at best to a quasi-gaseous-cum-quasi-liquid interior condition.

The magnetic field seems to me to be induced mechanically by the whirling vortex, and I have seen on more than one occasion on the sun's limb an exact and complete representation of the converging luminous H_α filaments, as represented in Dr. Störmer's theoretical diagram, page 31, No. 109, of the Mount Wilson Contributions, these luminous lines strikingly representing the magnetic lines of force. The creation of a magnetic field about sunspots by the vortex appears to me a direct result of the violent temperature changes which are going on. Thus, for example, the conduction of hot steam into cool water means abrupt condensation and is accompanied by strong electric effects, particularly noticeable when the vessel containing the cool water is fairly well insulated. I have often wondered why this simple experiment has not been followed up and made use of industrially. Once electric effects are admitted in connexion with, and due to violent temperature changes, it does not appear very difficult to understand the possibility of attraction and repulsion effects also. ALBERT ALFRED BUSS.

22 Egerton Road,
Chorlton-cum-Hardy,
Oct. 12.

Flame and Combustion.

As a result of investigations on the effect of 'antiknock' compounds on the ignition of hydrocarbons, it was concluded that the combustion of hydrocarbons was autocatalytic and that the 'antiknocks' delayed oxidation by destroying the catalyst. It was further pointed out that these processes of catalysis were connected with the peroxidation of the fuel and of the antiknock, and that the course of the catalysis depended on the oxygen concentration (*Jour. Inst. Pet. Tech.*, pp. 244-280; 1927).

The effect of carbon disulphide on ether-air mixtures (cited by Dr. White in NATURE of Jan. 8, 1927), its effect also in raising the igniting temperature of petrol and in preventing 'knock' in engines in spite of its inflammability, can be ascribed to similar actions. Sulphur (particularly if combined with a reducing radical) can act as an 'antiknock' in the same manner as selenium, though to a less degree.

One is led to expect that the effect of water and of hydrogen on the combustion of carbon monoxide—air mixtures would be a similar case of catalysis, in which the peroxidation would be influenced by 'antiknock' compounds. The first experiments made to test this point were unsuccessful; Mr. Gates and I found that lead tetraethyl did not influence the combustion of carbon monoxide—hydrogen—air mixtures (except sometimes, it seemed, in explosions of a vibratory character). It was thought that the lead tetraethyl vapour probably did not have time to be decomposed before reaching the zone of combustion and could therefore not modify the flame speed. This surmise appears to be correct; Mr. Goodey and I have found that iron carbonyl, which decomposes at a lower temperature than lead tetraethyl, modifies the combustion of carbon monoxide—hydrogen—air mixtures very considerably.

The object of this letter is to direct attention to the importance of the study of the stages of combustion which precede inflammation—an importance to which Prof. Bone, from another point of view, has directed attention by his recent work on the explosion of methane—oxygen mixtures (*Proc. Roy. Soc.*, **114**, p. 442; 1927). The process which goes on in the body of the gas is catalytic and has a great influence on the subsequent ignition of the mixture, and is even important in the narrow region of heated gas immediately in front of an advancing flame. A. EGERTON.

Clarendon Laboratory,
Oxford.

IN conjunction with Mr. D. L. Hodge, for some time past I have been studying experimentally the combustion of $2CO + O_2$ (moist and dry) in a steady high tension direct current discharge, and the experiments have resulted in some new observations which seem to have an important bearing upon the function of steam in the combustion of carbonic oxide. We hope soon to communicate a detailed account of them to the Royal Society; meanwhile, in view of the general interest in the subject, we should like to make the following brief statement of the results.

In such a high tension direct current discharge, combustion may be wholly localised *either* (*a*) at the cathode *or* (*b*) in both the cathode and the positive column zones. By the methods which we have employed, we have been able to study the influence of moisture on both the cathodic and the positive column combustion. Our results have shown that in the cathode zone, where the fall of potential is very steep and the ionisation accordingly intense, the rate of combustion is quite independent either of the gas pressure or of the presence of moisture, but is proportional to the current passing, that is, to the number of ions arriving at the cathode per unit of time. In this region, the presence of moisture, so far from assisting combustion, slightly hinders it, owing to its diluent effect. Thus a sulphuric acid – dried $2CO + O_2$ mixture combined in this region at a rate about 15 per cent. faster than did the same mixture when saturated with water vapour at 17° C.

In the positive column region, however, where the potential gradient is slight as compared with that of the cathode zone, the presence of moisture greatly accelerated the combustion.

It would thus appear that, whereas moisture may accelerate combustion in a $2CO + O_2$ mixture in a region of comparatively weak ionisation, it has no influence, other than that of a diluent, in a region of sufficiently intense ionisation. Such results confirm the conclusions already drawn by Prof. Bone from his experiments, namely, that moisture is not essential to the combustion of carbonic oxide, and that (in cases where it accelerates the process) its rôle is electrical and not chemical. G. I. FINCH.

Department of Chemical Technology,
Imperial College of Science and Technology,
London, S.W.7.

IN commenting upon our previous letter in NATURE, Oct. 22, Prof. Armstrong stated that, in comparing the heats of combustion of carbonic oxide and hydrogen *in flames*, he had taken into account the heat of formation of water, not that of hydrone (steam), which can only mean that he supposes water (not steam) to be formed in flames. This being so, will he then kindly vouchsafe us an answer to the question put to him in our letter, namely: *Is there, indeed, any evidence that not 'hydrone' (steam) but something much more complex and 'hydronolic' (water) is formed in flames?* For we want to know what his answer is before deciding whether or not it would be safe for us to accept (as he suggests) the guidance of his 'imagination' whilst wearing our 'thinking caps.'

WILLIAM A. BONE.
D. T. A. TOWNEND.

Oct. 31.