synthesise actin destined for the cell surface, whereas actin for thin filaments does not accumulate.

These considerations require re-evaluation of reports of the time during myogenesis when the messenger RNAs for myosin are transcribed and translated. If the presence of a molecule with the molecular weight of 200,000 is taken as evidence for the synthesis of myosin (Yaffe and Dym, *Cold Spring Harb. Symp. quant. Biol.*, **37**, 543; 1972) then all cells, including replicating presumptive myoblasts, must be transcribing and translating mRNAs for some kind of myosin. Accordingly it is not surprising that Rubinstein and colleagues (*Biochem. biophys. Res. Commun.*, **57**, 438; 1974) now report that myosin and actin are indeed coordinately synthesised and turned over, not only in myotubes but also in mononucleated presumptive myoblasts, cartilage cells, fibroblasts and BUdR-suppressed myogenic cells.

Lastly, a smouldering controversy of considerable interest to molecular geneticists exists between those who claim that myoblasts withdraw from the cell cycle as a precondition to fusion, and those who claim that cessation of DNA synthesis results from fusion. The most emphatic statement of the second position is that of Doering and Fischman (*Devl Biol.*, **36**, 225; 1974). Based on what is termed a "% fusion" index they conclude that myogenic cells whose DNA synthesis is blocked by Ara-C fuse; according to these authors replicating myogenic cells have the option to replicate, or to fuse, and, as a consequence of fusing, cease replicating. Before these important conclusions can be accepted, however, it should be noted that: (1) Ara-C is routinely used to kill replicating cells, so that the design of the Doering and Fischman experiment must yield a spuriously high "% fusion" index; (2) early fusion cannot be measured with the light microscope; and (3) it is impossible to distinguish 'fibroblasts' from presumptive myoblasts. Given these uncertainties it will be interesting to see if those who speculate that myoblasts withdrew from the cell cycle as a precondition to fusion can devise more cogent experiments.

H. Holtzer

Slaved disk model for Hercules X-1

from James Pringle

A POSSIBLE solution to some of the more puzzling aspects of the X-ray star Hercules X-1 has been proposed in a recent article by Roberts (*Astrophys. J.*, **187**, 575; 1974). The X rays from Her X-1 are regularly pulsed with a period of 1.24 s and the source of X rays is one member of a binary star system which has an orbital period of 1.7 d. The X-ray source is thought to be a neutron star with a strong dipole magnetic field and the X rays are produced by material transferred from the 'normal' star of the binary system accreting on to the compact neutron star. Because of the strong magnetic field, the accreting material is channelled down on to the magnetic polar caps of the neutron star dissipating its kinetic energy of infall when it strikes the surface. So much energy is liberated in such a small region that the temperature rises to more than 10^7 K. Thus most of the radiation emerges as X rays. The two magnetic polar caps are then two X-ray emitting hotspots: if the magnetic axis is offset from the rotation axis, rotation of the star with a 1.24 s period provides a natural explanation of why the observed X rays are regularly pulsed.

Furthermore, the X-ray source displays a third periodicity. The X rays are visible for only about 10 to 12 consecutive days, reappearing regularly at 35-d intervals. Explanations of this phenomenon—for example, variable mass transfer or precession of the pulsing neutron star—have difficulty in accounting for another aspect of the problem. The 'normal' component of the binary system was identified in 1972 as the previously known variable star HZ Herculis. This star is so close to the luminous X-ray source that X-ray heating causes one side of it to be about four times brighter than the other. The brightened face follows the neutron star around its orbit, and thus HZ Her can be observed to vary regularly in brightness with a period of 1.7 d. The puzzling feature of this 1.7-d optical variation is that, although the X rays can be seen for only 10 out of every 35 d, the heating of the side of HZ Her nearest to the X-ray source continues throughout the cycle, even when no X rays are observed.

Roberts' explanation of this is quite simple. He suggests that HZ Her has its rotation axis at an angle to the orbital rotation axis. In this case, the rotation axis of HZ Her precesses about the orbital rotation axis with a period of about 35 d. The material transferred by HZ Her towards its companion has too much angular momentum to be able to fall on to it directly and, instead, forms an accretion disk around the neutron star. In the disk, viscosity transfers angular momentum outwards, allowing the material to spiral slowly inwards. Roberts notes that the disk, which is opaque to X rays, will lie in the plane perpendicular to HZ Her's rotation axis, and thus in general not in the orbital plane of the system. Roberts names this the Slaved Orientated Disk, or SOD for short. Thus the angle between our line of sight to the X-ray source and the plane of the SOD varies with the 35-d precession period of HZ Her. Since the X-ray source can only be seen when this angle is sufficiently large, one expects the visibility of the X rays to vary with the 35-d period. On the other hand, HZ Her is so close to the X-ray source that the (X-ray) shadow cast on its surface by the disk is quite small. Thus one expects the heating of HZ Her to continue, even when the disk temporarily obscures the X-ray source from observation.

This is by no means the whole story. Roberts also explains why the rotation axes might be expected to be misaligned and shows how his model can account for several further observational details. There are now a number of models which seem to account for the 35-d period of Her X-1 and its associated problems, but nobody has yet performed any detailed calculations. Roberts, however, excuses himself by quoting J. A. Wheeler's First Moral Principle: "Never do a calculation until you already know the answer".

Asia as a composite continent

from Peter J. Smith
Geomagnetism Correspondent

WHETHER or not it is realistic to suppose that any of the present continents could have formed by the accretion of separate crustal blocks, the important question of continental fusion continues to receive considerable attention. Most recently the debate has centred particularly on Africa (see, for example, Piper *et al.*, *Nature*, **245**, 244; 1973) with new evidence suggesting that the orogenic belts between the major cratonic areas of that continent may not be sutural but more probably formed *in situ*, although the idea of what Kropotkin (*Eos*, **53**, 180; 1972) has termed the "composite continent" was actually first applied to Asia by Argand (*Coll. Rep. 13th Int. Geol. Congr. 1922*, **1**, 171; 1924) just 50 years ago and long before the new global tectonics had been thought of.

Since then, evidence supporting the composite nature of Asia has been adduced from palaeomagnetism, palaeontology, geology and petrotectonics. In a useful and commendably concise article Burrett (*Earth planet. Sci. Lett.*, **21**, 181; 1974) has now brought all these data together to delineate the Asian block boundaries and to estimate the timings of the various collisions thought to be involved. Although the field information is not entirely clear in all cases, there seem to be about nine blocks present; and Burrett summarises the evidence for each.

The general conclusion that Burrett comes to is that the coincidence of orogenic belts containing zones of high pressure metamorphism, ophiolites and deep water sediments with faunal province boundaries only makes sense in plate tectonic terms, the belts being the sutures along which the crustal fragments collided and coalesced. He then goes on to discuss when these collisions took place, beginning with the assumption that in the Lower Palaeozoic the various blocks were separated by considerable widths of oceanic crust. According to this analysis the first collision took place in the Upper Carboniferous, although the fusion of all blocks into what is now Asia was not complete until well into the Mesozoic.

Burrett admits that his model is based on "very incomplete data" but nevertheless suggests that "there does not appear to be much room in which to alter the boundaries of the blocks here identified nor the timing of their collisions". It remains to be seen whether, as in the case of the African orogenic belts, a static model can be made to explain the data even more convincingly.

Sources of natural radiation

from J. R. A. Lakey

THE largest source of ionising radiation exposure to the United Kingdom population originates from terrestial and cosmic radiation. This natural radiation was the subject of a meeting of the Society for Radiological Protection held on April 2. C. R. Hill (Institute of Cancer Research, Sutton) stressed that the exposure is by no means uniform. The living habits of human beings have a marked effect on the dose because of the natural radionuclides in the diet and the radioactivity of building materials. These differences have been exploited—in attempts to deduce a dose/effect relationship—but with little success because control populations are hard to find. Nevertheless there has been some pressure to use the apparently solid ground of natural radiation exposures as a basis for setting radiation protection standards. The International Commission on Radiological Protection has not made its recommendations on this basis but J. Vennart (Medical Research Council, Radiobiology Unit, Harwell) reminded the society that natural radiation is deliberately neglected and controls are applied only to artificial radiation exposure.

An interesting dilemma arises from the use of building materials which are naturally radioactive. G. A. M. Webb (National Radiological Protection Board, Harwell) revealed that the Soviet Union has limits designed to avoid 'abnormal' radiation exposure and prohibits building materials containing more than 10 pico curies of radium-226 per gram. Most building materials are not significantly radioactive so that the house walls and foundation act as a shield against natural radiation exposure.

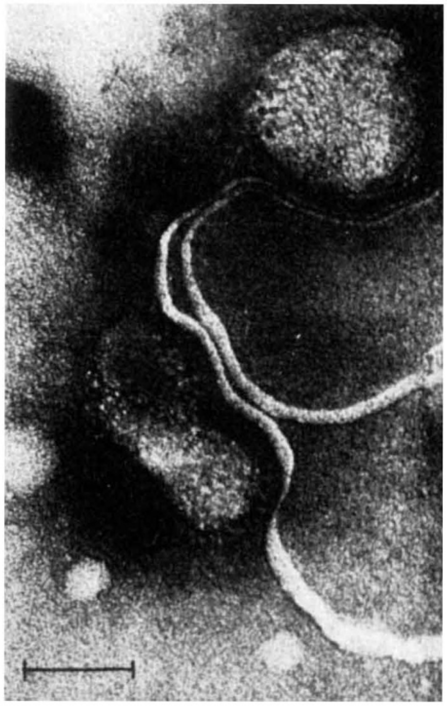
Several speakers referred to the more insiduous radon-222 which is present in air at around 0.1 pico curies per litre and in some cases appears in drinking water at concentration as high as one million pico curies per litre. E. I. Hamilton (Institute of Marine Environmental Research, Plymouth) said that the apparently inexplicable variations in the activity of radon in drinking water occur because the gas can move through the crack system from rocks as deep as 3,000 m.

The dose from natural radiation has been reviewed extensively by the United Nations Scientific Committee on the Effects of Atomic Radiation (UNSCEAR). F. W. Spiers University of Leeds) discussed the dose due to internally deposited radioactivity, and said that doses reported by UNSCEAR for cortical and trabecular bone should be revised. The fat cells, which account for 53% of bone marrow, concentrate carbon-14 and the dose becomes four times higher than UNSCEAR reported. Surface-seeking alpha emitters also increase the dose to osteoblasts lining the cavities in bone. The genetic effect of natural radiation has been of most concern to human populations and it must account for some of the births subject to genetic disease. R. J. Berry (Royal Free Hospital, London) said that the radiation dose to double the mutation rate is thought to be between 30 to 80 roentgens. Nobody has been able to correlate natural radiation dose with genetic diseases and it is not necessarily correct to assume that all mutations are harmful. Indeed there is some evidence to suggest that some radiation-induced effects are repaired.

Sendai virus receptors in a model membrane

from a Correspondent

VERY little is known about the first step in replication of animal viruses—the absorption of the virus to receptors of the host cell. It is surprising, for instance, that the question of whether the small oncogenic DNA viruses bind to specific cell receptors is still unresolved. By contrast, the complementarity involved in the reaction of myxoviruses and paramyxoviruses, such as Sendai virus, with specific receptors, at least in the non-permissive erythrocyte, is well known. Haywood (*J. molec. Biol.*, **83**, 427-436; 1974) has extended this system to a study of the interaction of Sendai virus with a model membrane incorporating the specific receptors.



Electron micrograph of Sendai virus adsorbed to a ganglioside-containing liposome. The virus can be distinguished by the spikes on the outer surface. The length of the attachment of the two viruses is 2,100 and 2,500 Å. The bar represents 1,000 Å. (From Haywood, *J. molec. Biol.*, **83**, 427; 1974.)

Sendai virus has a spiked appearance, the spikes being surface glycoproteins which absorb to sialic acid groups of the receptors of erythrocytes and presumably also of permissive host cells. Haywood now reports that sialic acid groups of gangliosides work well as receptors for Sendai virus if they are incorporated into synthetic lipid membranes at relatively high surface density. Electron micrographs show virus particles absorbed to the liposomes containing ganglioside along long stretches (210 nm–250 nm) of the virion. Assuming the area of attachment to be a circle of this diameter, then it seems that the virion is absorbed to a considerable patch of membrane and makes multiple attachments between spike glycoproteins and clusters of gangliosides, perhaps as many as 3,000. It would be interesting to know if the clustering of receptor molecules is actually induced by binding to the virus. If so, then this process might be related to cell fusion induced by viruses such as Sendai, since high local concentrations of gangliosides destabilise lipid bilayers.

The absorption of Sendai virus to