copies of genes associated with the nucleolus and specifying ribosomal components are made at a time when the oocyte is laying down stocks of ribosomes for the egg cell.

Bell's experiments also raise the question of why *I*-somes and *I*-DNA have escaped detection for so long. Part of the answer seems to be that experimenters have never seriously looked for them because they have no place in current dogma. As Bell points out, there have been several reports of cytoplasmic particles which contain messenger RNA and protein; the blinkers of theory seem to have inhibited analysis for DNA. Last August, however, Bond *et al.* (*Science*, **165**, 705; 1969) reported the discovery of a unique class of DNA in microsome fractions from rat liver. It is tempting to speculate that this DNA, which is not apparently a contamination of either nuclear or mitochondrial DNA, is *I*-DNA associated with liver ribosomes, being the counterpart in rat liver cells of the *I*-DNA in embryonic muscle cells. If this proves to be the case *I*-DNA may well be more than a particular example of gene amplification.

HEAT FLOW

New Terrestrial Analysis

from our Geomagnetism Correspondent

SINCE the last spherical harmonic analysis of terrestrial heat flow was made in 1965, the number of observations has almost trebled—from 1,162 to 2,934. A new analysis was thus clearly called for, if only to check the conclusions reached in 1965. Horai and Simmons (*Earth Planet. Sci. Lett.*, **6**, 386; 1969) have recently analysed the 2,822 most reliable measurements. The distribution of observations is still far from perfect, however, for only about a quarter of the 5° latitude by 5° longitude grid areas contain any measurements at all. Africa, South America and Antarctica are particularly badly represented although the available data cover enough major geological features to give a good idea of the variation of heat flow with physiography.

The picture derived from the last analysis remains qualitatively unchanged. The average values for continents ($1{\cdot}65 \pm 0{\cdot}89 \times 10^{-6}$ calories/cm^2 s; 474 observations) and oceans ($1{\cdot}64 \pm 1{\cdot}11 \times 10^{-6}$ calories/cm^2 s; 2,348 observations) are almost identical (all errors are standard deviations). The average of fifty-eight observations in the Canadian, Baltic, Ukrainian, Peninsular (Indian), Australian and South African shields ($1{\cdot}04 \pm 0{\cdot}42 \times 10^{-6}$ calories/cm^2 s) is significantly lower than the world mean of $1{\cdot}65 \pm 1{\cdot}08 \times 10^{-6}$ calories/cm^2 s. The mean of sixty-one values from the continental lowlands of North America, Russia, India, South Africa and Australia, $1{\cdot}60 \pm 0{\cdot}54 \times 10^{-6}$ calories/cm^2 s, is slightly lower than the world average.

On the other hand, the average value for the island arcs and marginal seas of the circum-Pacific belt ($2{\cdot}01 \pm 0{\cdot}94 \times 10^{-6}$ calories/cm^2 s), based on 375 observations in the Bering Sea, the Sea of Okhotsk, the Japan Sea, the Japanese Islands, the East China Sea, the Celebes Sea, the Coral Sea, the Fiji Basin, the Tasman Sea, the Timor Sea and the Flores Sea is appreciably higher than the world average. An expected high average of $1{\cdot}92 \pm 1{\cdot}64 \times 10^{-6}$ calories/cm^2 s also emerges from 540 observations over the East Pacific Rise, the Mid-Atlantic Ridge, the Gulf of Aden, the Red Sea, the Indian Ocean Ridge and Iceland. This is ample evidence that surface heat flow depends critically on broad scale geological features.

The resemblance between the heat flow distribution and the shape of the Earth's gravitational field can no longer be upheld. This supposed resemblance was based on heat flow data and gravitational analyses available in 1964, and implied a causal relationship between temperature and excess mass in the Earth. There is almost no correlation between heat flow and recent gravitational analyses, which suggests that thermal and gravitational effects are of basically different origin. The analysis by Horai and Simmons, the first to be carried up to seventh order coefficients, shows why this is so. In the heat flow field the higher harmonics are dominant, suggesting that regional heat flow variations are shallow (that is, crustal and perhaps partly upper mantle) effects. The sources of gravitational anomalies, on the other hand, are thought to lie chiefly in the mantle. It thus seems that surface heat flow gives a poor picture of the thermal state of the mantle.

Science Research Council Grants (£ Thousands) 1966-69

	1966–67	1967–68	1968–69 (provisional)
Aeronautical and Civil Engineering	427	420	371
Astronomy	378	816	497
Biological sciences	1,177	1,090	1,128
Chemical engineering	386	539	481
Chemistry	1,429	1,518	1,290
Computing science	529	918	366
Electrical and systems engineering	426	477	877
Enzyme chemistry	—	—	333
Mathematics	90	164	174
Mechanical engineering	738	528	903
Metallurgy and materials	868	876	661
Nuclear physics	1,154	1,071	1,605
Organometallic chemistry	—	—	427
Other physics	1,057	847	957
Polymer science	—	—	57
Radio	19	26	57
Space	977	129	780
Total	9,655	9,419	10,964

PULSARS

Gravitational Brakes

from our Astronomy Correspondent

THE first of a series of four papers on what makes a pulsar tick has been published in the *Astrophysical Journal* by J. P. Ostriker and J. E. Gunn of Princeton (**157**, 1395; 1969). The chief value of the paper is that it considers the archetypal pulsar *NP* 0532 in the context of the Crab Nebula supernova remnant in which it is immersed. The authors also make some bold numerical predictions of the rate of rundown of pulsars in general and the Crab pulsar in particular. The ticklish question of precisely how such highly