exception of a small fraction which were striking an uncooled surface near the image slit. The slits were each 0.1 mm. wide by 1 mm. long and were separated by a distance of 7 cm. The intensity of the beam was measured by means of an ionisation gauge, having as its only opening a slit of the same dimensions as of the two referred to above. The gauge was mounted in the vacuum in such a manner that it could be moved into or out of the beam at a point 8 cm. beyond the image slit. The change of pressure which took place in the ionisation gauge, when it was moved from a position outside of the beam into its centre, was assumed to be proportional to the intensity of the beam.

With this arrangement a beam could be detected when the oven pressure was 0.1 mm., a pressure slightly below that at which a maximum would be expected to occur, if the interpretation which Knauer and Stern have placed upon their results is correct. It was found, however, that with oven pressures ranging from 0.1 mm. up to 30 mm., *the beam intensity increased uniformly with the oven pressure.* Within this pressure range the beam was well defined and had the width calculated from the geometry of the slits. At oven pressures greater than 30 mm., the beam intensity increased more slowly with the pressure, and passed through a maximum at an oven pressure of 100 mm. Within this range the beam gradually became more diffuse, until at the last pressure it was several times its geometric width.

The maximum may be analogous to the maximum observed by Knauer and Stern; it is possibly due to scattering by molecules which have been reflected from the small uncooled area near the image slit. The more complete elimination of such reflected molecules accounts for the fact that the maximum occurred at an oven pressure about one thousand times greater than that predicted by Knauer and Stern.

The mutual collisions referred to above are also an important cause of scattering at these large beam intensities. For this reason the production of a beam of greater intensity will not be materially aided by a further elimination of the reflection of molecules from the walls of the chamber between the two slits.

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The Mechanism of 'Knock' Suppression.

THE letter by Messrs. Egerton and Gates in the issue of Mar. 19, p. 427, concerning the mechanism of 'knock' suppressors such as lead tetra-ethyl, prompts me to add certain points of view material to the discussion.

The idea that lead tetra-ethyl acts as an inhibitor of the oxidation of aldehydes was expressed by me in January 1924 at a meeting of the North-Eastern Section of the American Chemical Society in Boston, reported in the News Edition of *Industrial and Engineering Chemistry* for February 1924, and in *Chemical and Metallurgical Engineering*, vol. 30, p. 148 (1924). At that meeting I was able to show an experiment in which the rate of oxidation of 5 c.c. of benzaldehyde was decreased from 1.5 c.c. absorbed oxygen per minute to 0.005 c.c. per minute by the addition of one drop of lead tetra-ethyl to 5 c.c. of benzaldehyde. The report of this work has been delayed, but a forthcoming publication by Mr. H. J. L. Bäckström will record in detail work of which this is one phase.

In the meantime we have obtained other results which demonstrate one other possible mechanism of known suppression by lead tetra-ethyl. Charch,

Mack, and Boord have suggested (*Ind. Eng. Chem.*, 18, 336; 1926) that the suppression is to be associated with the liberation of fine particles of the free metal in the gaseous mixture, these atoms functioning as catalysts of oxidation, themselves undergoing rapid oxidation and producing, at a definite stage in the engine cycle, a large number of oxidation centres. A homogeneous combustion throughout the gas mixture ahead of the flame front would thus occur, thereby suppressing the formation of a detonation wave and consequent knock.

Our own experiments on the properties of hydrogen atoms (*Trans. Faraday Soc.*, vol. 21, 1926) have led also to a study of the decomposition of metal alkyls of the lead tetra-ethyl type and to an important addition to the above concept. Not only may the lead atoms function as oxidation centres, but also, and to a very much more marked extent, the free radicals, *e.g.* C_2H_5 , liberated by the thermal decomposition, are extremely reactive in the presence of hydrocarbon-oxygen mixtures. Complete disappearance of oxygen is secured at temperatures below 300° C. Indeed, with hydrogen atoms, in the presence of ethylene and oxygen, reaction is secured at room temperatures, oxygenated organic compounds being produced. Free radicals, therefore, may function as oxidation centres producing homogeneous combustion, an effect supplementary to the inhibitory action of the metal alkyl on oxidation of the aldehydes produced by partial oxidation of hydrocarbons. The action of the free radicals may well account for the inhibitory effects produced by non-metallic knock suppressors of the type of aniline. As yet, there does not seem to be any method whereby the relative importance of these several possibilities may be estimated.

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A Mawken Canoe in Algoa Bay.

ACCOMPANYING this is a photograph (Fig. 1) of a dug-out canoe which I found washed up on the sea beach in Algoa Bay at a point known as New Brighton. The canoe is 22 feet long, 16 inches in

FIG. 1.

width, and 14 inches deep. It has been hollowed out from a large tree. Towards the stem there is a cavity in the bottom of the canoe for the reception of a mast. The side pieces, which have the appearance of rowlocks, can be clearly seen in the photograph.

Dr. Ernest Schwarz, professor of geology at the