When manoeuvring full ahead the propeller of M.V. *Southbank* makes about 90 r.p.m. This is in accord with the observed frequency of the disturbance, which was about 1·4 c/s.

In common with the majority of 'singing' events observed at Rabaul, most of the energy was propagated longitudinally in a north–south plane. There have, however, been occasions on which the maximum effect has been recorded on the east–west component at the Observatory, and on the north–south at Sulphur Creek.

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Ellipticity, Viscosity and Expansion of the Earth

It is known that the ellipticity[1] of an Earth in hydrostatic equilibrium $(3·3632 \pm 0·006) \times 10^{-3}$ is greater than that of the actual Earth $(3·3535 + 0·0003) \times 10^{-3}$ derived from high-precision satellite observations[2].

The purpose of this communication is to show that, if the gravity constant is inversely proportional to a time parameter comparable with the age of the Earth, that is, in the case of the Dirac-cosmology, then the observed ellipticity may be regarded as the ancient ellipticity of an Earth in hydrostatic equilibrium retained by its viscous inner part.

For the ellipticity, the Clairaut-equation is valid:

$$\varepsilon = 3/2\ J_2 + 1/2\ m + 1/2\ \varepsilon^2 - 1/7\ \varepsilon m - 4/7\ \lambda$$

where $J_2 = \frac{C-A}{Ma^2}$ and $m = \frac{\omega^2 r_1^2}{fM}$ (M is the mass of the Earth, A and C are the moments of inertia, ω is the angular velocity, a the equatorial radius, r_1 the mean radius, and λ a quantity of an order of magnitude of 10^{-8}).

The gravity constant, f, in the case of the Dirac-cosmology is $f = \frac{x}{t}$, where x is a constant and t a time parameter comparable with the age of the Earth. The recent value of t can be taken as $4·5 \times 10^9$ years.

In the case of hydrostatic equilibrium:

$$C - A = \frac{8\pi}{3} \int_0^a \varepsilon\, \rho r^4\, dr$$

(ε is the ellipticity, and ρ the density, as a function of radius).

Therefore, in the case of an Earth in hydrostatic equilibrium the following expression is valid for unit time:

$$\frac{d\varepsilon}{\varepsilon} = \frac{2Q}{\omega} \cdot \frac{d\omega}{dt} + \frac{Q}{t} + \left(5Q + \frac{3\rho_0}{\rho_k} - 2\right)\frac{\alpha}{a}$$

where $Q = \frac{m}{2\varepsilon} = 0·513$; $\rho_0 = 2·85$, the surface density; $\rho_k = 5·52$, the mean density of the Earth; α = the yearly radius increase.

The recent value of $\frac{d\omega}{dt} = -4·81 \times 10^{-22}$ radian sec^{-2} = $-1·44 \times 10^{-14}$ rad sec^{-1}/year (ref. 3). $\frac{d\varepsilon}{\varepsilon} = (2·9 \pm 0·3) \times 10^{-3}$. In the case of $t = 4·5 \times 10^9$ years the value $\frac{d\varepsilon}{\varepsilon}$ is positive only if $\alpha > 0$, that is, in the case of an expanding Earth.

It has been shown that the minimum rate of the Earth's expansion amounts to $0·6 \pm 0·1$ mm/year[4].

In this case the yearly value of:

$$\frac{d\varepsilon}{\varepsilon} = 0·6 \times 10^{-10}$$

that is, the value of $2·9 \times 10^{-3}$ may be obtained only in $4·8 \times 10^7$ years.

The maximum rate of expansion gives the radius of the Earth divided by its age. This is 1·4 mm/year, and the foregoing relative change of ellipticity may occur in $0·9 \times 10^7$ years.

If the difference between the actual ellipticity and the equilibrium ellipticity can be ascribed to viscosity, the time interval obtained can be regarded as the relaxation time of deformations retarded by viscosity. In the mantle the rigidity is always greater than 1×10^{12} dynes cm^{-2}. Therefore, the viscosity (according to the Maxwell relation) is:

$$\eta = \mu\tau \geq 3 \times 10^{26} \text{ poise}$$

and probably:

$$> 7 \times 10^{26} \text{ poise}$$

It has been shown by Niskanen[5], and recently by Crittenden[6], that the viscosity of the subcrustal material is less than $10^{21} - 2 \times 10^{22}$ poises, at least to a restricted depth. Therefore, the viscosity of the greater part of the mantle must exceed several times 10^{26}–10^{27} poises. This excludes the existence of convection currents in the greater part of the mantle.

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Gravity Field of the Niger Delta (West Africa)

Gravity data are now available for 73 land stations situated in the general area of the Niger Delta, West Africa. The Bouguer anomaly map shows a gravity low of −35 mgal (the 'Niger Delta Minimum') which occupies a large part of the sub-aerial Niger Delta, and a gravity high of +40 mgal (the 'Ekenie High') situated in the extreme south-western corner of the sub-aerial delta. Isostatic reduction does not very appreciably affect the anomalies, as is only to be expected in an area where the topography is low and gentle. The isostatic anomaly maps, based on various possible systems of isostatic compensation, accordingly do not differ very much one from another or from the Bouguer anomaly map, and show the same general features as the latter. However, there is some difference in the 'Ekenie High' area; isostatic anomalies there are less pronounced for a higher degree of regionality. This is interpreted as an indication that the continental slope off the Niger Delta is regionally compensated.

If the sediments constituting the Niger Delta had been laid down on a completely rigid, unyielding crust which was in isostatic equilibrium before the sediments were deposited, one would expect to find strongly positive gravity anomalies of, say, +125 to +220 mgal, depending on the density value assumed. In reality, gentle negative anomalies down to −40 mgal are encountered. This is interpreted as meaning that the Niger Delta is practically in isostatic equilibrium. Accordingly, there must have been adjusting crustal movements (subsidence) to bring about this state of near-isostatic equilibrium and there is every reason to interpret this as subsidence under a sedimentary load.

A simple relation exists between initial water depth and the total thickness of sediment that can be deposited. If, namely, W is the initial water depth (density of sea