Metallurgy and serendipity

It is well-known that the steel is a pig iron with less carbon. The steel is obtained with much more difficulty than the pig iron because it melts at a higher temperature: 1450°C instead of 1250°C.

Here is how it was invented the procedure by which the majority of steels is produced nowadays.

The legend says that the young Henry Bessemer was an apprentice in a pig iron foundry in England at the beginning of the 19-th century. The pig iron was poured manually from melting pots with a weight of about 30 kg. The pouring pot was made of steel plate lined with refractory material. The lining was of river sand with little clay as binding material. When the lining wears out, it must be restored or repaired; otherwise the pot would be perforated.

The master saw that a pot was worn out and he told his apprentice to fix it, but this one did not make the necessary repairs and he considered that another charge could be poured with it. But when the pig iron was poured, it reddened in a place, as a sign that it was going to develop a hole. Bessemer took quickly the compressed air hose and he blew in it in order to cool off the respective place.

But instead of cooling, the reverse took place. The pot warmed in that place, sparkles started to spring and it developed a hole. Bessemer introduced the pipe in that hole and he continued to blow. Now, sparkles were springing from the whole pot. When the master saw that, he ordered that the pig iron from the pot to be poured directly on the ground.

The block of pig iron should have been broken for the remelting process, but when hit with the sledge hammer, it did not break but it bent. The pig iron had become steel. The master did not notice this fact and he fired the careless apprentice.

But Bessemer noticed the transformation and he also found the explanation: in contact with the air, the carbon from the melted pig iron started to burn and by this, the liquid pig iron warmed, and lacking carbon, it became steel. Later, Bessemer licensed the method and also invented the pot in which the respective process takes place.

The process is quick, about 30 minutes instead of 8 hours at Siemens-Martin furnace. Nowadays, the conversion of the liquid pig iron in steel is performed in the roller mill, which is a kind of pot but it has two alterations to the Bessemer roller mill. First of all, it is not the air that is blown, but the oxygen and not from the bottom of the roller mill but at its top, with the help of a copper pipe cooled with water.

The operating roller mill can be heard from the distance because it makes a kind of roar and it produces a red smoke. The red smoke is the iron oxide, because not only the carbon is burned, but also the iron. The collected smoke is a high quality iron ore and it can be reused in order to obtain the pig iron.

We might say that the Bessemer method was reinvented in 1970, when the oxygen was disposed at an industrial scale. The steel obtained with insufflation of air was fragile, because rough and fragile iron nitrate was forming and because of that, the method was abandoned for 100 years.

Another event led to the invention of the malleable pig iron with high mechanical resistance. The malleable pig iron is used for small parts, such as those for the sewing machine. The disadvantage of the poured pig iron is the high fragility and the reduced mechanical resistance. The reduced resistance is due to the inclusions of graphite in the shape of leaves, such as those of a cabbage, but having microscopic dimensions.

The malleability consists of re-burning the parts at a high temperature during which, a part of the carbon contained in the pig iron spreads at the exterior and it burns, and another part gathers up in small and almost spherical agglomerations. The method was invented in England and it was performed by protecting the oxidizing parts by packing them in iron ore sand.

The parts became malleable such as the flexible steel, such as that used for the nails, because the basic mass was lacking in carbon. The graphite diminished very little the mechanical resistance being concentrated in those agglomerations.

An American, an automobile constructor, wanted as well to use the malleable pig iron in his factory and came to gather documentary evidence in England. He transferred the technology, but he forgot a detail namely the red color of the "sand" and he used river sand. He had the pleasant surprise that his parts became malleable, but kept the mechanical resistance as well, and more, they could be hardened such as the steel. The river sand did not burn the carbon from the basic mass the same as the iron ore and the parts were exactly like the steel except of the small agglomerations of graphite.

The example from metallurgy presented above is eloquent for the way how great discoveries appear and are developed. Sometimes the event plays a role that cannot be neglected, but it remains, in essence, that quality of the man (scientist or technician) to grasp, from that event, the core of a great discovery. This quality received the name of **serendipity.**

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