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A REPORT PREPARED UNDER THE DIRECTION OF
THE PRESIDENT'S SCIENCE ADVISORY COMMITTEE
AND
THE IGY COMMITTEE OF THE NATIONAL ACADEMY OF SCIENCES

THE ARGUS EXPERIMENT

This report discusses the scientific [illegible] results and implications of the Argus experiments. Because of the fact that many of the experiments performed in connection with these bursts involved both the electron trapping phenomenon and classified military effects phenomena, it was considered advisable to keep the results classified until a proper sorting of the information could be accomplished. Since reports on relevant military aspects have only become available within the last two [illegible], it has not been [illegible] possible to release any of this information.

The scientific aspects of these experiments, involving [illegible] altitude, small atomic bursts over the South Atlantic in August [illegible] September 1958, are regarded by many participants as one of the [illegible] achievements of the International Geophysical Year. The [illegible] these experiments engaged the coordinated resources of a large [illegible] of the scientific talent of the nation, and it was apparent that [illegible] of the experiment, if successful, would be [illegible] by [illegible] the far-flung international network of the IGY. The [illegible] observational and interpretative contribution [illegible] the many [illegible] will doubtless stand as a durable milestone [illegible] development [illegible] knowledge of the great natural phenomena of the earth's [illegible] which have engaged his study for many [illegible].

The Christofilos Proposal

The underlying idea for the Argus experiments was [illegible] Nicholas C. Christofilos, physicist at the [illegible] Radiation Laboratories of the University of California [illegible] 1957 [illegible] to the fascinating physical effects which might be expected [illegible] atomic burst in the near-vacuum of outer space, high above the earth and its dense atmosphere. Of the various effects contemplated [illegible] interesting one promised to be the [illegible] trapping of [illegible] electrons at high altitudes in the magnetic field of the earth. [illegible] the burst there would be thrown off [illegible] mediate atomic weight. Most of these [illegible] radioactive and subsequently decay [illegible] electrons and gamma rays. Most of [illegible] minutes.

The fission fragments themselves [illegible] move at high velocity. Hence, their paths in the near-vacuum [illegible] of outer space would be controlled [illegible] by the earth's magnetic field and would be helical ones around magnetic lines of force. [illegible] electrons resulting from their decay would likewise move in helical paths in the magnetic field. In accordance with the theory [illegible] motions, which has been known and demonstrated in laboratories for many years, it could be expected that [illegible] high energy [illegible] would be trapped in the outer reaches of the earth's [illegible] would only slowly "leak" down into the atmosphere and [illegible] collisions with air molecules in the [illegible] upper atmosphere [illegible] trapping region would be in the form of a thin "magnetic [illegible] the earth and bounded by lines of force. Trapping times [illegible] minutes to weeks were estimated for electrons whose [illegible] ranged as close to the solid earth as [illegible] 2000 miles, [illegible]

The proposal of Christofilos [illegible] of other scientists and the idea [illegible] intensively [illegible] following months.

Meanwhile, the United States had succeeded in launching [illegible] IGY satellite, Explorer I, which had [illegible] primary purpose [illegible] of cosmic radiation in the vicinity [illegible] this satellite as well as those with [illegible] wards, led to the discovery of a [illegible] phenomenon [illegible] existence in the region around the earth [illegible] corpuscular radiation due to natural [illegible]

The first public report of this [illegible] and of [illegible] in terms of magnetic trapping wa[illegible] May 1, 1958, at [illegible] symposium of the National Academy [illegible] and the [illegible] Physical Society. The report was [illegible] with his colleagues of the State [illegible] had [illegible] carried out the experiments.

The existence of the natural [illegible] all validation of the proposal of [illegible] the problem of whether observati[illegible] injection of electrons would be p[illegible] "background."

Initiation of [illegible]

The fate of the entire enterprise [illegible] Science Advisory Committee sin[illegible] involved a mixture of scientific [illegible] interests [illegible] of the President's Science Advis[illegible] group [illegible] tatives of the scientific communit[illegible] defense [illegible] brought together to apprais[illegible] in latter April 1958 to proceed wit[illegible] experiment [illegible] national undertaking. The operat[illegible] the project was vested in the new [illegible] Research [illegible] of the Department of Defense. In his [illegible] Chief [illegible] Herbert York directed the progra[illegible]

The Air Force Special [illegible] of a series of high altitude sound[illegible] fringes of the expected effect at [illegible] about 300 [illegible] five-stage solid propellant rocket [illegible] NACA. The Air Force Cambridge [illegible] Center [illegible] Research Institute develope[illegible] of equipment at suitable ground st[illegible] The difficult mission of delivering [illegible] high altitude and detonating them [illegible] South Atlantic Ocean was undertak[illegible] organized for the purpose.

Explorer IV

Meanwhile, the Academy's [illegible] was planning [illegible] vigorously further studies of the Van Allen radiation belts [illegible] revealed by Explorers I and III. To secure more detailed [illegible] the Van Allen radiation belts, and to observe any artificial [illegible] from the proposed Argus experiment, instrumentation [illegible] designed and developed at the State University of Iowa. [illegible] rockets of the type developed by the [illegible] the Jet Propulsion Laboratory of the California Institute [illegible] had already been scheduled as sa[illegible] program was the launching of Ex[illegible]

Conduct of Argus Experiment

On July 26, 1958, Explorer [illegible] inclined at a 51° angle with the [illegible] perfectly, immediately began transmitting valuable [illegible] the nature, intensity and distribution [illegible] inclination orbit proved to be a distinct advantage over [illegible] used 34° inclination orbits due to [illegible] greater [illegible] Meanwhile, the new observing stations [illegible] being set up [illegible] task force was enroute to the designated [illegible] Preliminary sounding rocket flights [illegible] Island in Virginia, Ramey Air Force [illegible] Air Force Base in Florida.

Bursts occurred on the 27th [illegible] of August [illegible] hours and on the 6th of September [illegible] time. In order to produce an electron shell having [illegible] it was desirable to minimize the [illegible] calculations showed that this could [illegible] the shell between longitude zero and [illegible] the fact that the earth's magnetic axis [illegible] to its rotational axis, so that the [illegible] the surface at these longitudes [illegible]

Because of the small yields [illegible] bursts, there was no fallout hazard [illegible]

A fascinating sequence of [illegible] was obtained [illegible] initial flash of the burst was [illegible] auroral luminescence in the atmosphere [illegible] along the magnetic line of force [illegible] taneously at the point where this [illegible] atmosphere in the northern hemisphere [illegible] near the Azores islands, a bright [illegible] was observed from aircraft [illegible] the event, and the complex series [illegible] time in history measured geophysical [illegible] were being related to a quantitative [illegible] into the earth's magnetic field [illegible] energies at a known position and [illegible]

The diverse radiation instruments [illegible] reported to ground stations the [illegible] shell of high energy electrons [illegible] the bursts. The satellite continued [illegible]

man-made shell of trapped radiat[illegible]
The physical shape and position of [illegible]
and the decay of intensity was observed. [illegible]
bution of the radiation was measured at each point. [illegible]
of a selected magnetic shell of the earth's magnetic field was [illegible]
plotted out for the first time by experimental means. [illegible]
excursions within this shell the trapped electrons were [illegible]
distances and were following the magnetic field pattern [illegible]
of over 4,000 miles. The rate of decay of electron density [illegible]
of altitude provided new information on the density of the [illegible]
atmosphere since atmospheric scattering was the dominant [illegible]
for loss of particles. Moreover, continuing observation [illegible]
of the shell served to answer the vital question as to the [illegible]
of trapped particles transverse to the shell. All of these [illegible]
of essential importance in a thorough understanding of [illegible]
the natural radiation and were now [illegible]
of the "labeled" electrons released [illegible]

Throughout the testing period [illegible]
altitude sounding rockets was carried [illegible]
valuable results in the lower fringe [illegible]

Explorer IV continued to observe [illegible]
from the Argus tests, making some [illegible]
exhaustion of its batteries in latter September, [illegible]
the intensity had become barely observable above the background [illegible]
natural radiation at the altitudes [illegible]

It appears likely, however, that the deep space probe [illegible]
detected a small residuum of the Argus [illegible]
December 6, 1958. But the effect [illegible]
before the flight of Pioneer I on [illegible]

The site of the Argus tests was [illegible]
injected radiation shell in a region [illegible]
radiation had a relative minimum. [illegible]
either higher or lower latitudes, the [illegible]
difficult to detect, plot and follow [illegible]

The immense body of observations [illegible]
pretation by a large number of persons [illegible]
now are satisfactory accounts becoming available from [illegible]
scientists. From these observations [illegible]
examples:

There was no diffusion of [illegible]
electron shell since the thickness [illegible]
constant. Also, traces of the [illegible]
days and possibly weeks.

Extrapolations of the earth's [illegible]
which have been based on [illegible]
confirmed by the experiment. [illegible]
it possible to predict the shape [illegible]
field with considerable accuracy [illegible]
order of several earth's radii.

The directness and clarity of the [illegible]
provided a sound basis for interpretation of the natural [illegible]
around the earth. It is likely that [illegible]

continue to arise from the great diversity of geophysical [illegible] being conducted by other countries participating in the [illegible] Geophysical Year.

The IGY group of the National Academy of Sciences plan[illegible] with its other programs, to make the scientific results of Expl[illegible] available as rapidly as analytical procedures permitted. [illegible] progress made by experimenters and analysts, the Academy [illegible] more than a week ago to arrange for a presentation of su[illegible] at its annual meeting on April 2[illegible]