the decomposition of the hydrogen peroxide and the oxidation of the hydrazine, and promotion factors were computed.

4. The effect of acidity was studied and observed to be quite analogous to the inhibition noted in studies of the decomposition of hydrogen peroxide in the absence of hydrazine.

5. The mechanism of the oxidation of the hydrazine is probably as follows. The hydrazine is oxidized both by the oxygen liberated in the reaction of the catalyst intermediate with the hydrogen peroxide and by that catalyst intermediate itself. When ferric and cupric sulfates are used together, producing both cupric and ferric acids, the ferric acid is more effective in the oxidation than is the cupric acid, the observed promotion in the oxidation reaction being almost wholly due to oxidation by the evolved oxygen which is liberated in an activated state.

MADISON, WISCONSIN

[CONTRIBUTION FROM THE CHEMICAL LABORATORY OF IOWA STATE COLLEGE]

REACTIONS IN LIQUID HYDROGEN SULFIDE. VIII. SPECIFIC CONDUCTANCE OF LIQUID HYDROGEN SULFIDE

BY S. D. SATWALEKAR, L. W. BUTLER[1] AND J. A. WILKINSON

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Introduction

There is but little agreement in the published values for the specific conductance of liquid hydrogen sulfide. Steele, McIntosh and Archibald[2] reported it as being an extremely poor conductor and gave the value for the specific conductance as about 0.1×10^{-6} at $-81°$. Magri[3] found it "much less than 4×10^{-7} at $-60°$." Quam and Wilkinson[4] concluded from qualitative observations that it was much less than this, being less than 1×10^{-11} reciprocal ohms. Borgeson,[5] using a sensitive Wheatstone bridge set-up, obtained values varying from 10^{-6} to 10^{-8} at $-78.5°$.

In view of these varying results it was the purpose of this work to make a quantitative determination of the specific conductance of liquid hydrogen sulfide at $-77°$.

Experimental

The liquid hydrogen sulfide was prepared in the apparatus described by Quam.[6] The conductivity cell was made from a wide test-tube with a stopper through which passed the glass tubes making mercury connections

[1] Assistant Professor of Physics at Iowa State College.

[2] Steele, McIntosh and Archibald, *Phil. Trans. Roy. Soc.*, **205A**, 99 (1906).

[3] Magri, *Atti Accad. Lincei*, [5] **16**, I, 510 (1907).

[4] Quam and Wilkinson, THIS JOURNAL, **47**, 989 (1925).

[5] Borgeson, unpublished data from this Laboratory.

[6] Quam, THIS JOURNAL, **47**, 103 (1925).

with the platinum electrodes sealed into them. The electrodes were of sheet platinum (3.25 × 2 cm.) and these were held rigidly in place about a millimeter apart by fine glass rods set between them and sealed together at the ends. This arrangement permitted the easy removal of the electrodes from the cell for cleaning. They were cleaned with mixed acids, washed with water, platinized, washed with water, alcohol and ether and dried with warm air. A mark was made on the test-tube where the volume was 20 cc., about 1 cc. above the tops of the electrodes, and the cell was filled to this mark each time.

The conductivity set-up included several dry cells as a source of electromotive force, a D'Arsonval galvanometer whose sensibility was 2.1×10^{-10} amperes per millimeter deflection on the three meters distant galvanometer scale. The cell was connected in series with the dry cells, a key, the galvanometer and a 10,000-ohm resistance to protect the latter.

The cell constant of the conductivity cell was determined at 25° with a 0.02 *N* potassium chloride solution. Using Kohlrausch's value of 2.768×10^{-3} for its specific conductance, six determinations gave a cell constant of $2.19 \times 10^{-2} \pm 0.3\%$. The resistances were all measured at −78.5° using a bath of ether and solid carbon dioxide in a Dewar flask.

TABLE I

RESISTANCE OF LIQUID HYDROGEN SULFIDE

Voltage	Deflection	$R \times 10^{-8}$	Deflection	$R \times 10^{-8}$	Deflection	$R \times 10^{-8}$
1.5			15	4.76	15	4.76
1.52	16	4.53				
3.00	25	5.71	26	5.49	25	5.71
4.5					36	5.95
5.8	48	5.75				
6.0			49	5.83	47	6.08
9.0			73	5.87	70	6.12
11.8	96 (unsteady)	5.83				
12.0	Unsteady					
19.25	Rose slowly					
Av. value for *R*		5.33×10^{8}		5.49×10^{8}		5.72×10^{8}
Av. value for sp. cond.		4.11×10^{-11}		3.99×10^{-11}		3.83×10^{-11}

As would be expected, if polarization takes place, the resistance becomes greater at the higher voltages and this is shown by the data. Although there is a gradual increase as the voltage rises, beyond three volts this increase is much less and if an average of the values beyond that point is taken the resistance is 5.87×10^{8} and the specific conductance for liquid hydrogen sulfide at −78.5° is 3.78×10^{-11}.

In one of the earliest runs it was observed that the resistances obtained were uniformly high and an examination of the cell showed crystals which were like those formed when water is present in liquid hydrogen sulfide at that low temperature. In order to find the effect of water on the resistance of liquid hydrogen sulfide, three runs were made, in one of which a mere trace of water was added, in the second about 1% and in the third 5%. Table II shows the results.

TABLE II

EFFECT OF WATER ON THE RESISTANCE OF HYDROGEN SULFIDE

Voltage	Galvanometer readings Dry	Trace H_2O	1% H_2O	5% H_2O
1.5	15	12	11	8
3.0	26	20	19	13
6.0	49	34	33	25
9.0	73	52	53	38

Conclusions

1. The specific conductance of liquid hydrogen sulfide determined at $-78.5°$ is 3.7×10^{-11} reciprocal ohms.
2. The presence of even small amounts of water increases the resistance a great deal.

AMES, IOWA

[CONTRIBUTION FROM THE LABORATORY OF PHYSICAL CHEMISTRY OF THE UNIVERSITY OF UPSALA]

THE STATE OF DISPERSION OF CELLULOSE IN CUPRAMMONIUM SOLVENT AS DETERMINED BY ULTRACENTRIFUGE METHODS

BY ALFRED J. STAMM[1]

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Very little is known about the state of dispersion of cellulose in cellulose solvents because hitherto there have been lacking adequate methods for determining the particle size or the molecular weight of coarsely dispersed materials. The usual osmotic pressure methods for determining the molecular weight of solutes of high molecular weight are of little value here, because of the high electrolyte content of the solvents. Even in the case of cellulose derivatives in organic solvents, this method is questionable, because the derivatives themselves cannot be sufficiently purified.

The diffusion experiments of Herzog and Krüger[2] furnish the only available information on the nature of cellulose dispersions in cellulose solvents. Applying Einstein's diffusion law these investigators have calculated the average particle size. Unfortunately, they did not carry their diffusion experiments to low enough concentrations to be sure that they were dealing with free diffusion, and their method of taking only a few samples for analy-

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[1] Fellow of the Rockefeller Foundation. Chemist on leave from the U. S. Forest Products Laboratory, Madison, Wisconsin.

[2] (a) Herzog, *Pulp and Paper Mag. Can.*, **24**, 699 (1926); (b) Herzog and Krüger, *Kolloid-Z.*, **39**, 250 (1926); (c) *J. Phys. Chem.*, **33**, 179 (1929).