

We intend to make further correlation of compressive and tensile creep in materials free from the metallurgical complexities of commercial creep-resistant alloys, in order to obtain further data.

We are indebted to the Ministry of Supply, under the sponsorship of which the work was conducted, for permission to publish these results, and to Mr. W. H. Mayes, who was responsible for the construction of the apparatus, which was similar in principle to a machine in use at the National Physical Laboratory.

A. H. SULLY  
G. N. CALE  
G. WILLOUGHBY

Fulmer Research Institute, Ltd.,  
Stoke Poges, Buckinghamshire.  
July 6.

<sup>1</sup> Greenwood, J. N., and Worner, H. K., *J. Inst. Metals*, **64**, 135 (1939).  
<sup>2</sup> Hanson, D., and Wheeler, M. A., *J. Inst. Metals*, **45**, 229 (1931).

### Isotopic Assignment of the $\alpha$ -Activity of Samarium

THE recent report by Dempster<sup>1</sup> that the earlier conclusion of Wilkins and Dempster<sup>2</sup> regarding the  $\alpha$ -active isotope of samarium is unreliable makes necessary the revision of a great deal of past speculation. Previously the  $\alpha$ -activity was assigned to <sup>148</sup>Sm; now it appears that <sup>152</sup>Sm is almost certainly the isotope responsible.

It is the object of this note to point out that (once the shock of this radical re-assignment is forgotten) the new result is more easily reconcilable with other evidence than is the old. Earlier arguments attempting to explain why the range of elements neodymium (60) to samarium (62) is particularly liable to  $\alpha$ -disintegration, and seeking to compare this range of elements with that neighbouring upon polonium (84), the most  $\alpha$ -unstable of the classical radioelements, are not affected; but the details of the picture are filled in with much greater consistency than before.

The outside evidence of most direct relevance is that regarding isotopic hyperfine structure in the spectra of neodymium and samarium. With samarium, Schüler and Schmidt<sup>3</sup> found an anomaly in the relative separations of the isotopic hyperfine structure components; later a closely similar anomaly was found by Klinkenberg<sup>4</sup> with neodymium. For all other even-numbered elements so far examined the isotopic hyperfine structure consists of components which to a good approximation are linearly spaced in respect of mass number on a frequency scale (at least so far as the components of even mass number are concerned). With samarium this linear spacing is interrupted by an abnormally large interval between the components of mass numbers 150 and 152, and with neodymium there is similarly an unusually large interval between components of mass 148 and 150. Basically these anomalies are interpreted as evidence for an abnormal increase of nuclear radius (more exactly of the proton-occupied volume of the nucleus) between <sup>150</sup>Sm and <sup>152</sup>Sm, as also between <sup>148</sup>Nd and <sup>150</sup>Nd; scarcely less directly they may be regarded as evidence for a 'discontinuous' decrease in nuclear binding energy as between these pairs of even isotopes. Classifying on this basis the samarium isotopes of mass numbers 144, 148, 150 and the neodymium isotopes 142, 144, 146 and 148 as 'tightly bound' and the samarium isotopes 152, 154 and the neodymium isotope 150 as 'loosely bound', it is clear that the only possibility for  $\alpha$ -disintegration from a

loosely bound samarium to a tightly bound neodymium is, in fact, the possibility <sup>152</sup>Sm  $\rightarrow$  <sup>148</sup>Nd. There is every reason to expect, therefore, that <sup>152</sup>Sm is the predominantly  $\alpha$ -active samarium isotope. A tentative suggestion to this effect was, in fact, made by Schüler and Schmidt<sup>3</sup> in 1934.

Returning to the comparison of the  $\alpha$ -activity of samarium with that of the classical radioelements—and with the  $\alpha$ -activities of the polonium isotopes in particular—we may note how recent results serve to correct previous misconceptions. Previously it has been too readily assumed that  $\alpha$ -activity becomes more pronounced as the mass number ( $A$ ) decreases; for polonium (84), at least, the work of Howland, Templeton and Perlman<sup>5</sup> shows that this is not the case. The annexed table gives the total energy of

$A$	206	207	208	209	210	211	212	213	214	215	216	217	218
$E$	5.3	5.2	5.24	?	5.40	7.53	8.95	8.45	7.83	7.51	6.90	(6.45)	6.11
	(MeV.)												

$\alpha$ -disintegration ( $E$ ) of the isotopes from  $A = 206$  to  $A = 218$ . The pattern of variation is obvious from the figures quoted. The 'pure  $\alpha$ -active' species for this element ( $Z = 84$ ) are the isotopes of mass numbers 208, 210, 211, 212, 213 (?), 214 and 216; these are the species which correspond to the stable isotopes of the elements<sup>6</sup> of atomic number  $Z \leq 83$ . It is clear that the maximum  $\alpha$ -disintegration energy in this case ( $Z = 84$ ) belongs to the even-numbered isotope, which occupies the mid-place in the sequence of  $\beta$ -stable species  $A = 208, 210, 212, 214, 216$ . The case of samarium is seen in comparison to be not so different as might previously have been supposed.

N. FEATHER

Department of Natural Philosophy,  
University of Edinburgh.  
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<sup>1</sup> *Phys. Rev.*, **73**, 1125 (1948).

<sup>2</sup> *Phys. Rev.*, **54**, 315 (1938).

<sup>3</sup> *Z. Phys.*, **92**, 148 (1934).

<sup>4</sup> *Physica*, **11**, 327 (1945).

<sup>5</sup> *Phys. Rev.*, **71**, 552 (1947).

<sup>6</sup> Turner, *Phys. Rev.*, **57**, 950 (1940); *Rev. Mod. Phys.*, **17**, 292 (1945); Feather, *Rep. Prog. Phys.*, **11** (1948).

### Spectrum of Helium-3

THE possibility of obtaining samples of helium in which the isotope of mass 3 has been enriched allows the isotope shifts in the arc spectrum of this element to be investigated. The first samples, which had kindly been made available to us by Dr. Rollin and Mr. Hatton<sup>1</sup>, had been prepared by means of thermal diffusion, and contained helium-3 in a concentration of 1:700. With an ordinary Fabry Pérot étalon, the detection of satellites several hundred times weaker than the main line is impossible, owing to the finite background intensity of this instrument. This difficulty was overcome by the use of two étalons, of equal spacings, in series. By suitable choice of apertures, distances and orientations of the wedge-shaped étalon plates, it was found comparatively easy to avoid secondary reflexions. The method appears to be very useful for the investigation of faint satellites very close to strong lines.

The upper part of the figure shows a photometer tracing of the line 2'S-3'P, 5015 Å., photographed with two étalons in series, each of spacing 0.318 cm. The peaks due to helium-3 are small, but clearly visible between the large peaks of helium-4, which appear flattened at the top as the result of over-exposure. A sample in which the helium-3 had been