vapour lamp and the iron arc, but apart from the already well-known small increase in the rate of oxidation of reduced iron and copper on illumination, no definite signs of catalytic effects were obtained, possibly on account of the relatively feeble intensity of the resonance lines for these metals in the arcs employed. In the case of mercury irradiated with the water-cooled mercury arc the catalytic effect is, however, most distinct. Thus in a series of experiments with *ca.* 30 c.c. of hydrogen and oxygen, in an approximate ratio of 2 : 1, at a total pressure of 300 mm., both in the absence and presence of mercury vapour the rate of combination was so slow that in a period of five hours a change in pressure of less than 1·0 mm. was obtained. In the presence, however, of a layer of mercury 10 cm. long, disposed in the horizontal reaction tube, a change in pressure of 60 mm. an hour was obtained. The rate of change is to a first order proportional to the area of mercury exposed. Amalgamated silver is likewise effective as a catalyst, but amalgamated brass possesses but little efficiency. In this latter case it may be observed that owing to the operation of the forces of surface tension, zinc and not mercury is the predominant constituent of the surface layer.

Whilst in the absence of hydrogen, ozone can be identified by the tailing of the mercury, when hydrogen is present mercuric oxide is formed on the mercury surface and is also deposited on the tube walls.

Auto-retardation of the rate of reaction is to be noted when formaldehyde and its polymerised products from carbon monoxide and hydrogen condense on the previously clean mercury surface. Although ethylene is sensitive to light in the absence of mercury, the combination of this gas with hydrogen proceeds smoothly at a greatly accelerated rate in the presence of the illuminated mercury surface.

The operation of this hitherto unsuspected catalytic action of a mercury surface in the photochemical combination of gases provides a reasonable explanation, so far as can be ascertained from the published information on the experimental methods adopted, for the high rates of combination frequently observed. It must, however, be admitted that the data of Coehn and Tramm do not conform to this view, for a remarkably rapid rate of combination was obtained for pure gases. It is possible that mercury was actually present, being drawn into the reaction vessel from the one ground-in joint with which their reaction system was provided, since their diagram lends support to the view that the joint was provided with a mercury seal.

We have not as yet obtained definite information as to the quantum efficiency of the surface, or whether water vapour is essential for this surface action; it appears, however, to be unnecessary for the operation of the Franck and Cario mechanism.

H. S. HIRST.
E. K. RIDEAL.

Laboratory of Physical Chemistry,
Cambridge,
November 20.

The Cierva Auto-gyro.

IN his article on the Cierva auto-gyro in NATURE of October 31, Prof. Bairstow repeats an argument originally used against the helicopter, that the longer spiral path of the blades, as compared with the straight path of aeroplane wings, causes a greater expenditure of energy for a voyage of a given length from point to point.

Munk arrives at the contrary conclusion in Technical Note No. 221 of the American Advisory Committee for Aeronautics. On pp. 10-11 he writes: "The average velocity of the helicopter blade is greater than that of the aeroplane wing and this involves greater loss. . . . However, the helicopter makes up again for this by its smaller wing area . . . ," and finally, "The loss due to the drag of the [helicopter] wing is accordingly smaller."

I find it difficult to simplify the basis of comparison sufficiently to draw any general conclusion, but am of the opinion that Prof. Bairstow's argument requires considerable modification on the lines laid down by Munk.

A. R. LOW.

London, November 28, 1925.

THE argument for relative efficiency of aeroplane *v.* auto-gyro as given in my article does not depend on the area of the wings used, and it would seem that Munk can only reach his conclusion by imposing on the aeroplane some disability not shared by the auto-gyro. The disability is made clear on p. 11 of the report referred to by Major Low, where we find "the aeroplane wing area is not chosen for the ordinary velocity of flight, but for the much smaller velocity used for taking off and landing, and in consequence is much greater than it would need be for ordinary flight alone." This paragraph means that at high speeds an aeroplane cannot use its wings at the best ratio of lift to drag, and this is a well-known phenomenon. The argument as to the advantages and disadvantages of the two types of craft becomes very technical if carried into this stage, and I cannot press my point further here than as one of opinion backed by the knowledge that experiments have not yet demonstrated the capabilities of the auto-gyro to overcome the disadvantage of the aeroplane to which attention has been drawn by Munk.

Put in terms of lift/drag the difference of statement seems to disappear; on p. 7 of N.A.C.A. Tech. Note No. 221 Munk says: "I proceed now to the energy balance of the tilted propeller. This will give information on the economy of the helicopter. It is enough to analyse the results of tests 136 to 141, which is done in Table VIII. The table shows that the ratio L/D of the propeller is considerably smaller than for ordinary wings. . . ."

L. BAIRSTOW.

The Free Path of Slow Protons in Helium.

POSITIVELY charged hydrogen atoms with velocities acquired by falling through 300 to 900 volts have been found to possess an unexpected range in helium and other gases. With helium pressures so high as 0·5 mm. of mercury, the protons will complete a semicircular path 16 cm. in length and still appear as a positively charged bundle of rays. The magnetic deflexion shows also that they remain charged throughout their entire path. As the free path given by the kinetic theory of gases for a rapidly moving particle is 1·5 millimetres at this pressure, the protons must pass unaltered through more than one hundred helium atoms. The capture of electrons by α-rays of various velocities observed by Henderson and Rutherford, and Rüchardt's experiments with canal rays, would lead one to expect a rapid neutralisation of protons of this velocity. The neutralisation of the more rapidly moving particles observed in those experiments has been explained by the presence of a great number of electrons, due to ionisation, with which the particles may combine, and we may account for the absence of neutralisation in the present experiments by the assumption that no free electrons are produced by protons of the velocity used. In fact, energy considerations would suggest the improbability of an