news and views

Meteorites which 'bounce' off the Earth

Bright fireballs shooting across the sky are often reported in the press. Meteorite collectors become very excited by these reports because careful analysis of the sightings enables them to calculate the trajectory of the incoming particle and to predict the impact point. The brilliant meteor observed over the western United States and Canada in the early afternoon of August 10, 1972 (see page 449 of this issue of *Nature*) however, would have disappointed them because it did not fall to ground but, in fact, 'bounced' off the Earth's atmosphere and flew off into space again. But it did not disappoint Rawcliffe of the Aerospace Corporation, Los Angeles or Barthy, Li, Gordon and Carta of Aerojet Electrosystems Corporation, Azusa who fortunately had a satellite-borne near-infrared radiometer in orbit over the United States at that time and detected the radiation from the meteorite. The meteorite path was found to have a perigee of 58 km, and, by assuming that all the loss in kinetic energy was transferred to thermal radiation from the meteorite, these workers found its mass to be 10^9g. Assuming it to have the density of iron, its equivalent diameter turns out to be 4 m.

From the ground (see *Sky Telesc.*, **44**, 269; 1972) it was seen as a blazing ball of fire, a metallic bluish-white in colour (like a carbon arc or welders torch) moving slowly ($\sim$15 km s^{-1}) across the sky, leaving behind a train which persisted for about an hour and looked rather like a smoke trail. The brightness of the fireball was intermediate between that of the Sun and the full Moon, the apparent magnitude being roughly -18.

Fortunately meteorites of mass 10^9g are uncommon—recent flux estimates indicate that one should hit the Earth every 10 to 20 yr. If this meteorite had hit the ground it would have produced a crater with a diameter of about 200–300 m. The failure of this meteorite to impact, however, is a much rarer occurrence and can only happen to the larger meteoroids (mass greater than a few grams). The 'bouncing' meteoroids enter the atmosphere almost tangentially and an estimate can be made of their frequency by comparing the cross-sectional area of the Earth plus its atmosphere with the area of an annulus of thickness one scale height ($\sim$ 7 km) surrounding the Earth at the height of the meteor region (100) km). This indicates that only 0.2% of the meteoroid flux will bounce, the remaining 98.8% falling to ground.

Rawcliffe *et al.* are not the only scientists to have recorded a 'bouncing' meteorite. On November 11, 1968 a camera mounted on the payload of a 'Hibal' balloon at 31 km above Queensland, Australia photographed a tangential meteor trail. Bigg and Thompson (*Nature*, **222**, 157; 1969) concluded that this meteorite consisted of four sizeable pieces of solid material together with a vast number of tiny dust particles.

It is thought that the effects of grazing meteorites have been observed by the micrometeoroid detector on the HEOS 2 Earth orbiting satellite. Hoffmann, Fechtig, Grün and Kissel (COSPAR, Konstanz 1973) report that this satellite from time to time encountered localised dense swarms of micrometeorites. These swarms were produced, according to Kaiser (University of Sheffield), by the fragmentation of grazing meteorites.

Returning to the report by Rawcliffe *et al.* it would be interesting to see estimates of the amount of energy lost by the meteorite due to frictional drag in the atmosphere. At 58 km, the meteorite perigee, the mean free path is about 0.02 cm and a shock wave could possibly have been produced. If this had occurred, the meteorite would have lost energy to atmospheric turbulence and the authors estimate of its size would have to be reduced. Only one of the ground reports recorded any sound. This was from an observer in British Columbia, where the meteorite was leaving the atmosphere, who reported a faint rumbling 2 to 3 minutes after it had disappeared. D.W.H.

Light and plant disease

The effect of light on the predisposition to, and subsequent manifestation of, virus diseases in plants has been studied for many years. Bawden and Roberts (*Ann. appl. Biol.*, **34**, 286; 1948) found that plants grown for long periods at low light intensity or subjected to periods of darkness before inoculation were more predisposed to virus infection and often produced more primary local lesions and/or became systemically infected, and thus diseased, in a shorter time.

Virus-infected plants often show more severe systemic diseases when grown in poor light, though subsequent work has shown that many viruses multiply more rapidly in plants that are grown at their optimum light intensity and photoperiod. Shorter photoperiods immediately after inoculation can reduce or delay local lesion formation, whereas high humidity often enhances the development of symptoms in infected plants (Yarwood and Fulton, *Methods in Virology*, **1**, 237; 1967).

Kirkham, Hignett and Ormerod reported recently (*Nature*, **247**, 158; 1974) that the response of cucumber plants to the inoculation of a virus was reduced by interrupting daylight with intermittent 2 min periods of darkness. The authors suggest that the reduction in the formation of local lesions on the inoculated plant was the result of a change in the hormonal complex within the plants. This change could have been stimulated by the intermittent dark periods, especially as the total time of light and dark were equal in all experiments so that the amount of photosynthate was equal in all plants.

Kirkham *et al.* did not, however, study the numbers of virus particles colonising the plants and multiplying within them. Nor was any observation made later to record total numbers of local lesions formed. Thus there is no information on whether interrupting daylight has an effect on initial colonisation of the plant by the virus or whether formation of local lesions was merely delayed and not inhibited. The effect of intermittent lighting on the multiplication and translocation of the virus or the subsequent systemic disease that this virus induces in cucumber was not mentioned.

The East Malling workers studied one virus in one plant and related the plant responses to those induced by two fungal pathogens in other plants growing in conditions of intermittent light. The hypothesis that plant hormones, stimulated by the intermittent light, influence plant disease responses does not take into account the many other physiological systems within plants that are photosensitive and