PHILOSOPHICAL TRANSACTIONS OF THE ROYAL SOCIETY A MATHEMATICAL, PHYSICAL & ENGINEERING SCIENCES

# Summary and Conclusions

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*Phil. Trans. R. Soc. Lond. A* 1987 **323**, 171-172
doi: 10.1098/rsta.1987.0080

*Phil. Trans. R. Soc. Lond.* A **323**, 171–172 (1987) [ 171 ]
*Printed in Great Britain*

# Summary and conclusions

By E. T. Hall

The subject of AMS has come a long way since the two classic experiments undertaken in 1977 almost simultaneously at Rochester and McMaster Universities. Although attempts at actual dates were made at that time, these experiments were largely qualitative, showing the way for more dedicated machines. Work is now being undertaken in some 33 laboratories around the World. The scientific community involved must consist of several hundred workers.

This community comprises three categories: in the first place, nuclear physicists, who initiated the technique, are still involved in improving and expanding the subject. The majority of those attending this conference come in this category. Then there are the archaeometrists who are concentrating on $^{14}C$ dating; Professor Litherland, Dr Hedges and Professor Oeschger gave us some account of their work. Lastly, the end users are here to tell of the projects with which they are concerned. We have had contributions from both archaeologists and the ever-widening circle of environmentalists. The papers at this meeting can largely be divided into three other categories: dating, tracer studies and what might be called the 'show it can be done' category.

## Dating

The emphasis in this category is still largely with $^{14}C$, which is the only AMS method actually producing firm dates. Moreover, this fact means that other disciplines such as archaeology, art history and museum curating give encouragement and (possibly more important) are the source of funds not only for the dating service itself but also for improvements to the technique. The AMS method is now comparable to, or even exceeds in accuracy, the normal conventional radiocarbon technique, and because of the shorter turn round of results will start to replace the old method. I have no doubt, as preparation of samples improves and new ion sources become available, that even the 'high accuracy' conventional laboratories will have rivals.

On this question of precision, there have been several reports from active laboratories of accuracies around 0.5% or better and when this is taken into consideration with production rates of up to 1000 per year, it can be seen that the conventional methods are under pressure. Moreover, in the majority of instances greater accuracy is meaningless because of the nature of the dendro calibration curve with its 'wiggles'. Reliability and the prevention of rogue results that are far from the truth is another matter. To the archaeologist, a wrong date is worse than no date at all. I would therefore appeal to everybody in the radiocarbon business to check and check again the validity of their routines so that AMS in particular does not get a bad name.

## Environmental studies

About half the papers submitted were concerned with these problems. In particular, the measurement of $^{10}Be$, $^{26}Al$ and $^{36}Cl$ were described by various authors and are now more or less routine procedures by AMS. These studies have mainly been concerned with geological tracer work, rather than with a dating technique. The long half-lives involved (1.5 Ma for $^{10}Be$) might seem to have scope for more remote dating than $^{14}C$, but at the moment there have been no viable schemes proposed. There is no doubt that the environmentalists will use these techniques on a broadening front in the future.

## The 'show it can be done' category

Dr Henning showed us that he was able to detect $^{41}Ca$ in Nature at very low levels, although he cannot pretend that his sensitivities allow it to become a dating method yet. He also showed that the high energies available at the Argonne laboratory enabled very low concentrations of heavy ions (e.g. $^{205}Pb$) to be detected.

Professor McKeown told us of the efforts at Stanford to detect fractionally charged particles (FCP), research associated with the belief in quarks having a charge of $\frac{1}{3}$ of the electronic charge. Even though sensitivities down to 1 part in $10^{19}$ were quoted, no FCP were detected!

Finally, Dr Hurst told us of his scheme to use lasers to detect individual isotopes by resonance ionization spectroscopy (RIS). This technique is in many respects complementary to AMS because it selects an atomic excitation, and therefore the atomic number $Z$, with subsidiary determination of the isotopic mass. The technique is elegant and will benefit from advances in laser spectroscopy generally because it relies on some dozen specialized lasers; as yet the technique has not reached the level of viability as AMS.