

Behaviour of Cylinders of Inflammable Gas in a Fire : Extinguishing Flames by Coal Gas

On the night of October 5, 1936, a fire occurred in Pearse Street, Dublin, in a shop which housed two full cylinders of compressed gas, one containing 150 cu. ft. of oxygen, the other 100 cu. ft. of coal gas. In each case the internal pressure was 120 atm. During the fire explosions took place, and a large portion of the building collapsed. It was found afterwards that three firemen had lost their lives. A Tribunal of Inquiry, appointed by the Minister for Local Government and Public Health of Saorstát Éireann, has recently issued its report (Stationery Office, Dublin). "The Tribunal is satisfied that the explosions must be attributed to the two full cylinders of coal gas and oxygen," and includes among the results of the explosions "the trapping of three firemen who were then within the building thereby causing their deaths".

The fire, and the inquiry which followed, raise a point of general interest. If a fire occurs in premises in which cylinders of compressed gas are stored, will that fire be likely to be much more disastrous than if cylinders are absent?

In the present instance, there is no doubt that the cylinders burst in the course of the fire, for they were found ruptured in the ruins. There was general agreement, however, that the result of the physical bursting of a cylinder of compressed coal gas, followed by the *burning* of its contents, was likely to be much less disastrous than if the contents of the cylinder became mixed with air and suffered chemical *explosion*.

The men of science who attended the inquiry as expert witnesses found themselves faced with the following problem. Suppose the back of the shop (where the coal gas cylinder was placed) in flames, and suppose the front of the shop not yet on fire. The coal gas cylinder bursts, presumably in the midst of the flames. Could the gas (if the burst took place on the suitable side of the cylinder) make its way through the flames into the air in the front part of the shop, form an explosive mixture, and explode if a flame reached the mixture before it had become too dilute?

There is no doubt that the emerging coal gas could extinguish the flames in immediate contact with the cylinder. Intense cooling (in this instance 500°–600° C.) would result from an almost adiabatic expansion. Further, the concentration of combustible material would far exceed the upper critical explosion limit, which is about 28 per cent of combustible in the case of Dublin coal gas. I expressed the opinion that the jet of coal gas, shot with high velocity from the ruptured cylinder, might thus extinguish the flames in its path, and blast its way through the surrounding fire to the air in the front of the shop, where chemical explosion would probably follow. The alternative picture submitted was that of the coal gas swelling out of the ruptured cylinder as a 'balloon' which would *necessarily* be kindled at its periphery. It would then make its way to the nearest outlet as a gigantic flame, prevented by a mantle of burnt gases from mingling with air so as to form an explosive mixture.

The essential problem is therefore: Can a jet of coal gas extinguish flame *without itself being ignited*? If the answer is in the affirmative, there exists a possibility of *chemical* explosion in a case such as the present. Whether explosion actually occurs will depend on a variety of factors, such as the *volume*

and pressure of the escaping combustible gas, and the extent of the fire by which the container is surrounded.

I have carried out experiments, which I believe to be new, showing that coal gas *can* extinguish flame without itself being ignited.

A coal gas flame, five or six inches high, was established in the open air. A small cylinder of compressed coal gas (20 cu. ft.), fitted with the usual nozzle to control the rate of discharge, was used. The nozzle was opened full and the stream directed, from a distance of 3–4 ft., on to the flame. After a little practice, one was able to extinguish the flame without igniting the stream of gas from the cylinder.

A less striking experiment was carried out as follows. A five-litre flask was filled with coal gas, and the mouth covered with thin paper to form a temporary barrier to the gas. The flask was adjusted, mouth downward. A small gas flame was prepared. The tube from which this gas issued was surrounded at the mouth by a short piece of wider glass tubing with irregular edges, to puncture the paper before the flame reached it. The edge of the wider tubing was only just above the level of the top of the flame. When the flame was pushed up into the flask of gas, it was of course extinguished. The gas which issued from the flask sometimes took fire, but on numerous occasions the flame was extinguished without igniting the gas.

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Formation and Breakdown of Amino-acids by Intermolecular Transfer of the Amino Group

WE have previously reported¹ the discovery in muscle of a highly active metabolic mechanism, by the action of which the amino group and two hydrogen atoms of glutamic acid are transferred to pyruvic acid (added or of metabolic origin) with the formation of alanine (and ketoglutaric acid). This is the key to the puzzling fact that glutamic acid is transformed into succinic acid by muscle tissue without the formation of either ammonia or amide nitrogen (D. Moyle-Needham).

Further work, to be published in detail elsewhere, showed this reaction to be a reversible one. From alanine and α -ketoglutaric acid muscle tissue rapidly forms glutamic and pyruvic acids, equilibrium mixtures of similar composition resulting in both the direct and the reversed reaction.

The presence of the enzyme system responsible for this process of *Umaminierung* can be readily demonstrated not only in muscle, but likewise in other organs (heart, brain, liver, kidney), irrespective of their capacity or inability to metabolize amino-acids by oxidative deamination or reductive amination respectively. In organs containing Krebs's aminodehydrogenase the intermolecular transfer of the amino group competes with oxidative deamination and, owing to its greater velocity, completely inhibits the latter process in the presence of an excess of pyruvic acid. Only with nucleated erythrocytes and malignant tissues no evidence of *Umaminierung* has been obtained up to the present.

α -Ketoacids other than pyruvic, for example, α -keto-butyric, α -ketocaproic, oxaloacetic or phenylpyruvic acid, may equally serve as acceptors for the amino group of glutamic acid. On the other hand, all