DISCUSSION.

Dr. Cecil H. Desch (*communicated*): The peculiar behaviour of alloys of magnesium and lead in moist air, the mass disintegrating to form a black powder, was recorded by Grube in 1905,* and has been noticed by many who have attempted to prepare the alloys. Alloys of magnesium and tin are attacked, but to a less extent, and Grube † used etching by steam as a means of developing their structure. Mr. Ashcroft's proposals to make use of the chemical reactivity of these alloys are very interesting, and it is to be hoped that he may be later on in a position to communicate some practical results.

Mr. C. C. Paterson said this paper naturally turned one's thoughts in the direction of getting rid of the last traces of oxygen in high vacua. Was it necessary for water to be present to get any action?

Mr. Ashcroft said that the action only went on to the extent that water vapour was present.

Dr. H. Borns asked if there would be no action at all if water vapour was not present.

Mr. Ashcroft said that was so.

Dr. J. A. Harker asked if the method had been used for taking out oxygen, which was the contaminant in hydrogen used for balloons. When they got down to 85 per cent. hydrogen in ordinary commercial aeronautics the hydrogen had to be scrapped. It seemed to him that it might be possible to get rid of the oxygen by this method. When the hydrogen got

* G. Grube, *Zeitsch. anorg. Chem.*, 1905, **44**, 117.
† Idem. Ibid. 1905, **46**, 76.

down to 85 per cent. there was the risk of explosion through a thunderstorm or atmospheric electric disturbance and the buoyancy was also reduced. Attention might be given to this possible application of the method.

Mr. Ashcroft said he was much obliged to Dr. Harker for mentioning this. It had not been overlooked and he thought it was entirely practicable.

Dr. E. K. Rideal said the fact that zinc and magnesium did not react, while an alloy of lead and magnesium was active, suggested that the action was a catalytic one, based on electrolytic processes. It was very similar to the behaviour of iron in removing small traces of chlorine from water. If it was passed through iron filings, the chlorine was removed very slowly by co-operation with the iron. The rate of removal of the chlorine could be increased several hundreds of thousands of times the normal speed, the acceleration being practically proportional to the electrolytic difference of potential between the metals being used, and in ascending order for copper, silver and gold. It would be interesting to know if the order was the same in this case.

Dr. H. C. Greenwood asked whether the action took place without undue violence if moist oxygen were used instead of air.

In such case it was possible to imagine a number of useful applications. For example, commercial oxygen manufactured by the fractionation of liquid air often contains some 2 to 3 per cent. of argon, and is conveniently used for the preparation of this rare gas by combustion of the oxygen with the correct quantity of hydrogen.

If the removal of oxygen by the alloys described by Mr. Ashcroft were readily controllable, it might afford a useful means of isolating the argon from the excess of oxygen. He would like to ask whether Mr. Ashcroft had carried out any experiments in this direction.

Mr. Ashcroft said he had not used his alloy for separating argon from oxygen, but he quite saw the utility of the suggestion. He thought it was quite feasible.

Mr. E. A. Ashcroft (*communicated reply*) : Since the discussion on the above paper I have seen Dr. Desch's communicated note, in which he refers to Grube's work on magnesium lead alloys, in which he noted the property possessed by some of these alloys of falling into a black powder by oxidization in damp air.

I am obliged to Dr. Desch for calling my attention to this research, which I have since carefully studied. It appears that Grube did not go much further than the above note. It has been established by several investigators that magnesium forms the compound Mg_2Pb, and my further investigations into this matter have established the fact beyond doubt that it is this compound which is the most highly reactive alloy, therefore the best results are obtained with an alloy containing approximately 19 per cent. of magnesium and 81 per cent. lead.

A further property of this alloy has been noted and investigated with a view to possible industrial application : that is, the continuous giving off of hydrogen from the alloy when exposed in a moist atmosphere which contains no oxygen. That is to say, the alloy will first extract the oxygen from any moist atmosphere, and afterwards yield hydrogen from the moisture in the deoxidized atmosphere, as long as any oxidizable matter remains in the alloy. The final reaction brings the magnesium to the form of hydrate and the lead to the form of the hydrate of the monoxide, and the rate of reaction, though slower than the rate of oxidization, is still sufficiently fast to be available for industrial purposes.

The use for these combined reactions which suggests itself most forcibly is to carry a small supply of the alloy in an airship, and so arrange matters that the gas may be continuously exposed to its action during a long voyage. This would have the effect of always keeping the hydrogen in a safe condition and very greatly prolonging the range of the voyage possible with one charge of hydrogen.