MATERIAL WITNESS

The materials of history

Although it would be too much to say that the history of materials technology has been largely an amateur pursuit of scientists, it hasn't enjoyed much support from professional historians. Yet the sophistication of some of the field's pioneers, despite lacking any formal grounding in the study of history, is remarkable.

Take the English metallurgist Cyril Stanley Smith, who worked on fissionable metals for the Manhattan Project before making reconstructions of ancient metallurgical techniques and translations of historical crafts manuscripts. With a fluent command of Latin, Smith was a member of both the humanities and metallurgy departments at MIT, and his translation, with John Hawthorne, of the treatise *On Divers Arts* by the twelfth-century Benedictine monk Theophilus remains a central reference on medieval craft methods. (Smith benefited perhaps from marriage to an eminent historian of science, Alice Kimball Smith.)

Then there is Trevor Williams, a chemist at the British chemicals company ICI, who was managing editor of the magisterial five-volume *History of Technology* in the 1950s. And the pre-eminent historian of chemistry in the twentieth century, James Partington, was a chemist who worked for a time with Walther Nernst.

That the history of materials culture has tended to rely on scientists rather than historians obviously has its pitfalls, for not all such enthusiasts acquire the historical nous of a Smith or a Partington. As archaeologist Marcos Martinón-Torres of University College London points out in a recent collection of papers on early modern chemistry (L. M. Principe (ed.) *Chymists and Chymistry* Science History Publications, 2007), "Many of the pioneer historians of alchemy and chemistry were chemists with an interest in the past. Most conducted outstanding work but, due to a lack of education as professional historians, sometimes committed oversights or anachronisms."

But Martinón-Torres goes on to say that today the tables are being turned: the study of chemical and materials history tends to focus on texts while "ignoring the fundamentals of chemistry and materials science." Martinón-Torres's own work illustrates what we risk losing with such neglect — his scientific analysis of the renowned crucibles of Hesse used by chemists in early modern Europe shows that they were made from mullerite, a refractory aluminium silicate that was not formally discovered until the twentieth century (M. Martinón-Torres *et al.* *Nature* **444,** 437; 2006).

A disjuncture between historians working from text and image, and scientists and archaeologists using quantitative analytical methods, is no recent complaint — in the 1980s the art historian Jan van der Meulen criticized studies of Gothic buildings for their indifference to the physical evidence. But why does this happen? It's tempting to blame the notorious fear of science in humanities departments, and there is probably some truth in that. But the wider reason is perhaps that an interest in 'materials culture', and a recognition that technologies are not only powerful forces of social and political change but also shapers of art, literature and philosophy, have not yet reached as far as they might.

Philip Ball

GRAPHENE

Buckle or break

The isolation of free-standing graphene sheets seems to contradict common belief about the existence of two-dimensional crystals. Monte Carlo simulations confirm that the sheets may be stabilized by the formation of finite-sized ripples.

Johan M. Carlsson

is in the Fritz Haber Institute of the Max Planck Society, Faradayweg 4-6, D-14195 Berlin, Germany.

e-mail: johanc@fhi-berlin.mpg.de

Can two-dimensional crystals exist in our three-dimensional world? This question has been the topic of a number of theoretical studies in the past. Mermin and Wagner concluded that, because the periodic order of the atoms cannot be maintained in an infinite two-dimensional crystal, such crystals may not exist[1,2]. Similarly, elasticity theory has predicted that two-dimensional membranes are unstable at finite temperatures (>0 K), such that large membranes, in particular, suffer severe buckling[3,4].

In contrast to these predictions are recent observations of individual layers derived from layered materials such as BN, MoS$_2$ and graphite[5]. The exfoliation of single graphene layers from graphite[6] has particularly given new life to our initial question. Graphene is a prime example of a two-dimensional crystal, as it is a single layer of carbon atoms and the building block of graphite and carbon nanotubes. The carbon atoms in a graphene sheet are depicted ideally as a flat hexagonal lattice, exactly one atomic layer thick, contrary to the predictions by Mermin and Wagner. Whether a graphene sheet is completely flat or not, however, has been difficult to prove experimentally because it may crumple, like a piece of paper, if not treated carefully. Experimental