ORIGINS OF

Magnetospheric
Physics

JAMES A. VAN ALLEN

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*To Alex Hessler,
with admiration
and best wishes,
Jim Van Allen
7/13/94*

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Note Van Allens almost
complete disregard of
theory. My paper w/
Vestine showed his
measurements were off
by ~ $10^6 - 10^8$. It
was some time before
he corrected it, and
the first acknowledgement
of the theoretical problem
is here, at the bottom of
p. 102. Van Allen wanted
to discover with minimum
attention to ~~can~~ any
← theory. Simpson likewise.
Simpson "assumed" a power law
for his measurements to
reproduce VA's findings —
but ~~took~~ no credit to VA.

2nd Example: I suggested he organize his data around the dip rather than the geographic equator. He refused.

↑

An example: Early on I was begging VA to state the angle between the Sun & his satellite. He would give only the geocentric distance.

The small magnitude of the currents in the + 15-v trap over the first part of the trajectory can only be interpreted by assuming that the flux of electrons with energies in excess of 200 ev in the region of the outer radiation belt does not exceed $2 \cdot 10^7$ (cm² sec)⁻¹. This result is in direct disagreement with the suggestion that the flux of electrons with energies E = 20–30 kev is larger in the region of maximum intensity of the outer radiation belt. The observed counting rate in experiments described in [Van Allen and Frank 1959a, b; Vernov et al. 1959b, 1961] was explained there by the production of X rays in the body of the container and the screens of the counters due to the impact of soft electrons (E = 20–30 kev). We suggest that the observed counting rate should be explained by a considerably smaller flux of much harder electrons. Associated results are

ter radiation belt the
r by several orders of
eld, and that the region of
s been found at 14,000 km
the diamagnetism of

he counting rates of the Geiger
f the outer zone at an altitude
nsity of (nonpenetrating) elec-
and an omnidirectional inten-
1×10^8 (cm² sec)⁻¹. Alter-
ional intensity of penetrating
n² sec)⁻¹, and the upper limit
s 1×10^2 (cm² sec)⁻¹ [Van
of Gringauz et al. was known
and relatively unconvincing
Russian language barrier and
of Soviet journals.
per of the Soviet workers was
f low-energy electrons along
sities of ~5 × 10² cm⁻³ (for
eratures in the range 10,000–
0 km and a fall-off by a factor
m to below their threshold of
ensity at a radial distance of
tion of what was later called
his work and that of Krassov-
ork than they deserved to be,
al gap between the American

A significant theoretical objection to the pure bremsstrahlung interpretation was also raised by Dessler and Vestine [1960], applying a basic theorem of Dessler and Parker [1959]. The latter authors had shown theoretically that the ratio of the total kinetic energy of trapped charged par-

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[handwritten note:]
I believe this is the only reference Van Allen made to my theoretical work. He studiously avoided theoretical inputs. Note is quote at top of P. 104, he makes no mention of the theory, although on p.104 he says it was "a reaction to these refutations.

alex Dessler

31 Jan 2018

ticles to the total volume integral of magnetostatic field energy external to the earth must be approximately equal to the ratio of the consequent (diamagnetic) depression of the equatorial surface field to the vacuum value of that field. During large magnetic storms the observed value of the latter ratio was known to be of the order of 300/30,000 or ~1%. On the reasonable assumption that this fluctuational ratio is of the same order of magnitude as the total value of the ratio, Dessler and Vestine concluded that the particle intensities required by the pure bremsstrahlung interpretation, if present throughout an assumed region of reasonable dimensions, were implausibly high and that the responses of my detectors must have been caused by penetrating electrons and/or penetrating protons.

I had no illusions about the speculative nature of the bremsstrahlung interpretation as stated in the original paper. But as an experimentalist, my principal reaction to these refutations was to redouble my efforts to determine the electron and proton spectra in the outer belt, as well as the inner belt, by observations of a direct and unambiguous nature. This point of view was expressed in the concluding paragraphs of my August 1961 invited discourse to the International Astronomical Union [Van Allen 1962]:
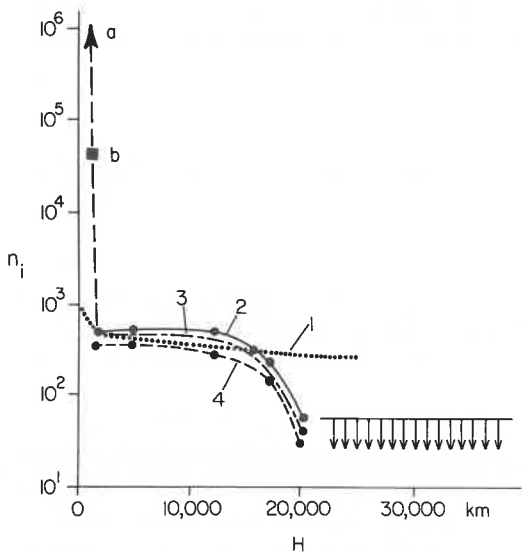
Fig. 36.   Number density of quasi-thermal ions as a function of altitude H *above the surface of the earth, observed with* Lunik II *[Gringauz et al. 1961a]. The curves labeled 1, 2, 3, and 4 correspond to various interpretations. Points a and b are from observations in the ionosphere at altitudes of 470 and 800 km, respectively, with* Sputnik III *[Gringauz, Bezrukikh, and Ozerov 1961]. One of the most significant features of these results is the discovery of the rapid decline of number density at an altitude of about 20,000 km, later called the plasmapause.*