marises 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.

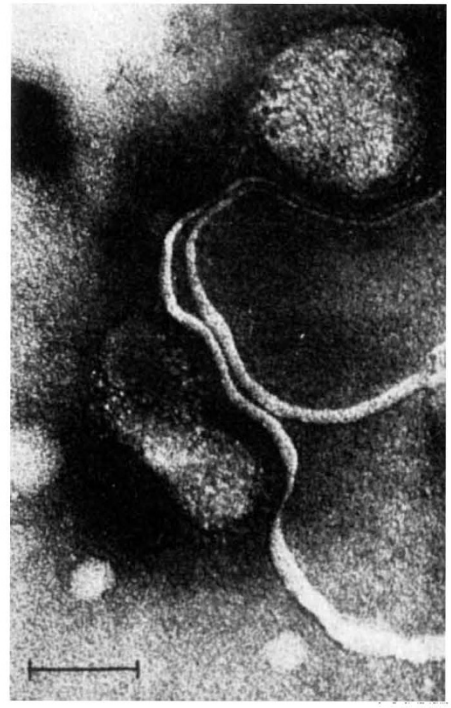
Several speakers referred to the more insiduous radon-222 which is present in air at around 0.1 pico curies per litre and in some cases appears in drinking water at concentration as high as one million pico curies per litre. E. I. Hamilton (Institute of Marine Environmental Research, Plymouth) said that 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