Hydrogen in Electrolytic Zinc.—By W. Roy Elliot, B. Sc., Dalhousie University, Halifax, N. S.

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Ralston, in a paper published recently in the Transactions of the American Electrochemical Society[1], called attention to the work of Schwarz on the hydrogen occluded by cathode zinc. This amounts to 5-11 c. c. per gram, and is doubtless the cause of the low specific gravity of electrolytic zinc. At the time the advanced copy of Ralston's paper appeared I was engaged on the study of the properties of zinc deposited under various conditions. I have used some of my depostits to determine the amount of hydrogen occluded as it seemed unlikely that Schwarz' results, obtained by dissolving weighed amounts of zinc in acid, could be exact. The quantities of hydrogen found are about one-tenth those found by Schwarz. In other respects my observations agree with Ralston's.

The zinc was deposited on small aluminium cathodes between lead anodes. The amount of zinc sulphate was kept approximately constant by the addition of small amounts of zinc oxide. The solutions were acid except at the beginning of the experiment and no glue was used. The deposits, except in the two cases mentioned in the table, were of good quality. They were from 0.3-0.4 mm. thick.

The volumes of the occluded gases were determined by placing a weighed amount of the zinc in a pyrex tube, connected to a Toepler pump by a mercury seal. The apparatus was exhausted to 0.01 mm., and allowed to stand for some time to see that no leak developed. The zinc was then melted by a resistance furnace, and the gases were pumped off and measured. No quantitative analysis of the gas was made, but qualitative tests showed it to be hydrogen.

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The results are given in Table 1.

Deposited from 8 per cent. Zinc Sulphate

Current Density (Amperes per sq. ft.)	Current Efficiency (Per cent.)	Apparent S. G.	C. C. Hydrogen per gram Zinc
10	93	7.2	1.3
20	68	6.1	1.3
30	45[2]	6.6	1.1
60	17[3]	6.2	2.2
	15 per cent. Zinc Sulphate		
20	89	6.5	0.7
30	84	6.8	0.4
60	87	6.5	0.7
100	84	6.2	0.8
	35 per cent. Zinc Sulphate		
20	95	6.5	0.6
30	94	5.9	0.8
60	98	6.5	0.4
100	95	5.7	0.9

In order to see whether any of the hydrogen was pumped off during the preliminary exhaustion, the volume of the pyrex tube was carefully determined, and the volume of the air displaced by the zinc calculated. The following are the results per gram of zinc.

Gas pumped off during exhaustion.....0.07 c. c.—13%
After standing for 24 hours at low pressure.....0.05 c. c.— 9%
On heating to 200° C.....0.06 c. c.—11%
On melting.....0.35 c. c.—67%

Total 0.52 c. c.; S. G. of Zinc 6.7

2. Poor Deposit
3. Poor Deposit: black surface.

As the thin sheets used in my experiments may have contained a different amount of hydrogen from that present in commercial zinc, I have made some experiments on freshly precipitated cathodes about 2.7 mm. thick from Trail, B. C., obtained through the courtesy of Messrs. Murray and Willis. Determinations were made on strips of the cathodes and on portions carefully planed free from oxide. The results are a little less than those obtained from the thinner strips.

Apparent S. G.	C. C. in a gram of zinc
7.03	0.31
7.08	0.38
7.08	0.40
....	0.54

Strips of commercial electrolytic zinc were heated to various temperatures for a short time, cooled, and the specific gravities determined. The "warts" mentioned by Ralston appeared on the inside surface at about 165° C., and there was marked bending with the inside surface convex.

Temperature	Apparent Specific Gravity	
	A.	B
20°	6.93	6.99
103°	6.90	6.93
165°	6.96	6.93
200°	6.86	6.89
254°	6.77	6.78
305°	6.50	6.58
400°	6.05	5.98

The effect of heating on the apparent specific gravity of the zinc is quite marked.

It appears then, that the hydrogen present in cathode zinc is less than that found previously by Schwarz, and consequently the pressures developed inside the zinc are small.