

alloys. Although the physical theories are quite different, the resulting equations do not differ greatly for molecules so similar in size as these metals. The agreement of equation (1) with the experiments is distinctly poorer than that of the other two equations, but the difference between these two is too small to choose between them, and either one checks the measurements almost within the experimental error. The results with the other alloys are equally indecisive. In fact, I know of no measurements, in systems for which the agreement might be significant, which agree distinctly better with the equation of Langmuir than with that of Van Laar, or *vice versa*. The choice of theory must rest on a more fundamental analysis, a further contribution to which I hope to publish shortly.

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GEORGE SCATCHARD

THE FORMATION OF HYDROGEN PEROXIDE FROM HYDROGEN AND OXYGEN

Sir:

I have recently reported [THIS JOURNAL, **52**, 5106-5110 (1930)] that hydrogen peroxide is formed, along with water, when hydrogen-oxygen mixtures at atmospheric pressure are passed through a Pyrex reaction tube at 500-550°. Thermodynamic data [Lewis and Randall, "Thermodynamics," McGraw-Hill Book Co., New York, 1923, p. 496] indicate that the peroxide cannot have been formed via water



but must have been produced directly



Since hydrogen peroxide dissociates to give water, the question arises as to whether all the water formed passes through the peroxide stage, or whether a part comes direct from the elements.

An attempt was made to answer this by determining the ratio of peroxide to water formed under conditions leading to successively lower total conversions. If hydrogen peroxide were the only primary product, one should obtain something approaching pure peroxide in the limit. As the experimental results were on the whole inconclusive, it seems unnecessary to report them in full. However, a representative set of data may be of interest.

The data of the table refer to experiments in which 19H₂:1O₂ mixtures were passed through a spherical Pyrex reaction vessel of 4.3 cm. diameter. The gases passed from flowmeters to traps cooled to -79°, then through

the reaction bulb and then through a weighing U-tube also cooled to -79° . Total product was determined by weighing; the peroxide was then titrated with 0.05 *N* potassium permanganate; and water was obtained by difference.

Temp., °C.	Approx. heating, sec.	Part press. in off-gas in 0.001 atm.		Ratio H ₂ O ₂ /H ₂ O	H ₂ re- acting, %
		H ₂ O ₂	H ₂ O		
550	0.5	0.068	0.37	0.18	0.046
550	1	.21	1.7	.12	.20
540	1	.19	0.76	.25	.10
530	1	.056	0.21	.27	.028

In spite of the extremely small total conversions (less than 0.2% H₂), the best result obtained was one mole of peroxide to four moles of water. The possibility of independent, direct formation of water from the elements is thus by no means excluded.

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SURFACE REACTIONS OF ATOMS AND RADICALS

Sir:

Recently we¹ have found that water vapor, dissociated in a discharge tube, will oxidize carbon monoxide to carbon dioxide. Since atomic oxygen is not very effective in causing this oxidation we are led to believe that the carbon dioxide is formed as the result of a reaction involving the hydroxyl radical. Assuming that this is the case, we can use the oxidation of carbon monoxide as a test for OH and in this way determine whether it is affected by certain catalytic surfaces.

By observing the effect of different catalysts on the yield of carbon dioxide, we have found that a dehydrogenation catalyst is inefficient in causing the H + OH combination while a dehydration catalyst is quite efficient. This result is in accord with the work of Taylor and Lavin² and shows, as might be expected, that a strictly dehydrogenation catalyst is only effective in causing the recombination of hydrogen atoms.

In light of the fact that we are able to observe the oxidation of carbon monoxide after practically all of the hydrogen atoms have been removed (by the dehydrogenation catalyst) it seems that we have here a method for the separation of H and OH.

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¹ Lavin and Jackson, *THIS JOURNAL*, **53**, 383 (1931).

² Taylor and Lavin, *ibid.*, **52**, 1910 (1930).