(*Scientific American* June 1974 p47), but it seems that no specialized sources were consulted. Computational complexity, neural works and computational linguistics are also beyond the scope of the book.

Since the book stems from the author's work in statistical physics, the treatment of self-organization in phase transitions, order parameters and critical phenomena is fairly comprehensive and satisfactory for physical systems, but is less satisfactory for evolutionary biology and economics. Nevertheless, she has put in a great deal of effort to impart to non-specialists some of the main ideas of many-body theories. Complemented by other references to fill the gaps, this book will certainly be useful for anyone interested in understanding complex systems.

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Paul Grant

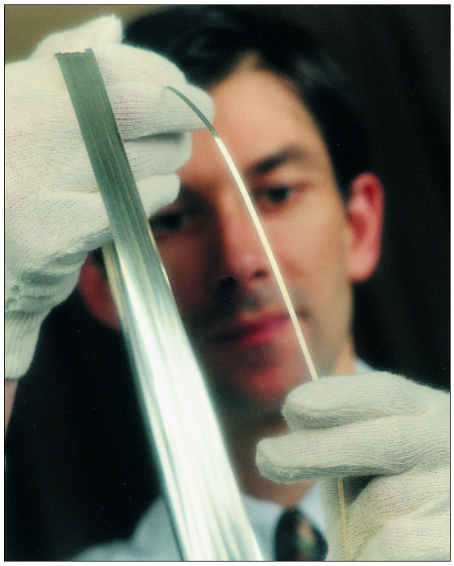
Superconductors get ready for action

Handbook of Applied Superconductivity
(ed) Bernd Seeber
1998 Institute of Physics Publishing (two volumes)
2039pp £350.00/$545.00hb

When I was asked to review the *Handbook of Applied Superconductivity*, the invitation came as both a surprise and a sentence. The sentence was that this two-volume set weighs about 4.5 kg and is some 2000 pages long – definitely not a casual afternoon read. The surprise was that I have only been involved in applications of superconductivity for the past three or four years. Most of my career before that was spent in basic research on "exotic" superconductors, low-dimensional organic and polymeric metals, and, of course, copper-oxide perovskites.

To take on the challenge of reviewing an opus such at this, which contains contributions by those with much more experience than me, was not therefore easy. One particular problem was that I was not on the scene in the 1960s, which was very much the "golden age" in the development of practical low-temperature superconductors. Nevertheless, my perspective is perhaps less preconceived and less preordained than that of others in the field.

Unfortunately, my impressions of these volumes are less than glowing – an outcome that I reached reluctantly, given the immense effort that was undoubtedly required by the editor and the individual contributors. For a start, I found the description "handbook" somewhat confusing. To me, a "handbook" implies a reference work containing data and information that are relevant to a particular problem or task. But when I looked up "lattice constants" or "unit cell parameters" in the index – numbers that I can never remember – there was nothing to be found. Similarly, a search on "thermal conductivity" yielded no general table of values, nor was I able to find this property sub-indexed under a particular material such as yttrium barium copper oxide (YBCO) or bismuth strontium calcium copper oxide (BSCCO). I only found such information in the chapter on current leads, and even there it was not well tabulated. I rather suspect that the editor wanted to create a "handbook" reference work in the tradition of the venerable *Handbuch der Physik* series – encyclopaedic in scope and intent.



BICC SUPERCONDUCTING/BIGCHEESE

Eye on the future – superconducting tapes

If this was indeed the aim, then I found the organization of the two volumes rather awkward. The introduction starts with an excellent treatment of the basic elements of superconductivity – particularly the attention given to Lev Shubnikov's seminal, yet often overlooked, work on "type II" superconductivity. However, I felt that this material should have continued with the discussion of critical-state issues in the chapters by Campbell and Cave, and then been followed by several of the sections on normal-state properties that appear much later on. Indeed, this combination would have formed a valuable separate introductory volume in its own right.

The topical balance also gave me some heartburn. For example, there are 56 pages on fusion – a technology that is unlikely to prosper – but only 14 on transformers, which almost certainly will succeed. Similarly, there are about 111 pages on superconducting generators – a power application that is not thought to be economically viable unless we start building many more nuclear-fission power plants. This seems out of proportion to the 94 pages spread between Josephson devices, superconducting quantum interference devices (SQUIDs) and passive-filter devices – technologies that are much more likely to take off.

My greatest interest came in the sections on the power applications of superconductivity, as this is the area that I have closest contact with in my daily work. Incidentally, it is here that the Eurocentric aspect of these two volumes is most pronounced. Out of the 92 authors, I counted just three from institutions in North America, one from China and four from Japan – all the rest being from Europe. At the risk of appearing chauvinistic, I believe this severe asymmetry adversely limits the content in a number of areas, especially on wire development, transformers, power cables and electronics, where most of the action is in North America and Japan.

Although most of the work outside Europe is adequately referenced, there are some glaring omissions. For example, I found no reference to the work at the Oak Ridge National Laboratory in the US on oriented YBCO films deposited on metallurgically textured base-metal tapes. In fact, the discussion of conductors coated with high-temperature superconducting (HTS) materials is somewhat skimpy and dismissive, which was surprising since this work could have a huge impact on power applications. Even the European efforts in this area were not thoroughly covered.

Another problem is that each contributor tends to centre on data and activity from within their own institution or past experiences, rather than outside. For example, the treatment of the properties of BSCCO tapes could have benefited from the inclusion of magneto-optic imaging data that are available from the University of Wisconsin and the Argonne National Laboratory in the US. I could also find no reference to the dip-coated bismuth-2212 tapes being developed at Intermagnetics General Corporation. These are the most likely wire candidates for HTS transformers and small superconducting magnetic-energy storage (SMES) units.

The chapters on transformers and power cables are also slightly out of date, although these particular fields are moving so fast that one is apt to be too critical. One example is the announcement last October of plans to install an HTS cable at one of Detroit Edison's substations. However, both chapters dwell principally on low-temperature superconductor embodiments of the past, which are useful only as guides, and pay little attention to high-temperature developments. Curiously, the chapter on transformers does not even refer to the recent test of the 640 kVA ABB/Services Industries de Genève transformer/fault-current limiter – even though it was being planned back in 1996. Most observers now feel that HTS transformers will be the first major commercial power application to emerge from the HTS discoveries around 1986/87.

The chapters on fault-current limiters and magnetic-storage devices are also victims of the fact that the book was compiled just before some important HTS developments. However, the chapter by Handschin and Stephanblome correctly emphasizes the importance of power electronics for all SMES applications, and is an excellent tutorial on this often neglected aspect of magnetic-energy storage – although whether we will see a major demand develop for fault-current limiters and SMES is not clear. To my knowledge only one HTS fault-current limiter is currently in operation. It remains to be seen whether a sustainable market will emerge for such power quality devices, especially in those industrial nations where electricity reliability and quality is good.

As I am not directly involved in the technology, I find it hard to comment on the section on electronic devices. However, I felt that the chapter on Josephson junctions by Rogalla is well done and could even have been in the introduction. Meanwhile, the chapter by Koji Nakajima on single-flux quantum devices is very timely, given the work on "rapid single flux quantum" based logic by Konstantin Likharev's group at the State University of New York at Stony Brook (see "Superconductors speed up computation" by Konstantin Likharev *Physics World* May 1997 pp39–43). This technology is being considered by NASA as a possible platform for its petaflop computing initiative.

The most useful parts of this handbook for me were several of the chapters on refrigeration and cryogenics, which could have stood together as a separate volume on its own. The chapter by Richardson and Arp on the properties of cryogens is superb, and contains data – particularly cryogenic liquid phase diagrams – that are difficult to find all in one place. It actually comes closest of all the contributions to satisfying my definition of a "handbook". The chapter by Ravex on small cryo-coolers is up-to-date and topical, and includes a discussion of pulse-tube devices, which are expected to be the "wave of the future" for small cryo-coolers. (Its inclusion reinforces the point that not all applications of high-temperature superconductors will use liquid nitrogen; in fact, most applications in electronics will not.) The section concludes with another excellent chapter by Richardson on "safety with cryogens" the likes of which I have not seen anywhere before and is highly relevant to applications such as cables and transformers that do need liquid cooling systems.

The *Handbook of Applied Superconductivity* has its place, but not on my desk or in my bookcase. I don't need it every day, or even occasionally to obtain a spur-of-the-moment factoid. It is also expensive. I feel that it might have been better for the publishers to have broken the book down into a series of smaller, more affordable volumes. After all, why should I have to buy into electronics or big magnets if I'm only interested in power? Splitting the book up would have also made it easier to update with new editions on fast-moving applications.

The proper home for the *Handbook of Applied Superconductivity* is in the libraries of institutions working in the field – the proverbial "valuable addition" as it were. My company's library is exactly where my copy is going.

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