% H_2SO_4 hydrolysis	28.86
Methoxyl	5.39
Acetic acid by hydrolysis	4.79
Loss in weight of shells due to 2.5% H_2SO_4 hydrolysis from acetic acid determination	18.74

[a] On basis of Cross and Bevan cellulose.

The results of the analysis are recorded in Table I.

Discussion of Results

The results indicate that the coconut shells have higher percentages of lignin, total pentosans, and pentosans in the cellulose than do the hardwoods. On the other hand, the percentages of the cellulose, the cellulose stable to a 15% sulfuric acid hydrolysis, and the holocellulose, which is the total carbohydrate material in the extractive-free shells, are considerably lower than the values of the corresponding materials in hardwoods. The acetic acid content and the methoxyl content of the shells are about the same as those of hardwoods.

Summary

Coconut shells have been analyzed by methods that have been developed for woods. The yields of lignin and pentosans from the shells are higher than those from woods. Conversely, the yields of holocellulose and Cross-Bevan cellulose from the shells are considerably lower than those from woods. The methoxyl content and the acetic acid content are about the same in the two materials.

MADISON, WISCONSIN RECEIVED SEPTEMBER 23, 1937

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[7] Geo. J. Ritter and L. C. Fleck, *Ind. Eng. Chem.*, **16**, 147 (1924).

[8] J. Ritter, R. M. Seborg, and R. L. Mitchell, *Ind. Eng. Chem., Anal. Ed.*, **4**, 202 (1932).

[9] L. F. Hawley and L. C. Fleck, *Ind. Eng. Chem.*, **19**, 850 (1927).

[CONTRIBUTION NO. 40 FROM THE DEPARTMENT OF CHEMISTRY OF THE POLYTECHNIC INSTITUTE OF BROOKLYN]

Preparation of Para-Aminobenzoic Acid Esters of Monoalkylamino Alcohols

BY SAMUEL D. GOLDBERG AND WILLET F. WHITMORE

Dialkylamino alcohols in the form of their esters with *p*-aminobenzoic acid have been used as local anesthetics for a long time. However, an examination of the literature reveals that no work has been reported on the preparation of analogous compounds where the monoalkylamino alcohols have been employed. The present investigation deals with the preparation of compounds of the latter type.

It was hoped to increase the anesthetic efficiency of the compounds without unduly increasing their toxicity in proportion to their increased molecular weight, since monosubstituted amino alcohols were used. For example, the monobutylamino alcohol ester has the same molecular weight as the diethylamino alcohol ester used in procaine. It was hoped also that these compounds would show some vaso-constrictor properties, in contrast to the dialkylamino compounds, since most of the vaso-constrictors have monoalkyl substituted amino nitrogen in their configuration.

Some monoalkylaminoethanols have been prepared by Knorr,[1,2] Mathes,[3] J. S. Pierce[4] and two members of the monoalkylaminopropanol series by Pierce and Adams.[5]

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[1] Knorr, *Ber.*, **22**, 2088 (1899).

[2] Knorr and Schmidt, *ibid.*, **31**, 1072 (1898).

[3] Mathes, *Ann.*, **315**, 104 (1901).

[4] Pierce, THIS JOURNAL, **50** 241 (1928).

[5] Pierce and Adams, *ibid.*, **45**, 790 (1923).