fragmentation and destruction, rather than any new crater. Whether or not the elastic limit of rock could be attained remains wholly conjectural.

Lunar comet impacts and terrestrial nuclear explosions differ by so many orders of magnitude in mass, energy, as well as temperature (quite apart from different gravity and absence of atmosphere around the Moon) that scarcely any valid conclusions can be drawn from their comparison. On the other hand, to postulate the occurrence of hundreds of thousands of major meteor impacts on the Moon without simultaneous consideration of the collisions with comets would be so grossly at variance with the present frequencies of both types of bodies as to make little or no astronomical sense. As the meteor impacts on the Earth or the Moon must be accepted as facts, and their effects traced, the same must be true of the comets; and if lunar maria are not the results of such encounters, what else have comets done to the Moon?

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Low-Energy Corpuscular Radiation at High Latitudes

IN high latitudes, at altitudes of order 100 km., a flux of electrons (50–90 keV.) dependent on latitude has been detected[1]. Protons of energy up to at least 90 keV. appear in auroræ[2]. I propose an explanation of this observed high-latitude corpuscular radiation on the basis of an acceleration mechanism discussed by Bohm and Gross[3].

This mechanism involves travelling (electron) electrostatic waves satisfying the dispersion relation:

$$V^2 = \frac{w^2}{K^2} = \frac{4\pi ne^2}{mK^2} + \frac{3kT}{m}$$

where V = phase velocity of the wave; w = angular frequency of the wave; K = wave number of the wave; n = electron density; e,m = charge, mass of electron; k = Boltzmann's constant; and T = temperature of region. Charged particles can be trapped[4] between the potential crests of such a wave and carried with velocity V, which increases as the wave is propagated into regions of increasing electron density.

Bohm and Gross[4] showed that electrostatic waves are infinitely damped as their wave-number approaches the lower limit $2\pi(kT/\pi^2ne^2)^{1/2}$. Hence, their band of allowable frequencies is given by:

$$\frac{4\pi ne^2}{m} \leqslant w^2 \leqslant \frac{4\pi ne^2}{m}\left(1 + \frac{3\pi}{4}\right)$$

From this it is seen that the maximum possible penetration of an electrostatic wave generated in a region of electron density n is to one of electron density $\left(1 + \frac{3\pi}{4}\right) n$.

I suggest that electrostatic waves are generated in the exosphere by solar corpuscular streams. The waves are propagated along the geomagnetic field lines, trapping charged particles and accelerating them down to levels where the electron density has increased by at most a factor $\left(1 + \frac{3\pi}{4}\right)$. At these levels the energy of the waves will have been fully converted to kinetic energy of particles moving down along the geomagnetic field lines.

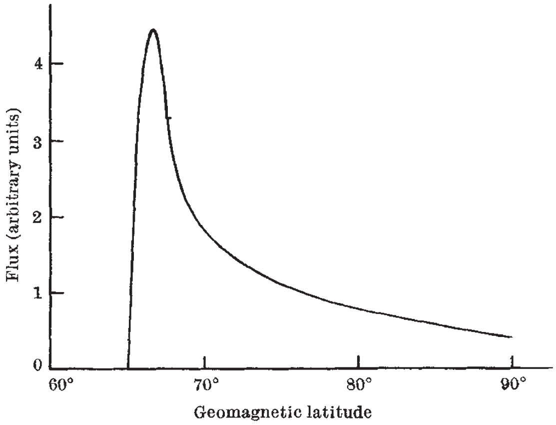

Fig. 1. Calculated variation with geomagnetic latitude of the flux of low-energy corpuscular radiation at the Earth

For purposes of calculation it is assumed that the electrostatic waves are generated at a spherical surface of radius 6·5 Earth radii and the trapping and accelerating region to be a spherical shell one Earth radius thick. Further, the flux of accelerated particles is assumed to be proportional to the volume of their trapping and accelerating region.

The calculated variation of accelerated particle flux with geomagnetic latitude is then of the form illustrated in Fig. 1. This closely fits the observations of Van Allen[1] for electron flux and resembles the latitude distribution of auroræ[5].

An estimate follows of an upper limit of the mean absolute flux, F, of accelerated protons (or electrons) at the Earth's surface. It is assumed that the energy of solar particles captured by the exosphere is fully converted to energy of electrostatic waves and then to energy of trapped particles. Hence, ignoring the kinetic energy carried by electrons:

$$sV_0\pi\alpha^2 \times \tfrac{1}{2}mV_0^2 = F \times f \times 4\pi a^2 \times \tfrac{1}{2}mV_1^2$$

where s = number density of protons (or electrons) in the solar particle stream, V_0 = velocity of solar particles, α = radius of spherical surface at which electrostatic waves are generated, m = proton mass, f = fraction of Earth's surface on which accelerated particles are precipitated, a = radius of Earth, V_1 = velocity of accelerated particles.

Taking $s = 10$ cm.$^{-3}$, $V_0 = 10^8$ cm. sec.$^{-1}$, $V_1 = 10^9$ cm. sec.$^{-1}$, $\alpha = 6\cdot5\,a, f = 0\cdot1$ (polar regions) leads to $F \approx 10^9$ cm.$^{-2}$ sec.$^{-1}$. This might be compared with the value 6×10^7 cm.$^{-2}$ sec.$^{-1}$ inferred by Chamberlain[6] for the flux of protons in auroræ and the value $10^6 - 10^8$ cm.$^{-2}$ sec.$^{-1}$ from Van Allen[1] for the flux of electrons.

From the above dispersion equation it is seen that this discussion is untenable unless $T \leqslant \frac{mV_0^2}{3k}$ in the particle-trapping region. For $V_0 = 10^8$ cm. sec.$^{-1}$ then we must have $T < 20{,}000°$ K.

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