



continue until the energy of the electrons was dissipated by collisions with other slower electrons and ions which normally inhabit the space above the earth.

The experiment bore out the theoretical predictions of Christofilos in a beautiful manner and provided scientific information of great value about conditions surrounding the earth. The electrons were observed by means of four counters in the satellite Explorer IV, which had been prepared with this experiment in mind. The counting rate was transmitted by radio to microlock and minitrack stations on the ground and recorded on tapes.

Many other observations in connection with the experiment were made near the launching site and also near the so-called "conjugate point" to determine the effect of the phenomenon on the ionosphere. Not all of these results are yet available. A significant check on the Explorer IV data was provided by sounding rockets carrying radiation measuring apparatus. Three shots in all were fired from the USS Norden Sound, separated by a few days. The first was apparently low in altitude but the other two were placed as planned. The best observations were obtained from shot III.

Military Significance

A nuclear explosion in space produces three kinds of effects of military importance. The high energy radiation including particles from the explosion produces effects in space; the whirling high energy electrons generate radio noise; and the delayed radiation from the fission products can affect radio transmission.

All of these effects are matters of degree, depending on yield, location and geometrical considerations.

All of the effects are bounded by about 70° magnetic N. latitude. It is doubtful if any long-lived effects can be produced nearer to the pole than this limit.

The effects are also limited by the tendency of the pressure of the products of the explosion to "burst" the earth's magnetic field. Too large a nuclear explosion would expel the bomb debris through a temporary "crack" in the field.

Page 3 5
Copy 1 3

REPRODUCED AT THE NAUGHT D. R. ...



1. a. Effect in Space. The effect in space itself is of importance to apparatus such as satellites and ballistic missiles exposed to this effect. The high energy electrons generate X-rays when they strike any material object; these X-rays are very penetrating and can damage electronic equipment. Of course, they are lethal to man in such quantities.

The experiment indicated that the KT bursts caused about one million electrons per second having energies greater than about 1 Mev to strike a square centimeter target for a period of several tens of hours. During the first few minutes, a much higher electron flux existed in the vicinity of the shot.

b. Duration. The duration of the effect is such that the electron counting rate decays two to one in about one day.

2. Radio Noise Effect. High energy electrons in a magnetic field radiate radio noise over a band extending from a lower limit below the broadcast band up to an upper limit typically in the region of one hundred megacycles.

The yield and altitude of the ARGUS experimental shot were so planned that the noise should not have been observed. The amount of noise is reliably predictable from the number of electrons of each energy and magnetic field orientation and therefore the experiment provides a basis for estimating the amount of noise produced by larger explosions.

3. Ionosphere Effects. Spots of greatly increased ionization several hundred kilometers across, at each end of the magnetic field lines passing through the shot, are formed at the top of the earth's atmosphere. These spots should exhibit radar reflections, intense auroral glow, and various effects on communications equipment. The experiment confirmed the existence of these effects and the data when fully utilized will permit an estimate of their military consequences.

Scientific Significance

The experiment provided a great deal of information of scientific importance.

[REDACTED]

Page 4 : 5
Page 1 : 3

REPRODUCED AT THE NAUGHT D. EISENHOWER LIBRARY



1. From the decay rate of the electron count, the density of the atmosphere at great heights above the earth can be inferred. The results so far seem to confirm the predictions that the "exosphere" is somewhat denser than had formerly been supposed, confirming recent clues from satellite drag data.

2. The experiment provides the first extensive experimental evidence concerning the structure of the earth's magnetic field above a thousand miles or so. The fact that the electrons emitted by the shot remained mainly confined to a layer about one hundred miles thick for two weeks shows that even 4000 miles above the earth the magnetic field is not unduly turbulent as some scientists had suspected.

3. Comparison of the man-made aurorae of the ARGUS experiment with natural ones may throw considerable light on the mechanism of those perplexing phenomena.

A. R. Killip

~~TOP SECRET~~
~~TOP SECRET~~
~~TOP SECRET~~
~~TOP SECRET~~

Page 5 of 5
Copy 1 of 3

REPRODUCED AT THE NATIONAL DEFENSE RESEARCH ESTABLISHMENT