The Formation of Diamond

The formation of diamond is a subject which has apparently commanded greater attention from eminent scientists than has been generally known. As a mere scientific achievement, the possibilities had a peculiar attraction, altogether apart from any commercial potentialities. It has long been known that the diamond is almost pure carbon, being converted to charcoal at high temperature, and burning in oxygen with the production of carbonic acid gas in the same proportion as pure carbon. If the transformation of diamond to charcoal takes place at high temperatures, what may be the possibilities of the reverse change, and, if effected, what are the prospects of commercially producing diamonds?

As crystalline carbon the diamond is worth millions of times as much as its amorphous allotrope, charcoal. Crystallization usually occurs during solidification from gas, liquor or solution. Metals crystallize on solidification from fusion, while salt and sugar crystallize from saturated solutions. Can carbon be made to crystallize from either of these conditions? As far back as 1880 Marsden showed that black diamonds were to be found in a mass of silver melted in a carbon crucible and raised to the temperature of melting steel. The first systematic investigation, however, was carried out by Professor Henri Moissan. Charcoal dissolves freely in iron at a very high temperature. With ordinary cooling the carbon separates as graphite. No diamonds result from slow cooling. Some consideration of the conditions likely to obtain in the formation of diamonds in nature led Moissan to a method which strikingly achieved success.

The procedure followed by Moissan, and the hypothesis which dictated it, came under critical review based on experiments extending over nearly forty years, brilliantly conceived and skillfully carried out by the Hon. Sir Charles Parsons, F.R.S., who unfolded his methods and results before the Institute of Metals recently. Methods of research, involving the production of extraordinarily high temperatures and pressures, were adopted in order to test Moissan's fundamental conception of the formation of diamond. The experimental work involved the application of enormous pressures—sustained or instantaneous—to graphite and carbon liquids, such as benzone, paraffin, treacle, carbon tetrachloride, and carbon disulphide. Upwards of 200 chemical reactions were arranged to deposit carbon under high pressure with central heating by electrical methods. The products were examined by the analytical methods adopted by Moissan and Crookes. Small residues of diamond, which occasionally occurred, appeared to be due to unintentional iron in the charge. Attempts were then made to melt carbon in bulk, but the greatest change appeared to be a slight alteration in the structure of the graphite. The same conclusion had been reached by Threfall, who found that, under a pressure of 100 tons, graphite electrically heated remained graphite. Still higher temperatures and pressures were obtained by the rapid compression of an oxy-acetylene flame with an excess of acetylene to supply the carbon. The evidence showed that a pressure of 15,000 atmospheres had been reached, but nothing more than a little brown amorphous powder easily destroyed by boiling sulphuric acid and nitre resulted. In this experiment it was calculated that the extraordinary temperature of between 15,000 deg. C. and 17,700 deg. C. had been attained. Other tests were made with which there is no space to deal.

Sir Charles Parsons, as the result of his work, advances the view that occluded gases, especially carbon monoxide, are responsible for diamond formation. Thus the weight of diamond found in an ingot in one case reached one part in 20,000, or about one-thousandth part of the carbon present, a quantity of about the same order as the amount of carbon present as occluded carbon monoxide. Having experimentally disposed of the bulk-pressure theory, and also in no less striking a manner shown that quick cooling of itself is similarly ineffective, attention was given to experiments suggested by the presence of diamonds in meteorites. By electrical heating of carbon in vacuo down to 1-6 mm. mercury, and even down to X-ray tube pressures, it was found that in no experiment with vacuum higher than 2 mm. mercury was diamond produced, but it