

# Bookshelf

● *From Hiroshima to the Iceman: the Development and Applications of Accelerator Mass Spectrometry* by Harry E Gove, Institute of Physics Publishing 07503 0557 6 (hbk £50/\$99) 07503 05584 (pbk £15/\$27).

Invented some 20 years ago, accelerator mass spectrometry (AMS) is one of the newer success stories in the applications of particle accelerators. It provides a powerful, fast and reliable means of measuring long-lived radioisotopes using only minute samples.

Radiocarbon-14, which has a half-life of 5730 years, was the first isotope to be measured this way, and AMS radiocarbon dating soon became a powerful tool for determining the age of organic material using small samples. Other isotopes are also suitable for AMS.

Radiocarbon dating was invented by Willard Libby in the 1940s and brought him the 1960 Nobel Prize for Chemistry. In its original form, radiocarbon dating counted the actual decays of residual carbon-14, requiring relatively large samples of material.

Jolted by news of carbon-14 measurements at a Berkeley cyclotron, Gove participated in pioneer AMS measurements at Rochester in 1977, which dramatically showed how the level of carbon-14 in commercial charcoal and fossil graphite is different, using milligram samples. It is usually no problem to take a milligram sample from even the most valuable relic.

Giving a reliable measurement of the age of a specimen can be vital input in archaeology, history and mineralogy, as well as being a focus of public interest. Such measurements can settle disputes and separate fact from myth.

One of the most spectacular AMS applications is the dating of the Turin Shroud, and Gove's earlier book, *Relic or Hoax?: Carbon Dating the Turin Shroud*, is a scientific account of this work. Multiple AMS measurements gave the origin of the shroud material, widely believed to be of biblical origin, as AD 1325 ± 33 years.

In his latest book, Gove casts the AMS net wider, describing the history and instrumentation of the technique, concentrating on electrostatic tandem accelerators, before turning to its application. The analysis examples, described in graphic detail, include radio-relics from Hiroshima and Nakasaki that provided new insights into the mechanisms of

radiation damage; North American archaeological remains; modern radioactive waste; the Turin Shroud revisited; Egyptian mummies; "Oetzi", the neolithic iceman discovered in 1991 in the Alps on the Austrian-Italian border; and the Dead Sea Scrolls.

For the dating of the Turin Shroud, one theory mentioned is that bacteria on cloth continue to ingest carbon-14 from the air, making the cloth look younger.

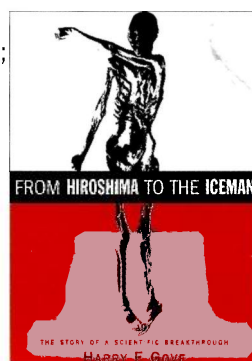
This is a fascinating account of a major particle accelerator application success by an enthusiastic scientist who played a major role in its development. Harry Gove contributed an article on AMS to the special July 1995 Applying the Accelerator issue of *CERN Courier*.

● *Making Physics: a Biography of Brookhaven National Laboratory, 1946-1972* by Robert P Crease, University of Chicago Press 0 226 12017 1 (446pp \$38/£30.50).

Crease calls this book a biography because he likens Brookhaven National Laboratory to a community, and a community lends itself to biographical treatment. Crease is a philosopher, but he has absorbed and is faithful to the ethos of the scientific community.

I have been at Brookhaven for 44 years but found much in this book that I did not know about the place. Crease had full access to the laboratory's archives and had interviews with many of the personnel. I found the book fascinating and a good read. He recounts the history of the founding of Brookhaven; the drive by I I Rabi to obtain large physics instruments for the east of the US after the Second World War; the interactions with the Manhattan District of the US Army, which had built the atomic bombs; and the finally successful negotiations with the Federal Government for the establishment of the laboratory at the US Army's Camp Upton site.

Brookhaven was the first civilian laboratory to have a reactor. Along with the reactor it was decided that accelerators would also be built there. The first two were a Van de Graaff and a 60 inch cyclotron. Both of these machines were built by commercial companies and neither worked properly until significantly altered by laboratory personnel. Rabi was insistent that a large synchrotron should be built at Brookhaven. In a compromise worked out with the funding agency and Berkeley, it



was agreed that Brookhaven would build a 2-3 GeV machine and Berkeley a 8 GeV machine with Brookhaven to get the follow-on machine later.

After the Cosmotron was finished, the Brookhaven accelerator builders were informed that a delegation of accelerator builders from a new laboratory, called CERN (modelled to a considerable extent on Brookhaven), would be visiting

with plans to build a machine more ambitious than the Cosmotron. Livingston felt that Brookhaven should do more than just show and tell, and organized a study group to brainstorm for improvements on the Cosmotron's basic design. Crease narrates how this study group came up with the ideas for alternating gradient synchrotrons. When the CERN group arrived they were caught up in the excitement, changed their plans and resolved to build what became the PS. Brookhaven built the AGS, which came on line shortly after the PS.

Crease goes into considerable detail about the work done in particle physics, in nuclear physics (both at the reactors and the accelerators) and in solidstate physics. Brookhaven is a multidisciplinary laboratory, and while Crease's emphasis is on physics, there is also information about some of the work in other disciplines, such as medicine, chemistry, instrumentation and biology. He cites the development of Tc99 as used in nuclear medicine. It is the predominantly used radionuclide in the several million nuclear-medicine procedures performed today.

Other fruitful developments include the first treatment for Parkinson's disease and the effect of salt on hypertension. Ray Davis's work on the detection of solar neutrinos was done in the chemistry department with help from the instrumentation department.

Science is made by human beings. Crease emphasizes the human side of Brookhaven, with miniportraits of many of the prominent personalities associated with the laboratory. He describes in some detail its administration, the interaction of scientists with the administration and how scientific policy is set. He describes interactions among strong-willed personalities and how some of this impacts the research done. He explains the science well and made remarkably few errors.

David C Rahm, Brookhaven.

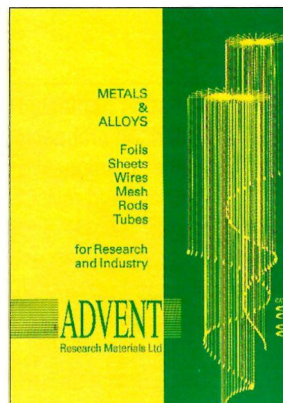


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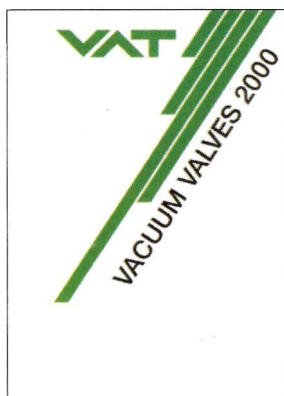
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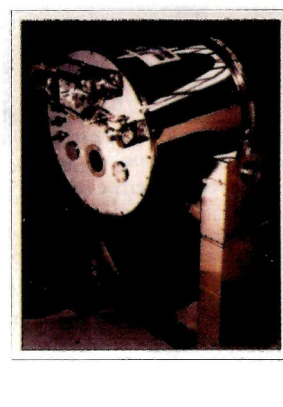
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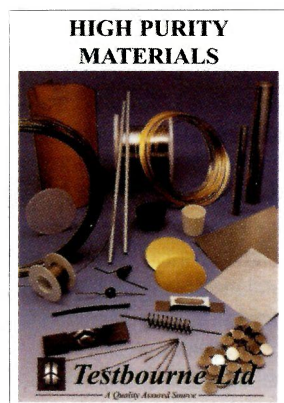


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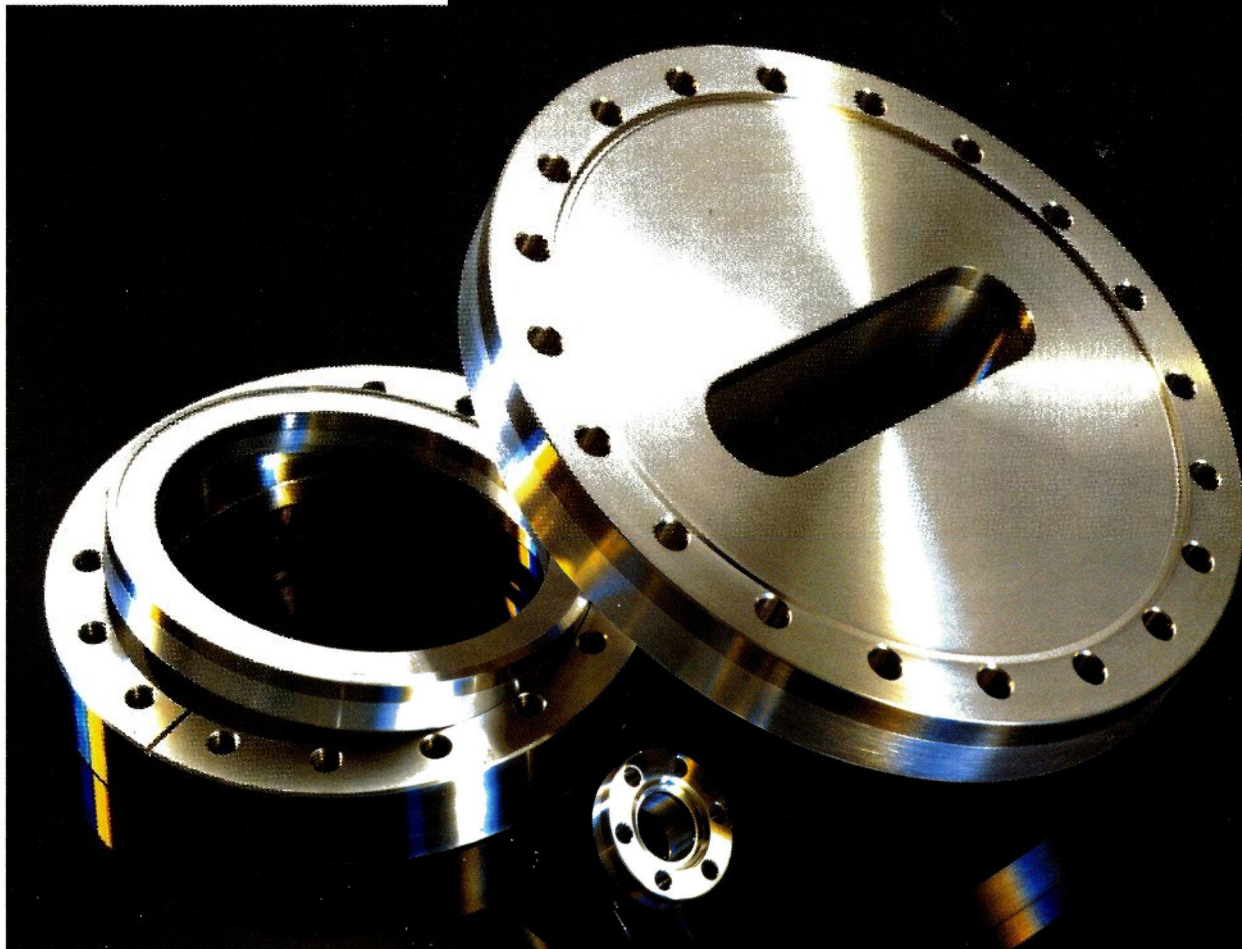
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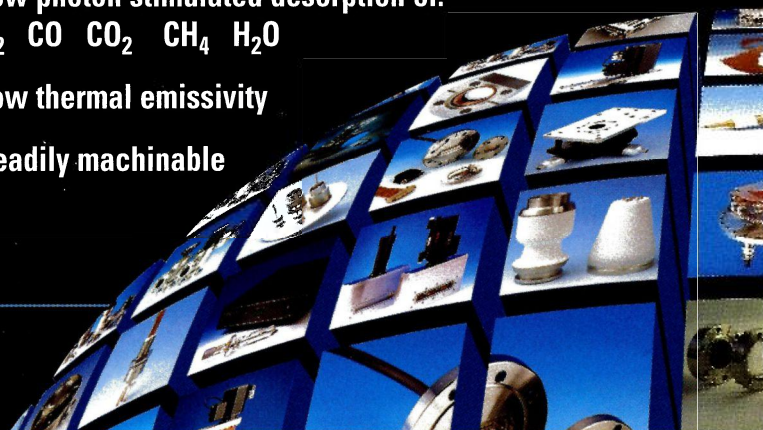


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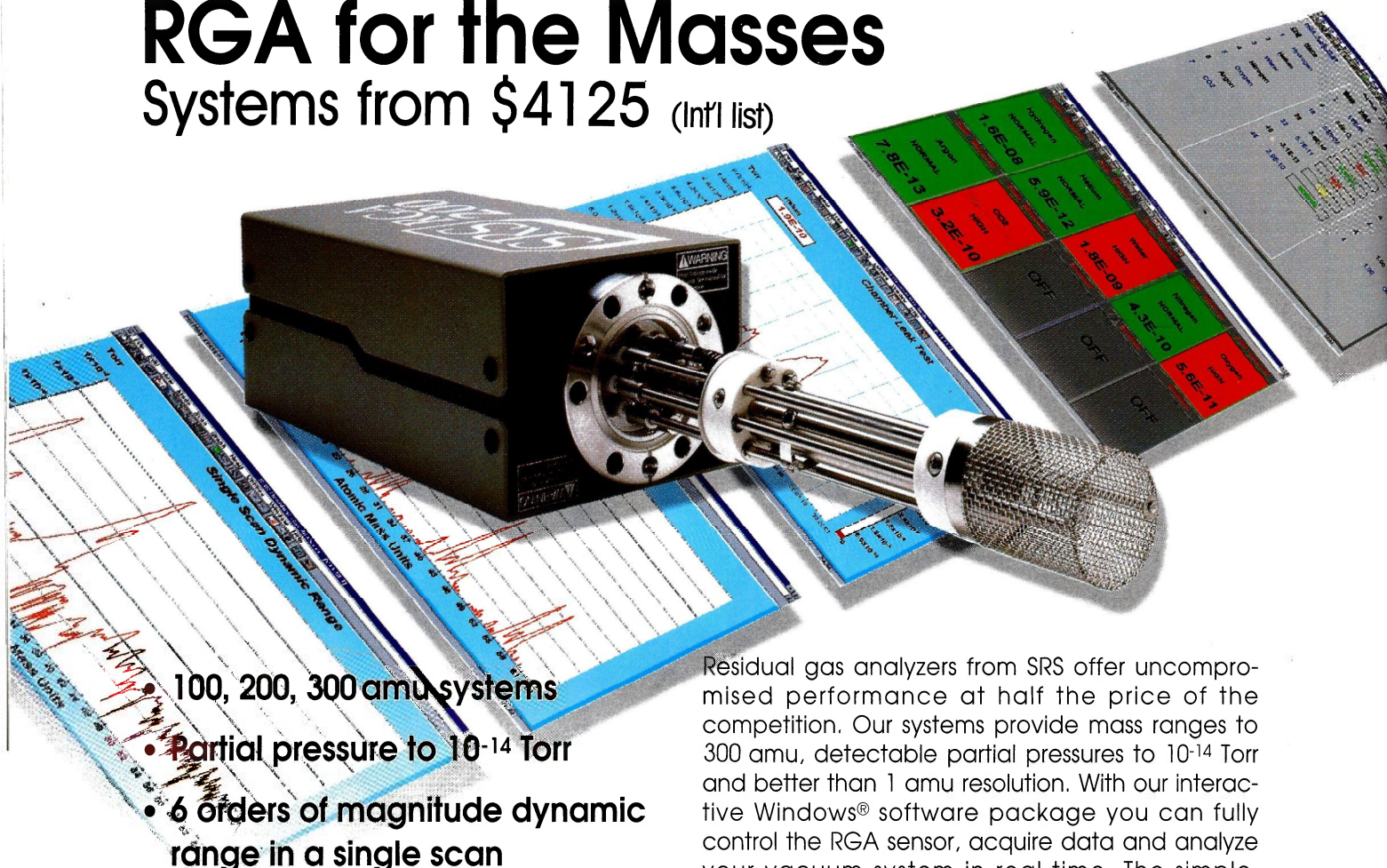
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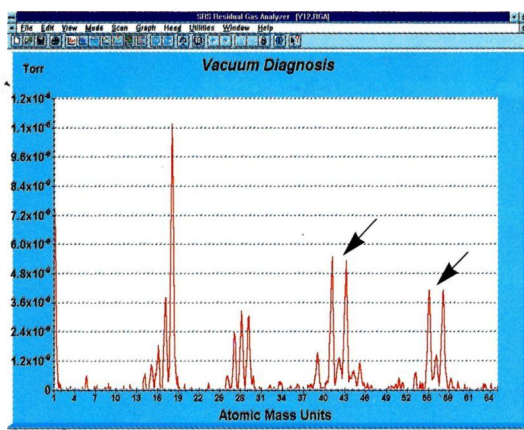
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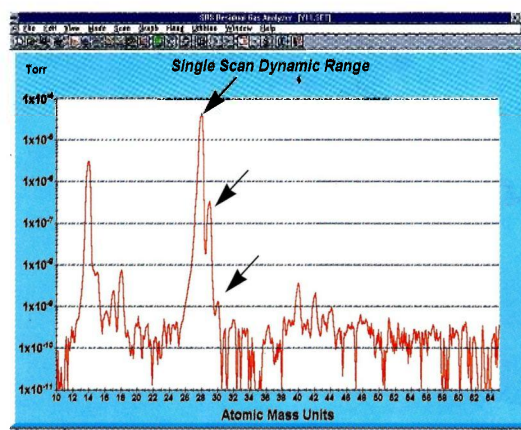


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