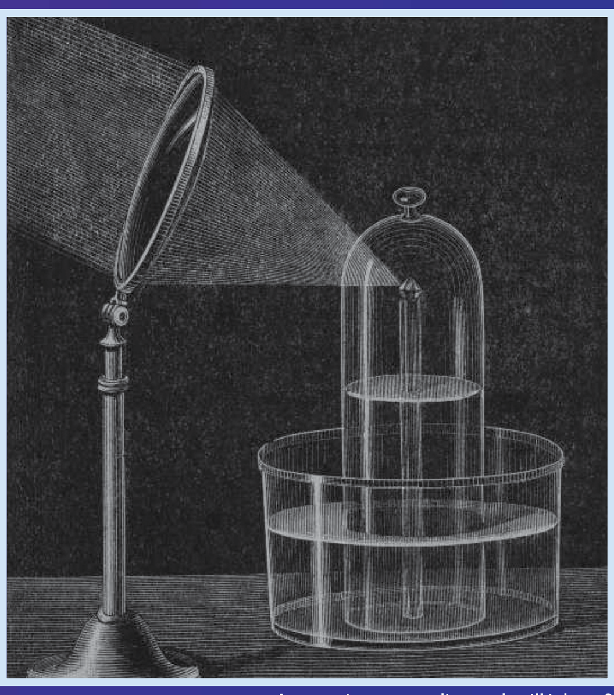
Diamond, diamond, burning bright...

Surprise, surprise! - The first experiments on the invincible stone in the 17th century showed that it burns. How can this be? Well, diamonds are made of carbon, like graphite. Perhaps they are twins?



An experiment on a diamond: will it burn ?
Diamants et Pierres Précieuses by Louis Dieulafait.

But this stone evaporates!

In the 1st century AD, Pliny the Elder wrote that diamonds resist fire and will not even heat up in the hottest of flames (as they transmit the heat) It was therefore against all expectations that Boyle, the Irish natural philosopher, discovered, without understanding why, that diamonds «evaporate» when subjected to great heat. More and more experiments were carried out up to the 19th century, by Darcet, Lavoisier and then later by Friedel, to try to understand the transformation.

Robert Boyle (1627-1691)

DESTRUCTION DU DIAMANT PAR LE FEU. 59

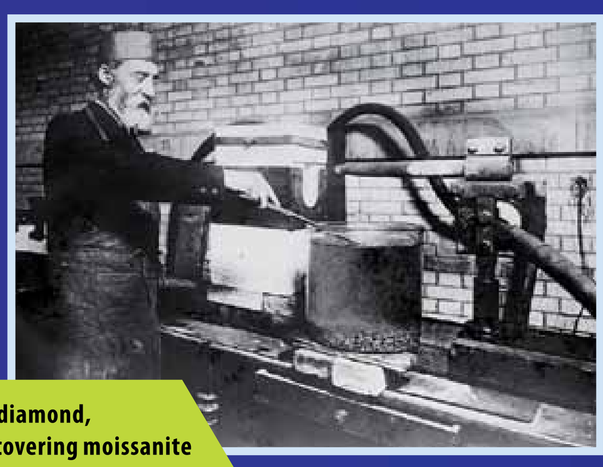
Lavoisier's «Mémoire» on the destruction of diamond by fire, in the Comptes rendus de l'Académie des sciences (1772) by Louis Dieulafait.

Identical twins, but very different in character

Scholars knew in the 19th century that diamond and graphite are both made of carbon But they were unable to explain the difference. One is hard and transparent; the other black and crumbly. Diamond is heavier than graphite. This suggested at that time that if you compress graphite into the volume occupied by a diamond of the same weight, **the graphite would be transformed into diamond!**

Or are they false twins?

At the beginning of the 20th century X-rays showed scientists the internal structure of both diamond and graphite; they are both very different.



Henri Moissan trying to create diamond in his laboratory

Hunting for diamond, ... and discovering moissanite

All sorts of experiments were performed up to the middle of the 20th century using very high pressure, in attempts to produce artificial diamond. Hannay and Moissan believed they had found science's Philosopher's stone, but...

- the diamonds found in the samples obtained from Hannay's experiments with explosives seem to have been put there by workers hoping to put a stop to dangerous experiments.
- Moissan, who was awarded the Nobel prize for chemistry in 1906, succeeded in producing very hard crystals, but they were of silicon carbide (SiC) and are now known as «moissanite».

Artificial moissanite crystals, Coll. LMGP Grenoble-INP

Growth forms in diamonds studied by Charles and Georges Friedel. © Néel-CNRS.

Growth forms in diamonds, seen through a polarising microscope. © E. Vleeschdrager

The difference between diamonds and graphite

The Braggs' first experiments in 1913 exposed the interior of diamond and determined the distances between the planes of carbon atoms.

- In 1921 Bernal, who worked in the same laboratory as Bragg, explained the structure of graphite.
- In 1930 Pauling explained the false twin paradox: the carbon bonds are not fixed and can combine in different ways (hybridization of orbitals). In diamond for example, every carbon atom is linked to 4 other carbon atoms all at the same short distance away. This creates a tetrahedron; the bonds are short and therefore strong, giving a solid, hard, dense and compact structure. In graphite, however, the carbon atoms are only linked to 3 other atoms on the same plane; this creates solid unattached sheets which crumble easily (the secret behind the good old lead pencil).