lengths as great as 8,000 km, produce a topography of the sea surface. This leads to problems in geodesy because of the reliance on mean sea level as a reference datum for elevation. Mather indicated ways of solving this problem by using the precise radar altimeters in the satellites of the forthcoming EOPAP project. If confirmed and when mapped on a global scale, the topography of the sea surface will provide information for predicting ocean currents—a potential boon for more economic navigation of commercial shipping.

J. D. Boulanger (Institute of Physics of the Earth, Soviet Academy of Sciences) tackled the complex problem of the observed variations in gravity with time, and the interpretation of these data in terms of, for example, tectonic processes occurring within the Earth's interior. Yet, according to Boulanger, significant data on this point are scanty. So he proposed an international programme for studying the precise variation of gravity with time throughout the world. He described a 10-yr programme being established in the Soviet Union with a network of gravimetric stations of high precision in the territory of Eastern Europe and the west of the Asiatic part of the Soviet Union.

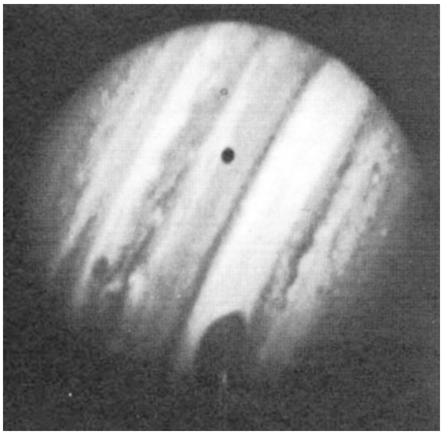
The network will be based on Sèvres, near Paris. Sevres has been chosen by the Russians because, Boulanger said, this is the only place where an absolute result for a rate of change of gravity with time has been obtained. The experimenter responsible for this result, A. Sakuma (Bureau Internationale des Poids et Mesures) described the determinations of absolute gravity made by his team; the precision of their measurements is almost one part in 10^9.

Pioneer 10 exceeds expectations

THE remarkable pictures of Jupiter received from Pioneer 10 are alone sufficient to ensure that the mission is remembered as a success, even without data from the other experiments on board the spacecraft. It will take some time for details of these data to emerge; but the simple fact that Pioneer 10 passed unscathed through Jupiter's magnetosphere is itself enough to require understanding of the planet's radiation belts to be rethought.

Most astronomers expected the spacecraft to suffer some damage when it encountered energetic particles trapped in the Jovian magnetosphere, and some suggested that the experiments and telemetry would be rendered completely useless. But a few voices suggesting the opposite view were raised, and two papers in the issue of *Science* dated December 7 (four days after Pioneer 10's closest approach to Jupiter) show the extremes of opinion which co-existed before the spacecraft's encounter with the planet. Stansberry and White describe (*Science*, **182**, 1020; 1973) a model of the trapping of electrons and protons from the solar wind by the magnetic field of Jupiter which implies very high particle densities in the radiation belts, reaching levels 100 times greater than those used in the design of Pioneer 10. "This indicates", they said in the paper, "that there is a significant chance of radiation damage to the spacecraft".

Clearly, they were wrong. And a clue to just how their calculations were in error comes from a study by Hess, Birmingham and Mead (*Science*, **182**, 1021; 1973) of the effect of Jupiter's satellites on the particle fluxes in certain parts of the Jovian magnetosphere. Three of the Galilean satellites, in particular, turn out to be very effective in limiting the fluxes of energetic protons and electrons diffusing inward. Ganymede, Europa and Io all produce "precipitous" drops in the flux, so that the average flux in the plane in which these satellites lie "should be about a factor of 100 less than . . . if there were no absorbing moons". Hess and colleagues suggest that "This may be enough to prevent serious radiation damage to the spacecraft", and it now looks as if they were right.



Jupiter's red spot, a shadow of the Moon Io and Jupiter's cloud structure are shown in this photograph taken on December 1 as Pioneer 10 was about 2,500,000 km (1,580,000 miles) from the planet.

The importance of this, of course, extends beyond the satisfaction of having an idea proved right. It seems clear from the success of Pioneer 10 that spacecraft can approach fairly close to Jupiter without being severely damaged, and the presence of a satisfactory theory to account for the low particle fluxes encountered by the spacecraft suggests that similar low flux conditions will be encountered by other spacecraft following suitable trajectories. The need for close encounters is two-fold: first, it enables spacecraft to take full advantage of Jupiter's gravity in directing them on to Saturn and the other gas giants; second, with the present state of the art a Jupiter rendezvous mission, leaving a spacecraft in orbit around the planet, can only be achieved by firing the spacecraft's motors when it is deep in the Jovian gravitational well. So Pioneer 10 has lived up to its name by showing the way for future missions to the outer reaches of the Solar System.

Code of practice for radiation protection

from a Correspondent

A MEETING in London on November 14 was arranged jointly by the British Institute of Radiology and the Hospital Physicists' Association to provide a forum for discussion of the requirements and implementation of the 1972 revision of the Code of Practice for the Protection of Persons against Ionising Radiations arising from Medical and Dental Use.

The morning session was concerned with the main provisions of the new code and difficulties in its interpretation. J. Cole (Dudley Road Hospital, Birmingham) reviewed the steps leading to the present revision following the publication of the first edition of the code in 1957. He pointed out that the basic policy in formulating the code was "to set out the basic principles, and to give general guidance on good practice".

H. Miller (University of Sheffield) described the changes in the scope of the code and the general protection measures required. He said that the wording of the new code was more precise and the conditions for both essential and desirable requirements had been clarified.

G. M. Ardran (University of Oxford) and S. K. Stephenson (Christie Hospital, Manchester) then outlined the changes in the code relating respectively to the medical and physical aspects of diagnostic radiology. The relative responsibilities of the clinician and radiologist in reducing patient exposure were mentioned in relation to the problems of implementing the '10-day rule' for avoiding irradiation of unsuspected pregnancies. Stephenson enumerated some of the twenty-five new obligatory requirements in the code; he felt that reduction of patient dose was the area where improvements could be made.

The measures for increasing protection in radiotherapy were examined by T. J. Deeley (Velindre Hospital, Cardiff); again a more positive identification of hazards was evident in the new code. Leakage radiation from therapy equipment and diaphragm systems were unsatisfactory features leading to unnecessary patient irradiation.

That the section of the code dealing