note that no amount of reason seems to have had the same eloquent effect on the nation as the 6,000 poisoned sheep in Utah, the missile sites lowering the tone of suburbia and (perhaps) Mr Hughes's earthquake-threatened real estate.

PARTICLE PHYSICS

All Types of Interactions

from a Correspondent

THE Institute of Physics and the Physical Society held a conference on elementary particle physics at Cambridge on March 26–28. Discussing experimental aspects of strong interaction physics at high energies, Dr D. R. O. Morrison (CERN) presented results of the first total cross-section measurements made at the 70 GeV proton synchrotron at Serpukhov (USSR). These data can be used to predict the results of future experiments using 200 or 300 GeV accelerators. At lower energies, where differential cross-sections for elastic scattering have been measured with great accuracy, a quark model seems to be the easiest way to explain the results, although other theories can be modified to fit the data. In many-body reactions, some results, such as the finding that transverse momenta are always small, have been known for some time, but more detailed analyses of the experimental data have been prevented by an inability to separate kinematical effects from the real physics. The multiperipheral Reggeized model has at last made it possible to carry out realistic calculations of the kinematical effects and to remove them before plotting the experimental results.

Strong interactions at lower energies were discussed by Dr J. J. Thresher (Rutherford Laboratory), talking about meson and baryon resonances. Reviewing the evidence for baryon resonances with positive strangeness (the so-called Z*s), he concluded that there is no strong case for the existence of these objects, which are difficult to fit into the quark model or SU(3) symmetry schemes. The latest phase-shift analyses of pion–nucleon scattering contain evidence for some twenty resonant states, some of which might, however, be due to systematic errors in the comparatively few experiments on which the analyses are based. Triple-scattering experiments should be carried out to confirm the present solutions. It will also be necessary soon to decide whether discovery of new resonances should continue to be given priority over establishing the detailed properties of those already known to exist.

The most important concept in theoretical strong interactions during the past year has been "duality". For some time, high energy scattering has been understood in terms of the exchange of Regge poles (particles the spin of which varies with energy). The duality hypothesis states that if the Regge amplitude obtained from high energy scattering is extrapolated to lower energies it will represent some kind of average over the resonant cross-section which exists there. Professor D. Amati (Orsay, France) and Dr R. J. Eden (University of Cambridge) both considered duality at some length and concluded that, while a great deal of theoretical work has been stimulated by the idea, it is still very difficult to make sufficiently precise predictions for meaningful comparison with experiment.

Professor E. Lohrmann (Deutsches Elektronen-Synchrotron, Hamburg) discussed electromagnetic interactions. The vector dominance model assumes that in photoproduction the incoming photon turns into a vector meson before interacting with the target via the strong interaction. Relations can be obtained connecting photoproduction cross-sections with those for similar reactions induced by vector mesons (which can only be inferred indirectly because of the short vector–meson lifetimes), and these relations are well satisfied by recent results from Hamburg, Cambridge (Massachusetts) and Stanford. Photoproduction cross-sections for pseudoscalar mesons fall off with increasing incident energy, in a similar way to those for two-body reactions involving strong interactions.

Dr G. L. Manning (Rutherford Laboratory) presented evidence that CP violation is definitely established by the $\pi^+\pi^-$ and $\pi^0\pi^0$ decay modes of the long-lived K^0 meson, although the strength of the violation in the latter decay mode remains in some doubt. The superweak theory made definite predictions, some of which agreed with experiment, while the position of others was less clear. Dr P. K. Kabir (Rutherford Laboratory) discussed the question of time-reversal invariance in K^0 decays. Present experimental uncertainties meant that invariance could not be quite ruled out, though violation was very probable.

COSMIC RADIATION

Origin of Gamma Rays

from our Astronomy Correspondent

LAST year's report of high energy gamma rays associated with the Galaxy and of some surprisingly strong far-infrared radiation are linked by two papers in *Physical Review Letters*. The papers, by R. Cowsik and Yash Pal of the Tata Institute of Fundamental Research, Bombay (**22**, 550; 1969), and by C. S. Shen of Purdue University, Indiana (**22**, 568; 1969), say that the infrared radiation may be the cause of the gamma rays. The mechanism is the inverse Compton effect, by which collisions with electrons increase the energy of photons, turning infrared photons into gamma rays. Thus much of the energy of the gamma rays comes from electrons, which must originally have been high energy cosmic rays.

Both the discoveries which the two papers link were published last year, the high energy gamma rays by G. W. Clark, G. P. Garmire and W. L. Kraushaar in *Astrophysical Journal Letters* (**153**, 203; 1968) and the far-infrared radiation by Kandiah Shivanandan, James R. Houck and Martin O. Harwit in *Physical Review Letters* (**21**, 1460; 1968). The gamma rays were discovered by the OSO 3 satellite, launched in 1967 and carrying a detector sensitive to energies greater than about 70 MeV. According to results compiled during thirty-six weeks of 1967, there was a large increase in counting rate corresponding to the plane of the Galaxy, and a maximum in the direction of the galactic centre. Clark and his colleagues obviously found it hard to account for the observed intensity, which according to rough calculations is twenty-five times what might be expected through interactions between cosmic rays and the interstellar medium.

If anything, the report of the far-infrared radiation is less definite, although Shivanandan *et al.* say they have