# COMMENTS

## *by Readers*

**A paper by F. H. J. Figge** (*Science*, March 28, p. 323) states some new and interesting results on the biological effects of cosmic radiation. The problem is a complex one, and possibly a physicist may properly call attention to a few of the pertinent physical considerations.

Most of the radiation reaching sea level consists of mesotrons (*Rev. mod. Phys.*, 1939, **11**, 122–296), some of which are extremely penetrating. Indeed, small residual intensities have been detected as far down as instruments have been carried. Thus, it cannot be stated exactly what thickness of absorber is necessary to reduce the intensity to zero, for some slight intensity is found to be present under matter equivalent to 300 feet of lead. Presumably, about a mile underground the intensity will be so low as to be immeasurable with present apparatus. It is true, however, that a few feet of lead will materially reduce the radiation at sea level.

At higher altitudes the intensity is much greater, for the atmosphere constitutes a barrier equivalent to about 3 feet of lead. At an altitude between 18,000 and 19,000 feet, depending on local conditions, half the atmosphere is below the observer. At 30,000 feet he has only about a third remaining above him, and at 60,000, only a tenth. Indeed, at the latter elevation the total intensity of the radiation is about 100 times the sea level value, the exact amount depending on the latitude and on the surrounding material, for any biological specimen would require a considerable amount of surrounding matter to survive at 60,000 feet. The intensity at most of our cities at high altitudes in the West is 4 or 5 times the sea level value. At La Paz, Bolivia, where over 100,000 persons live at elevations of between 11,000 and 13,000 feet, and at the mines, such as Morococha, Peru, where the whole community lives at nearly 15,700 feet, the radiation may approximate 10 times the sea level value. The word "approximate" is essential, for the effect of surrounding material is considerable. High-altitude mines, where tunnels provide place for controls subject to much-reduced radiation, would appear to be the ideal location for experiments on biological effects of the radiation. The intensity at each station would have to be determined, in order to enable the effect of surrounding matter to be assessed, but this measurement is fortunately not difficult.

Figge correctly cites the effect of lead plates in providing concentrated matter in which shower production is accentuated, so that below these plates there is more intensity than above, providing that by intensity one means a flux, or number of rays per square centimeter per second. If one means energy, then the statement is not true, for the total energy below the lead plate is less than that above by the amount of the energy absorbed in the lead. Thus, below the plate there are more particles, but each has a lower energy than those above. Biologists might find that the low-energy rays are more effective biologically than high-energy rays, for they are, on the average, more ionizing and lose more energy—and perhaps have more biological effect—per centimeter of path through the specimen.

The effect of surrounding matter is of the greatest importance. The astonishment on the face of a colleague who brought a cosmic-ray shower counter indoors and noted the considerable increase in number of showers indoors will always be a lesson in point. Inside a complex structure like a building, conditions are not uniform and in general not calculable, but again the intensity is readily measured.

Neutrons and protons are produced (S. A. Korff and E. T. Clarke. *Phys. Rev.*, 1942, **61**, 422) by the cosmic radiation. The number, energy distribution, and subsequent history of these particles depends on the altitude and on surrounding matter. Possibly these particles may contribute to biological effects.

Finally, a word should be said about normal radioactive contamination. Often half the total ionization produced at sea level is produced by local contamination. Unfortunately, local radiation varies from place to place and from day to day, depending on meteorology and other factors. Even if a biological specimen received no cosmic radiation, it is another problem to shield him from local rays. Local radiation can be reduced to a low value by a 10-cm. lead shield, but in the case of biological experiments this shielding is never complete, due to contamination of the specimen, his food, the container, and the air. If such radiation can penetrate a few centimeters of lead, it can certainly also produce some biological effects, and this would have to be taken into account. Again, the amount of local contamination is readily measured.

The results of the experiments reported by Figge are interesting and important and should be continued. Techniques exist whereby the intensity, either in flux or in energy, of the radiation can be measured, as can the amount of local contamination. Possibly this has already been done, but it was not so stated in the paper, and without this additional information it is hard to evaluate the results, or even to be certain that the results were attributable to cosmic rays and not to local contamination. (S. A. Korff, *New York University.*)

**Chromatographic studies** showing the presence of $\alpha$-aminobutyric acid and methionine sulfoxide in urine have been reported in a recent communication by C. E. Dent (*Science*, March 28, p. 335). The quantity of these metabolites excreted was increased after methionine administration; hence it was concluded that they were derived from methionine. The fact that methionine can be oxidized to the sulfoxide *in vivo* and, under certain conditions *in vitro*, leads him to question the validity of analytical procedures for the determination of methionine in urine by oxidation reactions ($H_2O_2$, etc.).

As the author of such an analytical procedure (A. A. Albanese, J. E. Frankston, and V. Irby. *J. biol. Chem.*, 1944, **156**, 293), the writer was naturally deeply concerned about this last suggestion and undertook to check his procedure in order to ascertain whether, in fact, aeration of the urine under these conditions would result in a loss of methionine by oxidation. It was found that prolonged aeration for 24 hours caused no appreciable reduction in the methionine content of urines or solutions of pure dl-methionine. The fear expressed by Dent would thus appear to be unwarranted. (Anthony A. Albanese, *New York University College of Medicine.*)