Long-period Waves over California's Continental Borderland
Part III. The Decay of Tsunamis and the Dissipation of Tidal Energy

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ABSTRACT

The characteristic damping (energy e-folding) time derived from the decay of the tsunami "pulse" can be compared to the dissipation time of the lunar semidiurnal tides as inferred from the discrepancies in the orbital motions of the Moon, Sun, and Mercury. The times are comparable, of the order of $\frac{1}{2}$ day, and this suggests that the same processes are responsible for the dissipation of the tide waves and tidal waves.

Successive spectra of tsunamis have shown (Miller *et al.*, 1962) that the energy density decays according to

$$E = E_0 e^{-\alpha t}, \qquad \alpha^{-1} \approx \tfrac{1}{2} \text{ day} \tag{1}$$

in the frequency range 1 to 20 cph. Apparently the decay time is not a sensitive function of frequency.

One is tempted to compare this result to the dissipation of tidal energy inferred from the discrepancy in the motions of the Moon, Sun, and Mercury. The work done by the lunar tidal couple is 2.7×10^{19} ergs $\text{sec}^{-1} = 2.3 \times 10^{24}$ ergs day^{-1}. If the ocean tides had their equilibrium amplitude, the tidal energy would equal 5×10^{23} ergs. The ratio

$$\frac{E}{-dE/dt} = \frac{5 \times 10^{23} \text{ ergs}}{2.3 \times 10^{24} \text{ ergs day}^{-1}} \approx 0.2 \text{ days} \tag{2}$$

is about half the value inferred from the tsunami attenuation. For further details concerning the astronomical evidence we refer to the discussion by Munk and MacDonald (1960: § 11.6.15 and p. 218).

The values for the decay times of tsunami and tides are not inconsistent, considering the uncertainties in both the oceanographical and astronomical investigations. But the exterpolation from the lowest measurable frequency band in the tsunami spectrum (1.25 to 2.5 cph) to the M2 tides (0.08 cph) cannot be defended. It should also be emphasized that the astronomical observations do not specify the manner in which tidal energy is dissipated; the dissipation could be associated with the bodily tides of the Earth, and for that matter with the tidal distortion of the Moon associated with the variable distance between Earth and Moon (Urey *et al.*, 1959).

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