was the upper limit of the receiver. 5 milliwatts output power was obtained.

We wish to thank the Admiralty for permission to publish this communication.

K. G. Hambleton
J. J. Low
R. J. Sherwell
Services Electronics Research Laboratory,
Baldock, Herts.

[1] Esaki, L., *Phys. Rev.*, **109**, 603 (1958).
[2] Sommers, H. S., *Proc. Inst. Rad. Eng.*, **47**, 1201 (1959).
[3] Gremmelmaier, R., and Henkel, H., *Z. Naturforsch.*, **14**, *a*, 1072 (1959)

GEOPHYSICS

Micropulsations in the Earth's Magnetic Field Simultaneous with Pulsating Aurora

Some preliminary results have been obtained from an investigation being undertaken at College, Alaska, concerning the correspondence of the Earth's magnetic field micropulsations[1] with pulsating aurora for the purpose of explaining the physical mechanism giving rise to the phenomena. Fig. 1 illustrates the nightly coincidence of micropulsations, measured with a 6-ft. diameter magnetic north axis loop antenna of 21,586 turns and 3914-Å. auroral pulsations from 70° of sky measured with a lens, interference filter, photo-multiplier system. Fig. 2 shows an occasion of simultaneous oscillations from the two phenomena.

Messrs. A. Belon, C. Deehr, M. Rees and G. Romick, of the Geophysical Institute Optics Division, have aided me in the development of the experiments.

W. H. Campbell
Geophysical Institute,
University of Alaska.

[1] Campbell, W. H., *J. Geophys. Res.*, **64**, 1819 (1959).

An Expanding Earth with Loss of Gravitational Potential Energy

Recently, and independently, Carey[1] and Heezen[2] have concluded that the Earth is expanding. The

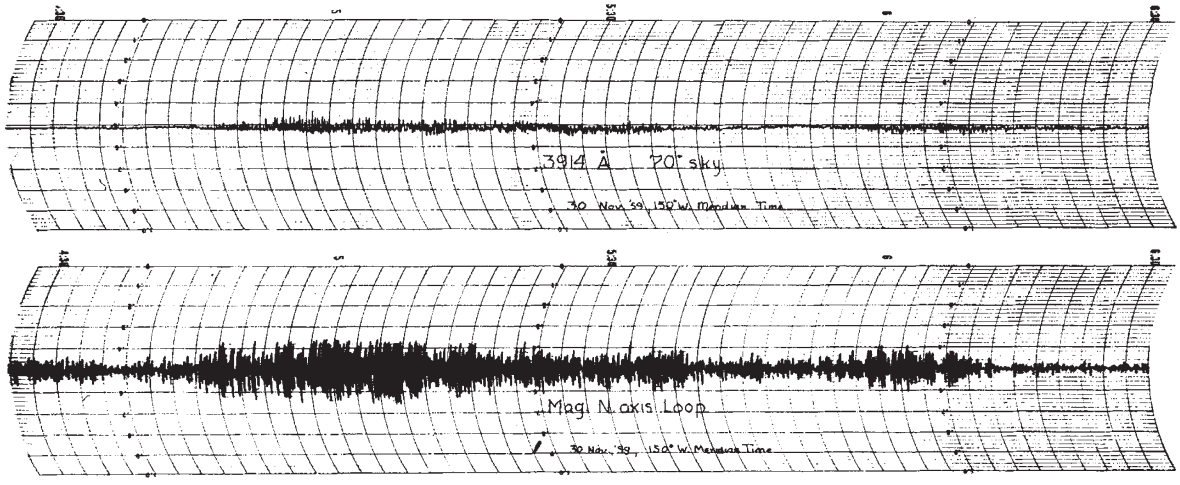

Fig. 1. Coincident pulsating aurora and magnetic micropulsations (12γ full scale)

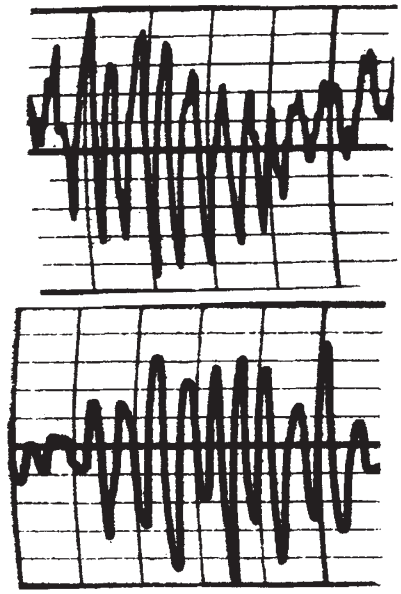

Fig. 2. Simultaneous oscillations of 3914 Å. aurora and micropulsations in the magnetic north–south direction

first question asked of such a hypothesis usually takes the form of an inquiry as to the source of energy for such an expansion. This question is based on the assumption that the gravitational potential energy of the Earth is inversely proportional to its radius, and the assumption in turn is presumably based on the well-known equation (see, for example, Loney's "Statics", p. 359).

$$E = -\frac{3}{5}\frac{GM^2}{a}$$

where E is the gravitational potential energy, G the gravitational constant, M the mass and a the radius of the Earth. However, the equation refers only to a sphere of uniform density, and one possibility that appears to have been overlooked is that a non-uniform Earth can expand and lose gravitational potential energy at the same time.

The following expressions for density ρ_r versus radius r in the Earth have been obtained by fitting linear density distributions of the form: $\rho_r = \rho_0 (1 - kr)$ to each section of Bullen's[3] model B of the Earth:

$0 < r < 1{\cdot}250 \times 10^8$ cm.	$\rho_r = 17{\cdot}900(1-1{\cdot}29162 \times 10^{-9}r)$
$1{\cdot}250 < r < 1{\cdot}389$,,	$\rho_r = 42{\cdot}078(1-5{\cdot}14625 \times 10^{-9}r)$
$1{\cdot}389 < r < 3{\cdot}471$,,	$\rho_r = 13{\cdot}403\ (1-7{\cdot}53631 \times 10^{-10}r)$
$3{\cdot}471 < r < 6{\cdot}291$,,	$\rho_r = 7{\cdot}505(1-7{\cdot}69678 \times 10^{-10}r)$
$6{\cdot}291 < r < 6{\cdot}338$,,	$\rho_r =$ constant $= 3{\cdot}34$
$6{\cdot}338 < r < 6{\cdot}371$,,	$\rho_r =$ constant $= 2{\cdot}79$