addition of small quantities of hydrogen (thereby taking the partial pressure of the hydrogen out of the critical range); it should be impossible to detect an intermediate stage in the formation of water vapour from the hydrogen (for example, OH molecules); and the temperature of the water vapour molecules formed in the knocking combustion should be considerably higher than in normal combustion. Evidence of these three effects has been forthcoming.

(1) In unpublished work performed at the Bureau of Standards early in 1921 it was found that the use of hydrogen in comparatively small amounts eliminated fuel-knock and the high pressures resulting therefrom.

(2) In a direct spectrographic comparison of the flames from knocking and normal combustion in an engine cylinder, OH bands in the ultra-violet disappeared from the knocking zone only when fuel-knock was present; in normal combustion they were detected throughout the cylinder[12].

(3) In work now proceeding at the Bureau of Standards on infra-red radiation from an engine cylinder (preliminary accounts of which have already appeared[13,14]) there are indications that the spectral distribution of the radiation during knocking and normal operation is essentially the same from the region where no knock occurs, while radiation from water vapour molecules on wave-lengths between 5μ and 10μ shows an increase when knocking conditions are compared with non-knocking in the region where knock occurs. The only change from knocking to non-knocking operation was the necessary variation in the proportion of benzole mixed with a fuel of low anti-knock value to eliminate the knock.

More complete data, and a discussion of this theory in its relation to existing theories of fuel-knock and knock-suppression will appear later, though it may be mentioned here that the combustion of hydrogen has been found to be remarkably inhibited by the presence of small amounts of anti-knock materials[15].

My thanks are due to Prof. S. Lees, from whom I obtained the original idea that hydrogen might be responsible for fuel-knock, and the acting director of the U.S. Bureau of Standards, for permission to publish this note.

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Hydrocarbon Combustion in an Engine

An outline of a theory of the behaviour of 'antiknocks', and of the character of the knocking type of explosion, was put forward in a lecture at the Royal Institution in 1928 (see supplement to NATURE of July 7, 1928). The ideas discussed were obtained by inference from a variety of experiments, rather than by direct demonstration. It was not demonstrated with any certitude, for example, that peroxides were formed during a knocking type of explosion in an engine cylinder; neither was it proved that the metallic 'antiknocks' were in an oxidised state before being effective as 'antiknocks' in the engine.

These and other points in agreement with the ideas then put forward have now been demonstrated, and, as then suggested, are of importance in connexion with the process of combustion of certain hydrocarbon vapours. By sampling the gases at various moments during the cycle of an internal combustion engine, by means of a special device which can be operated over a very small crank angle, the amounts of aldehydes and peroxides, etc., have been determined. Substances behaving as peroxides rise to a maximum, and then fall off in quantity prior to the passage of flame past the valve, whereas the aldehydes are at a maximum 1/240 second later, when the flame reaches the valve. The amount of 'peroxide' appears to be connected with the phenomenon of knocking. Benzene gave rise to no measurable peroxides, though aldehydes were present in considerable quantity.

It has also been demonstrated that thallium, which acts as an even more powerful 'antiknock' than lead, when let into the engine cylinder as vapour by a special valve, is only effective when previously oxidised.

It is intended to publish an account of these experiments on the completion of the investigation.

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A New Type of Photoelectric Effect in Cuprous Oxide in a Magnetic Field

When a plate immersed in liquid air and placed in a magnetic field parallel to its plane is illuminated by a beam of white light perpendicular to its plane, an electromotive force E is produced between A and B (Fig. 1). This electromotive force changes its sign when the magnetic field is reversed, its absolute value remaining unaltered. We investigated the dependence of E upon the intensity of the magnetic

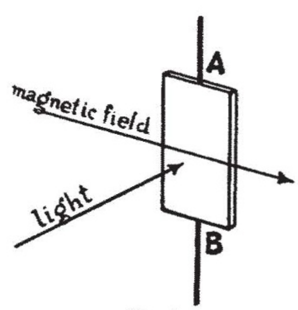

Fig. 1.

field H and found that up to fields of about 2,500 gauss, E is a linear function of H, the maximum electromotive force at this field strength reaching 2·7 volts. It may be noticed also that when the plate is illuminated from the opposite side, with the direction of the current in the electromagnet remaining unchanged, the electromotive force is reversed in sign. The existence of this electromotive force must evidently be looked upon as an indication of