Active Hydrogen.

In March last I observed an interesting phenomenon while conducting certain experiments, in the Maharajah's College, Vizianagaram, with detonating mixtures with excess of hydrogen when they are subjected to the silent electric discharge in an ozoniser. In one experiment the oxy-hydrogen mixture, after leaving the ozoniser, was allowed to pass through an alkaline solution of potassium permanganate. In the course of the experiment an electric spark accidentally took place in the mixture, and as a consequence an explosion occurred in which a part of my apparatus was smashed to pieces; but to my surprise I found that the whole of my permanganate solution turned green at once.

It was surmised from this that the instantaneous reduction might be due to the presence of an active modification of hydrogen produced in the circumstances, since molecular hydrogen brings about the same change very slowly. In order to study the problem more conveniently, I filled a Hofmann eudiometer with an alkaline solution of potassium permanganate, and a few cubic centimetres of an explosive mixture with excess of hydrogen (3 vols. of hydrogen and 1 vol. of oxygen) were admitted into the explosion tube and the mixture was sparked, as soon as the spark passed through the solution it turned green.

With the object of testing further the reducing efficiency of this new form of activated hydrogen, its effect was examined in a number of reactions. It was thus found that with this hydrogen an alkaline solution of indigo was converted into indigo white, ferric chloride into ferrous chloride, potassium nitrate into potassium nitrite, arsenious acid into arsine, potassium perchlorate into potassium chloride, and a number of other reactions were also tried with like results.

Some references to the literature relating to this subject of active hydrogen may be of interest. In 1913 Sir J. J. Thomson was led to conclude from examination of the paths of positively charged particles that they "revealed the presence of particles having an atomic weight of 3, presumably triatomic molecules of hydrogen." Duane and Wendt showed, in 1917, that when hydrogen is exposed to the bombardment of α-particles from radium emanation a contraction in volume occurs, a fact which has been incidentally observed by Usher, and confirmed recently by Lind. In 1912 Dr. Langmuir discovered an active modification of hydrogen by heating a metallic filament in hydrogen at low pressures. Again, so late as May last, Gerald and Robert S. Landauer published a paper on triatomic hydrogen in the Journal of the American Ghemical Society. These investigators activated hydrogen in different ways, all the methods being dependent on gaseous ionisation. The hydrogen was activated by the α-rays, by the electrical discharge in a vacuum, by the corona, and by Schumann light, though the last means of activating hydrogen was unsuccessful.

Sir J. J. Thomson found in 1913 (Proc. Roy. Soc., A, lxxxix., 20) that "X_3 disappears when a mixture of it with hydrogen is sparked with sufficient oxygen to give a violent explosion." In my experiments, however, I find that the active hydrogen appears with the explosion; moreover, the fact that under similar conditions with excess of oxygen ozone is produced, and with excess of hydrogen an active form of it makes its appearance, is significant when we consider the nature of the chemical process of the formation of water when explosive mixtures are subjected to an electric spark.

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July 23.