hop delays at 5 kc./s. can drop as low or lower than 0·8 sec. at Byrd following the onset of a magnetic storm. The record in question was obtained on the day following a magnetic disturbance in which the 3-hr. K_p index reached a maximum of 6. Thus it is quite possible that the delays observed are in fact consistent with the whistler-mode interpretation.

The fact that we cannot rule out the whistler-mode echo explanation does not, of course, disprove Dowden's hypothesis that the noise bursts were generated by bunches of electrons bouncing back and forth between magnetic mirror points. Our comments are intended only to suggest the inherent complexity of the problem and the need for more complete data on the relationship between whistler-mode propagation and very-low-frequency emissions.

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GEOPHYSICS

Age of the Earth's Crust and Lead Model Ages

OVER the past few years the observed time-dependence of the isotopic composition of lead in ore deposits has been used in attempts to estimate a 'model age' for each deposit. In the main, two general lines of attack appear to have been used. On one hand Canadian writers[1] have adopted a simple model, with a single growth curve, the parameters of which have been determined empirically; whereas the European workers[2] have set up models which allow for a greater variety of relative abundances of uranium–lead–thorium in the parent material, and where the parameters are physical constants which can be determined by independent methods. These two methods of attack have seemed to give different values of the age, and the further suggestion has recently been made[2] that the two models furnish very different values for the age of vein deposits.

In calculations which I have carried out in connexion with some results to be published elsewhere, I have shown that the major part of the discrepancy in model ages obtained by the two methods rests on the value of t_0, the 'age of the earth's crust'.

In the Holmes–Houtermans equation (2):

$$\frac{y - y_0}{x - x_0} = \frac{1}{137{\cdot}8} \times \frac{e^{\lambda_2 t_0} - e^{\lambda_2 t}}{e^{\lambda_1 t_0} - e^{\lambda_1 t}}$$

where x, y, are the ratios $^{206}Pb/^{204}Pb$, $^{207}Pb/^{204}Pb$ for the sample, x_0, y_0, the corresponding values for 'primordial lead' (average of Patterson's[3] values for Canyon Diabolo and Henbury troilite leads), and λ_1, λ_2, the decay constants for ^{238}U, ^{235}U (ref. 4), three values now used of t_0 have yielded three very different values for the model age calculated for the one (x, y) (Table 1).

Table 1

t_0 × 10^9 yr.	4·50 (ref. 2)	4·510 (ref. 1)	4·550 (ref. 3)
age × 10^6 yr.	1669	1640	1524

These compare with a value 1,524 million yr. for t_{6-7} of Russell and Farquhar[1], whose empirical equation yields an independent value for $t_0 = 4{\cdot}56 \times 10^9$ yr. Over quite a variety of specimens from Precambrian localities, which range from 'conformable' leads through vein deposits to those distinctly anomalous, close agreement has been obtained between the t_{6-7} model age and that calculated according to the Holmes–Houtermans model, using $t_0 = 4{\cdot}55 \times 10^9$ yr., with the standard deviation of the ages of a set of comparable specimens slightly less in the first case than in the second.

Thus it would seem that both models yield very similar conclusions, and that any discordance which has appeared in the past has resided almost entirely in the value chosen for t_0. The large error magnification exhibited here would appear to be an inevitable consequence of the exponential function used in all lead calculations, of which the equation quoted is a typical example. Where t_0–t (or in the general case t_1–t_2) is small, this magnification should prove to be less than unity, which is perhaps one reason why this effect has not been remarked on previously.

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PHYSICS

Direct Conversion of Fission Heat to Electric Power

EXPERIMENTS have been performed in the reactor *Pluto* as a stage in the development of cæsium-neutralized diodes for the direct conversion of fission heat to electric power. This work is similar to that being carried out in the United States, and the first fission-operated diode was reported by Grover at Los Alamos in 1959[1]. Due to its greater cathode area, the present device has produced a larger value of output current than hitherto reported and incorporates a number of new features. Measurements were made with two rigs, the object being to test the fuel rod material and method of mounting, to determine temperature distributions and heat transfer data and to study the performance of the diodes as generators.

Each diode (Fig. 1) contained a cylindrical cathode of UC/ZrC solid solution brazed to a tantalum support, and a stainless-steel anode which was extended to form a catchpot and a cæsium reservoir. The radial spacing between cathode and anode was 0·5 cm. In this intermediate design the emission current circulated via the extended anode casing and cathode support, so that a ceramic/metal insulating seal was not required. The output was determined by monitoring the voltage across the extended anode casing above the ceramic spacer. The cathodes were 5·7 cm. long and 1·0 cm. in diameter, enriched to contain 8·3 gm. uranium-235 over the lower 3·0 cm., the remainder containing natural uranium. The composition of the UC/ZrC was 45/55 mol. per cent with a melting point more than 3,000° C. Cathode temperatures were monitored by means of a W/WRe, beryllium oxide insulated, tantalum sheathed thermocouple situated at the junction of the natural and enriched material. Other thermocouples of chromel/