SOLAR WIND AND THE MAGNETOSPHERE, AURORAE, POLAR CAPS AND MAGNETIC STORMS

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Abstract: It will be shown that during an impact of solar-wind particles of aurorae and polar caps need not be of extraterrestrial origin, that they need not have come from the Sun through the Earth's tail, which is just on the opposite side.

The mechanism derived in the author's previous report (Woyk, 1976), which dealt with the effect of combined magnetic and gravity fields on the trapping of exploded plasma streams and their further development, will now be applied to the processes in the terrestrial magnetosphere.

It has been pointed out (results A4, B6, and C of the report mentioned previously) that particles of extremly high energies are often trapped by a relatively thin shell of toroidal form, which apparently looks quite immobile. In the terrestrial magnetosphere these are the van Allen belts in which the magnetic field is nearly dipole, $n=3$. The motion of the particles inside the belt is governed by formulae (1—12) of the report mentioned earlier; this means they are valid between any two adjacent collisions.

In an undisturbed magnetosphere approx. $n=3$. If, however, a solar wind occurs, its impact on the magnetosphere brings about a squeezing of the uppermost parts of the atmosphere, the diameter of the "magnetic tubes" becomes smaller, and the intensity H of the magnetic field increases there. Hence, the variation of H with the radius-vector r proceeds slower, and n varies from 3 towards 2. But, when n decreases, the magnetic mirrors sink, the plasma particles precipitate downward, and this is then observed as an aurora (particles from the van Allen belts) and polar caps (particles rather from the Earth's tail), etc. The deformed magnetic field lines, as well as the matter in it, begin to oscillate and this is observed as a magnetic storm.

It looks as though the "magnetic tubes" have pushed their inner matter from regions squeezed more by the impact towards regions which have been squeezed less.

At the beginning of the aurorae some discrete streams could appear. They originate from discrete field lines along which the plasma density is higher (known from whistler propagation). Later, the mean magnetic mirror of all magnetic tubes sink much deeper than before, producing twisting auroral draperies and other phenomena.

Polar caps rather tend to result from the squeezing of the Earth's tail, so that they occur later and look different.

After the impact has ceased, n increases from smaller values to the equilibrium stage with $n=3$, the magnetic mirrors rise to their initial altitude, and the observed phenomena slowly vanish. The auroral and polar cap particles have again been absorbed by the van Allen belst and by the region close to the Earth's tail.

References

WOYK-CHVOJKOVÁ, E. (1976): This volume.