Since protein synthesis elongation factor I recognises aminoacyl-tRNA and is also involved in RNA synthesis (at least in bacteria) then perhaps the aminoacylviral RNA is somehow used to integrate protein and RNA synthesis in virus-infected cells.

Two technical problems should be borne in mind, however; first, Salomon and Littauer could only charge about 20% of their Mengo RNA with histidine, and, second, cell-free protein synthesis systems are so very inefficient compared with whole cells that any subtle effects which might be caused by tRNA 'modulation' *in vivo* may be completely lost *in vitro*.

ALAN E. SMITH

258,247 dam earthquakes

by David Davies

BUILD a large reservoir and expect earthquakes. This has been a common experience in the past 20 years. The Koyna Dam in India and the Kariba Dam in Africa both triggered off much seismic activity and there have been many other similar cases. A well-documented example in China is now presented by Shen Chung-Kang in a recent issue of *Scientia Sinica* (**17** (2), 239–272; 1974).

The Hsinfengkiang Dam in Kwangtung Province was started in July 1958 and by August 1960 was producing electric power. The reservoir covers 390 km^2 and impounds 11,500 million m^3 of water. The dam is 440 m long and has a maximum height of 105 m. The immediate vicinity was no more seismic before the construction of the dam than any other area in China, where there is, of course, much scattered seismicity.

Within a month of the first impounding of water in October 1959, seismic activity started up and as the water level rose so did the frequency of quakes. Many of the earthquakes could only be detected instrumentally, but a few were felt in the area around the dam—these generally had a surface-wave magnitude of 2 to 3. A set of seismometers was moved into the area to enable accurate locations to be produced and these still operate.

The first earthquakes were in the region of the dam itself, but progressively the activity spread to other regions. Relatively few events were located under the water itself, the majority being within a kilometre of the water's edge on the landward side. Each new rise in water level seemed to stimulate fresh activity; the depths of the earthquakes were typically 4 or 5 km. Finally in March 1962 came a magnitude 6 event within 1 km of the dam and 5 km deep. The intensity at the epicentre was VIII—a violent shock, but the dam survived since it had been strengthened months previously on the basis of the earlier activity.

In the last 20 days before the main shock there was a marked reduction in activity everywhere in the reservoir region, and those small earthquakes that there were began to move towards the epicentre of the main shock. Since March 1962 aftershocks have continued with characteristics conventionally expected of an aftershock sequence and the activity in the area continues to this day. Up to 1972, 258,247 shocks with Ms greater than 0.2 were recorded.

What causes reservoir earthquakes? The best general explanation put forward so far, which the author also favours, is that water percolates into the underlying rocks and finds its way into groundwater channels and deep fissures. As the seepage pressure rises the water acts as a means of lubricating, as it were, the faults in the region. Thus earthquakes are facilitated as slippages along these faults. Such an explanation in terms of pore interstitial fluids, is increasingly being favoured as a general explanation of tectonic earthquakes.

Healthy carriers of hepatitis B

from Arie J. Zuckerman
Medical Virology Correspondent

NUMEROUS seroepidemiological surveys on selected groups have shown that the prevalence of hepatitis B antigen, a marker of infection with hepatitis B virus, in apparently healthy persons in Western Europe and North America is 0.1–0.6% by comparison with 5–20% in tropical Africa, South East Asia and the Far East (*Tech. Rep. Ser. Wld Hlth Org.*, No. 512; 1973). Although relatively little information is available from serial samples collected over a period of time, which would permit more precise determination of the carrier rate in defined populations, the implications are that there may be tens of millions of individuals throughout the world who carry silently in their serum the hepatitis B antigen. For practical purposes it has been agreed that a persistent carrier state exists in persons in whom the antigen has been detected repeatedly for more than 3 months. The carrier state may be life long; Zuckerman and Taylor (*Nature*, **223**, 81; 1969) described the

Tidal drag cannot move plates

from Peter J. Smith
Geomagnetism Correspondent

THE idea that continents might be displaced by tidal forces was discussed at some length by Wegener in various editions of his book *The Origins of the Continents and Oceans*. But ever since Jeffreys (*The Earth*, Cambridge University Press, 1929) showed that the stress over the Earth's surface arising from tidal friction is only of the order of 10^{-4} dyn cm^{-2}, few people have considered tidal drag a likely driving mechanism for continental drift or plate motions. On the other hand, such a mechanism does seem to be feasible from the energy point of view. Recent calculations suggest that the energy dissipated tidally may exceed 5×10^{19} erg s^{-1} (Rochester, *Eos*, **54**, 769; 1973), of which about 2.5×10^{19} erg s^{-1} is likely to be the maximum dissipated in shallow seas and of which less than 10^{18} erg s^{-1} is lost in the solid Earth. Thus, in principle, as much as $2–3\times10^{19}$ erg s^{-1} might be available for driving plates.

Recently, Bostrom (*Nature*, **234**, 536; 1971) and Moore (*Geology*, **1**, 99; 1973) have revived the tidal drag mechanism, citing in its support such phenomena as the dependence of seismicity on latitude and the tendency of oceanic ridge segments to lie north–south (with transform faults lying east–west). But Jordan (*J. geophys. Res.*, **79**, 2141; 1974) has now carried out a 'simple calculation' showing that although a plate velocity of 5 cm yr^{-1} would involve the dissipation of energy at a rate of only 0.8×10^{17} erg s^{-1} (well within the amount available), a torque of 10^{33} dyn cm would be required to maintain it. The actual couple exerted on the Earth by the Moon is probably less than 10^{24} dyn cm, or 9 orders of magnitude too small to allow plate motion if currently quoted values of asthenospheric viscosity are accepted. Tidal forces could produce lithospheric motion, but only if the viscosity of the asthenosphere were to be as (unbelievably) low as 10^{11} poise.

In further support of the view that tidal forces are not relevant to present-day plate tectonics, Jordan cites recent plate models based on the fixed hot spot hypothesis, which suggest that the westward displacement of the lithosphere as a whole is small compared with the relative motions of plates. In the meantime, however, all this leaves open the rather different question of what happens to the balance of the energy released by tidal friction.