----- Treated (average of 7 tumours).

————— Untreated (average of 10 tumours).

Extract given in doses of 0.5 c.c. b.d. Intraperitoneally. First injection 11 days after inoculation.

Tumour size evaluated as product of two diameters.

in sodium hydroxide. The alkali-soluble part is found to be growth acceleratory, as indicated by the accompanying graph.

As these results were only incidental to the main research on substances inhibitory to cancerous growths, no further investigations were made. It is felt desirable, however, to record them for the use of other research workers in this field.

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¹ NATURE, 150, 660 (1942).

² Medical Press and Circular, 205, 334 (1941).

The 'Age' of Terrestrial Matter and the Geochemical Uranium/Lead Ratio

IN 1937 Stefan Meyer¹, of the Radium Institute in Vienna, using the data then available, obtained a value for the 'age' of the sun, or rather of terrestrial matter (assumed to be of solar origin). Assuming matter to have taken on its present elementary composition when radioactive disintegration was also started, Meyer calculated the length of time required for producing all the uranium- and actinium-lead in existence through disintegration of uranium I and of actino-uranium respectively. In his calculation Meyer made use of the figures for the isotope ratios of uranium and lead determined by the mass spectrograph, and also of the geochemical uranium/lead ratio worked out by Goldschmidt. Finally, he assumed the activity ratio between the uranium and the actino-uranium series to be as 25 : 1. The

result gave $(4.6 \pm 0.4) \times 10^9$ years as the age of the sun and, incidentally, the half-period of actino-uranium was found to be $(7.0 \pm 0.5) \times 10^8$ years.

Thanks to recent very accurate measurements by J. O. Nier², it is now possible to revise these calculations. Also the half-period of U^{235} has been found by independent methods (7.1×10^8 years). Using the latter value, the calculation can be carried out without using the hypothetical value of the geochemical uranium/lead ratio, which can be determined instead through the calculation. From Nier's determination the following constants are used: Isotope ratio of lead $Pb^{204} : Pb^{206} : Pb^{207} = 1.5 : 22.6 : 22.6$; Decay constant of actino-uranium, $\lambda_{acu} = 9.72 \times 10^{-10} a^{-1}$;

Isotope ratio of uranium, $\frac{U^{238}}{U^{235}} = \beta = 139 : 1$.

From the law of radioactive decay it follows that:

$$\lambda U^t a = \ln U_a / U_0. \quad (1)$$

If U_a was the number of uranium atoms t_a years ago and U_0 their present number, we find

$$U_a = U_0 + \alpha_u \Sigma Pb. \quad (2)$$

From equations (1) and (2):

$$t_a = (1/\lambda_u) \ln(1 + \alpha_u \Sigma Pb / U_0). \quad (3a)$$

For the actinium we find a similar equation

$$t_a = (1/\lambda_{acu}) \ln(1 + \alpha_{acu} \beta \Sigma Pb / U_0), \quad (3b)$$

where λ_u is the decay constant of uranium ($1.535 \times 10^{-10} a^{-1}$), α_u the ratio $Pb^{206} / \Sigma Pb = 0.226$ and α_{acu} the ratio $Pb^{207} / \Sigma Pb = 0.226$.

By a graphical method we find from the preceding equations $t_a = 5.33 \times 10^9$ years, whereas the geochemical lead/uranium ratio is found to be 5.6. It should be observed that the latter figure is derived directly from the radioactive constants. It agrees fairly well with Goldschmidt's assumption that per 100 atoms of silicon there are 0.0008 atoms of lead and 0.00016 atoms uranium present, giving a lead/uranium ratio of 5 : 1. We further find the present-day lead/actino-uranium ratio to be 750 : 1, whereas the uranium/urano-actinium ratio at the starting point, 5.33 billions of years ago, should have been as 1.78 : 1.

The age of matter thus found is seen to agree with the short-time scale now generally adopted in cosmic physics. It is of the same order of magnitude although numerically less than the new maximum age for iron meteorites given by Paneth³ at 7.8×10^9 years.

The figure here found for the age of terrestrial matter obviously represents a *maximum*, since any non-radioactive genesis of the lead isotopes Pb^{206} and Pb^{207} would mean a corresponding reduction in the time required for their production through disintegration. On the other hand, the age as stated only applies to the uranium isotopes, leaving the possibility open that when they were evolved the other elements may have existed for an indefinite time.

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¹ Meyer, S., *Mitt. Inst. Radiumforschung*, No. 393, No. 407.

² Nier, J. O., *Phys. Rev.*, 55, 150, 153 (1939); 60, 112-116 (1941).

³ Arrol, W. J., Jacobi, R. B., and Paneth, F. A., *NATURE*, 149, 235 (1942).