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Disappearing iron

Something funny happened to the iron wood rests in my fireplace. The rods sticking into the fire were originally 15 mm by 15 mm, but steadily thinned down to about 7 mm. Granted, this happened over quite a number of years. But the question remains: Where did the iron go?

It is unlikely that it has evaporated: the boiling point of iron is over 3100 K, and the vapour pressure is far below 10^{-10} bar even at 1000 K. The iron has not even melted, which would require about 1800 K, a temperature that the iron never reaches in my fireplace: judging from its dark red color at the highest temperature reached, it never exceeds about 900 K. This is not hot enough for melting, and barely sufficient to make the iron a bit soft, which made one of the pieces bend at the thinnest spot under its own weight.

What must have happened is that the iron has oxidized somewhat according to the exothermic reaction $4\text{Fe} + 3\text{O}_2 \rightarrow 2\text{Fe}_2\text{O}_3$. In other words: the iron has burned down a bit.

Of course! Just think of the cutting torch, or flame cutter. This instrument neatly cuts through iron using

precisely this reaction. It does not make the iron melt, it makes it burn. In this case extra oxygen is supplied to keep the reaction going. The oxide formed has a much lower melting point than the pure iron, so it is deposited at some cooler place. Which provides an extra reason to clean my chimney once in a while.

Incidentally: the fact that the reaction is exothermic has its bright side: some chemical hand warmers make use of this oxidation of iron, as skiers and mountain climbers may remember. So at least nature provides me with some extra heat while eating my wood rests. ■

