

cells into lymphocytes developed. These results suggest that for large animals, including man (just as for mice), the thymus is necessary for functional differentiation of polypotent stem cells into lymphoid precursor. These preliminary results indicate that even a strongly reduced thymus in adult dogs is effective. By analogy with the results already cited²⁻⁹ one is led to believe that the thymus of adult large animals and man plays a part in the restoration of immunogenesis after radiation, 'teaching' remaining stem cells. In connexion with this assumption it seems reasonable to attempt to delay the restoration of immunogenesis (depressed by massive whole-body irradiation and cytostatics) by preliminary thymectomy prior to transplantation of tissues and organs in man.

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An Unusually Radioactive Fossil Fish from Thurso, Scotland

A PLATE of *Homosteus* from Clardon Haven about two miles east of Thurso was found to be radioactive to the extent of 1.2×10^4 γ /min/g. In order to characterize the radioactive isotopes present, the energies of the emitted γ -rays were measured using a γ -scintillation spectrometer.

The spectrometer was a 3 in. \times 3 in. sodium iodide phosphor used in conjunction with a photomultiplier, a high-gain amplifier and a 512-channel pulse-height analyser.

The energy range 80 keV–3,500 keV was examined and from the absorbed energies it was evident that the radioactivity was due to the decay chain of ²³⁸U with

| Isotope | Table 1 Half-life | Gamma energy (keV) |
|-------------------|--|---|
| ²³⁸ U | ²³⁸ U chain 4.5×10^9 y | 48 |
| ²³⁴ Th | 24.1 d | 29, 63, 91 |
| ²³⁴ Pa | 1.18 min | 750, 1,000 |
| ²³⁴ U | 2.5×10^5 y | 51 |
| ²³⁰ Th | 8.0×10^4 y | 67 |
| ²²⁶ Ra | 1,630 y | 188 |
| ²²² Rn | 3.815 d | — |
| ²¹⁸ Po | 3.05 min | — |
| ²¹⁴ Pb | 26.8 min | 243, 295, 317 |
| ²¹⁴ Bi | 19.9 min | 610, 1,120, 1,760 and others up to 2,430 |
| ²¹⁴ Po | 1.6×10^{-4} s | Several very weak |
| ²¹⁰ Tl | 1.3 min | — |
| ²¹⁰ Pb | 21 y | 47 |
| ²¹⁰ Bi | 5.0 d | — |
| ²¹⁰ Po | 138.4 d | 800 (very weak) |
| ²⁰⁶ Pb | Stable | — |
| ²³² Th | ²³² Th chain 1.41×10^{10} y | 59 |
| ²²⁸ Ra | 6.7 y | — |
| ²²⁸ Ac | 6.13 h | 57 to 1,640 many gammas |
| ²²⁸ Th | 1.91 y | 84 |
| ²²⁴ Ra | 3.64 d | 240 |
| ²²⁰ Rn | 51.5 s | — |
| ²¹⁶ Po | 0.158 s | — |
| ²¹² Pb | 10.6 h | 120, 240, 300 |
| ²¹² Bi | 60.5 min | 40 |
| ²¹² Po | 0.3 μ s | 280, 510, |
| ²⁰⁸ Tl | 3.1 m | 580, 860, 2,620 |
| ²⁰⁶ Pb | Stable | — |

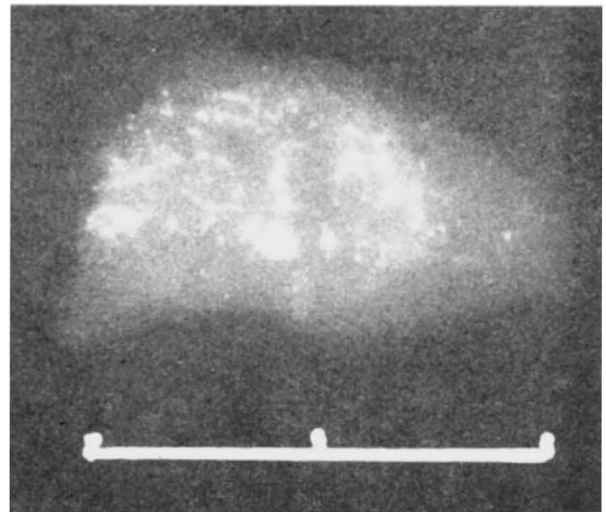


Fig. 1. Autoradiograph of a polished section of the bone of *Homosteus*. Scale, cm. The extremely bright spots are due to α -particles

some contribution from the ²³²Th chain. The components of these chains and the appropriate gamma energies are shown in Table 1.

To assess the distribution of activity across the specimen a section was polished and an autoradiograph was obtained using industrial X-ray film (Fig. 1). The distribution is not uniform but is concentrated into a few small areas.

A quantitative examination using the spark excited emission spectrum examined by a Hilger medium spectrograph indicated the chemical constituents as being: major, calcium; minor, strontium, phosphorus, magnesium; heavy trace, barium.

The fact that the major activity was due to the decay chain of ²³⁸U differs from previous results reported by Bowie and Atkin¹, who, working on an unidentified *Homosteus* plate (GSM 89090), found the major activity to be due to the decay chain of ²³²Th.

Similar examinations were made on a small specimen of *Dipterus valenciennesi* from Scrabster Brae about 1.5 miles west of Thurso and on a specimen of *Thursius pholidotus* from the shore of Thurso Bay about one mile west of Thurso. These specimens, of similar age from stratigraphical evidence, showed no unusual activity. It would therefore seem that we only find excessive radioactivity in those fossil fishes having heavy dermal armour, for example, the arthrodira.

The penetrating γ -photons from the $4n+2$ series can be readily observed using a sensitive portable γ -detector which could be a useful aid in locating specimens in the field.

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¹ Bowie, S. H. U., and Atkin, D., *Nature*, **177**, 487 (1956).

Continuous Irradiation of HeLa Cells at -196° C

THE incorporation of a suitable quantity of tritiated water in the growth medium permits the continuous irradiation of cells cultured *in vitro*. A uniform source of β -radiation is thus provided which can be used in a variety of cell culture techniques. Some observations on the effects of continuous irradiation of HeLa cells grown as a monolayer at 37° C have already been published^{1,2}. This communication reports some results of the continuous irradiation of HeLa cells at -196° C.