see if the two approaches could be combined and a new technique developed which would unite the relative simplicity of the copying technique with the further possibilities provided by the methods of chemical synthesis. □

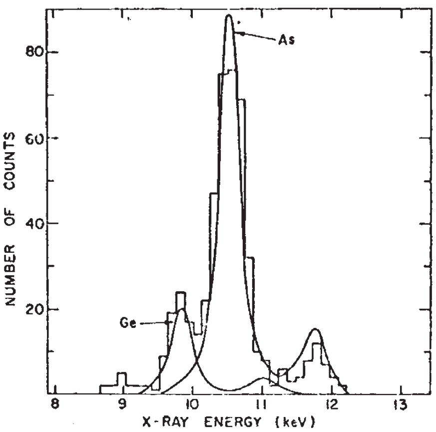
New method for measuring nuclear lifetimes

from P. E. Hodgson

AN ingenious method for measuring very short nuclear lifetimes has recently been developed that greatly extends the range covered by existing techniques. This is an important advance because these lifetimes can often be calculated from nuclear wavefunctions, and thus provide a sensitive test of the theories used to calculate the wavefunctions.

Nuclear lifetimes are usually measured by the delayed coincidence and the Doppler shift techniques, and these cover a wide range of times greater than about 10^{-15} s. For shorter lifetimes there has hitherto been only the blocking technique which is restricted to a few suitable materials. The new method seems likely to provide a way of measuring lifetimes from about 2×10^{-15} to 6×10^{-18} s, and thus extends the region of measurable lifetimes by more than two orders of magnitude.

The new method is based on a very simple idea. If a nucleus of charge Z decays by electron capture to an excited state of another nucleus of charge $(Z-1)$ a vacancy is left in the atomic K-shell from which the electron has been captured. This vacancy will soon be filled by a transition from a higher atomic state with the emission of an X ray. Now if the X-ray transition takes place before the nuclear state decays, its frequency is characteristic of the nucleus of charge $(Z-1)$. But if the nucleus decays by proton emission before the X-ray transition takes place, then the X ray will have a frequency characteristic of the nucleus of charge $(Z-2)$. Since these X-ray frequencies can easily be measured, it is easy to find out whether the nuclear decay took place before or after the atomic decay. In practice there is of course a distribution of decay times for both processes, so it is the relative proportion of the two types of decays that is measured and this gives the ratio of the nuclear and atomic lifetimes. Since the atomic lifetimes are well known both experimentally and theoretically, the nuclear lifetime is found.



Histogram showing the spectrum of all X rays in coincidence with all decay protons. The curves show the spectra measured independently for the As and Ge decays.

This method has been devised by a group of scientists from the Chalk River Laboratories and the University of Toronto in Canada. They have obtained data on the lifetimes of ^{65}Ga, ^{69}As, ^{73}Br, and ^{77}Rb, and in their first publication (*Phys. Rev. Lett.*, **37**, 133; 1976) they give details of their result for ^{69}As.

In this case the decay sequence starts with $^{69}_{34}$Se undergoing electron capture to an excited state of $^{69}_{33}$As, which in turn undergoes proton emission to a state of $^{68}_{32}$Ge.

The initial nucleus ^{69}Se was produced in the ^{40}Ca(^{32}S,2pn)^{69}Se reaction using the 100 MeV beam of the Chalk River tandem Van de Graaff accelerator. After irradiation, the target was moved rapidly to a counting position where arrays of counters measured the X rays from the atomic transitions, the delayed protons from the decay of the ^{69}As to ^{68}Ge, and the gamma rays from the nuclear transitions in As.

The histogram in the figure shows the energy spectrum of all the X rays in coincidence with the delayed protons, compared with normalised curves corresponding to the decays of Ge and As found in independent measurements. It is clear that the histogram can be very well fitted by the sum of these two curves.

Many states of ^{69}As can be reached by electron capture, so the decay protons are themselves varying in energy. Since the relation between the relative numbers of Ge and As X rays depends on the proton energy, so do the lifetimes of the states of As. The lifetimes of the states in As vary from 2×10^{-16} to 10×10^{-16} s. These numbers are average lifetimes for successive bands of states and rather detailed calculations based on the statistical theory of nuclei are required to interpret them in detail.

If there had been only one state in As fed by the electron capture in Se the experiment would have given an unambiguous determination of its lifetime. The technique is clearly successful and is likely to be applied to determine the lifetimes of many states, and hence to increase our knowledge of nuclear structure. □

Effects of a long hot summer

from Peter D. Moore

THE unusually warm and dry summer experienced in Britain this year has undoubtedly influenced our vegetative cover. Apart from widespread damage by fire, the high temperatures and low water availability have themselves produced some very evident changes. Roadside verges and lawns are parched, with only the deep-rooted rosette species showing signs of life. Among trees, birch appears particularly susceptible and dead birches are now abundant on heathlands and in mixed woodland both in the lowland and the upland zones of the country.

Many of the common species affected will probably recover quickly and even if they do not, any change in status will be difficult, if not impossible, to assess. There are certain species, however, which may merit especial attention at this time, such as those which lie at their climatic limit in Britain and which may expand or contract their range as a result of the effects of this and preceeding summers. There are also those species which are restricted to lower altitudes in the British Isles because of the shorter growing season in higher regions; they may attain new heights. And there are those arctic alpine species which are limited by high summer temperatures and which may, therefore, be suffering.

One species which reaches its northwestern limit of distribution in the British Isles and which might be expected to respond to the present conditions is the stemless thistle (*Cirsium acaulon*). Pigott (in *The Flora of a Changing Britain*, edit. by Perring, F., 32, Classey, Hampton, Middlesex, 1970) has shown that the temperature of the flowering head of this plant is critical in determining the rate of development of the embryo. Only in southern and eastern Britain does the plant normally produce viable seed, though some outlying populations in the north and west appear to have been established during exceptionally warm summers.

Many plants are common at fairly low altitudes and yet fail to flourish on mountain summits because of their inability to grow adequately, or flower, or produce mature, viable seed, within