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James C. Hagerty, Press Secretary [illegible]

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THE PRESIDENT'S SCIENCE ADVISORY COMMITTEE
AND
THE IGY COMMITTEE OF THE NATIONAL ACADEMY [illegible]

THE ARGUS EXPERIMENT

This report discusses the scientific [illegible] results and implications of the Argus experiments. Because [illegible] that many of the experiments performed in connection with the [illegible] bursts involved both the electron trapping phenomenon and classified military effects phenomena, it was [illegible] advisable [illegible] results classified until a proper sorting of the information [illegible] accomplished. Since reports on relevant military aspects have [illegible] become available within the last two weeks, [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 [illegible] achievements of the International Geophysical Year. The [illegible] these experiments engaged the coordinated resources of a [illegible] of the scientific talent of the nation, and it was apparent that [illegible] of the experiment, if successful, would be recorded by instruments [illegible] the far-flung international network of the IGY. The [illegible] observational and interpretative contributions [illegible] will doubtless stand as a durable [illegible] knowledge of the great natural phenomena [illegible] which have engaged his study [illegible]

The Christofilos Proposal

The underlying idea for the Argus experiments was [illegible] Nicholas C. Christofilos, physicist [illegible] Radiation Labora- tories 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 [illegible] 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] fragments [illegible] mediate atomic weight. Most of these [illegible] radioactive and subsequently decay [illegible] electrons and gamma rays. Most [illegible] minutes.

The fission fragments themselves [illegible] electrically [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 a laboratory [illegible] for many years, it could be expected that [illegible] high-energy [illegible] would be trapped in the outer reaches of the earth's magnetic [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 shell" [illegible] the earth and bounded by lines of force. Trapping times ranging [illegible] minutes to weeks were estimated for electrons whose [illegible] ranged as close to the solid earth as [illegible] to 2000 miles [illegible]

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

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

The first public report of this discovery and of its interpretation in terms of magnetic trapping was [illegible] May 1, 1958, at [illegible] symposium of the National Academy of Sciences and the American Physical Society. The report was given by James A. Van Allen [illegible] with his colleagues of the State University of Iowa, had [illegible] carried out the experiments.

The existence of the natural trapped radiation [illegible] all validation of the proposal of Christofilos. At the same [illegible] the problem of whether observation [illegible] injection of electrons would be possible in the presence of the [illegible] "background."

Initiation of Argus Experiment

The fate of the entire enterprise [illegible] Science Advisory Committee since it was clear that the [illegible] involved a mixture of scientific and military interests. At the [illegible] of the President's Science Advisory Committee, a group of represen- tatives of the scientific community and the defense community [illegible] brought together to appraise all aspects of the matter. [illegible] in latter April 1958 to proceed with the Argus experiment as a [illegible] national undertaking. The operational and technological [illegible] the project was vested in the new Advanced Research Projects Agency of the Department of Defense. In his capacity of Chief [illegible] Herbert York directed the program for that agency.

The Air Force Special Weapons Center undertook [illegible] of a series of high altitude sounding rockets for the study of the fringes of the expected effect at altitudes of about 500 miles [illegible] five-stage solid propellant rocket vehicle that had been [illegible] NACA. The Air Force Cambridge Research Center and the [illegible] Research Institute developed, located [illegible] of equipment at suitable ground stations and aboard aircraft [illegible] The difficult mission of delivering three small-yield atomic [illegible] high altitude and detonating them [illegible] South Atlantic Ocean was undertaken by a Navy task force specially 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 Army Ballistic Missile Agency [illegible] the Jet Propulsion Laboratory of the California Institute of [illegible] had already been scheduled as satellite vehicles. [illegible] program was the launching of Explorer IV.

Conduct of Argus Experiment

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

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

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

A fascinating sequence of [illegible] was obtained [illegible] initial flash of the burst was [illegible] faint but [illegible] auroral luminescence in the atmosphere extending upward [illegible] along the magnetic line of force through the burst point. [illegible] taneously at the point where this [illegible] returned to the [illegible] atmosphere in the northern hemisphere [illegible] so-called "magnetic [illegible]" near the Azores islands, a bright [illegible] appeared [illegible] was observed from aircraft present [illegible] the event, and the complex series [illegible] began [illegible] time in history measured geophysical [illegible] were being related to a quantitative [illegible] into the earth's magnetic field of a [illegible] quantity of [illegible] energies at a known position and [illegible]

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

(over)

man-made shell of trapped radiat[illegible]
The physical shape and position o[illegible]
and the decay of intensity was obse[illegible]
bution of the radiation was measure[illegible]
of a selected magnetic shell of the [illegible]
plotted out for the first time by experimental means. [illegible]
excursions within this shell the trapped ele[illegible]
distances and were following the magnet[illegible]
of over 4,000 miles. The rate of decay [illegible]
of altitude provided new informatio[illegible]
atmosphere since atmospheric scattering [illegible]
for loss of particles. Moreover, [illegible]
of the shell served to answer the [illegible]
of trapped particles transverse to [illegible]
of essential importance in a thorough [illegible]
the natural radiation and were now [illegible]
of the "labeled" electrons release[illegible]

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

Explorer IV continued t[illegible]
from the Argus tests, making som[illegible]
exhaustion of its batteries in latter [illegible]
the intensity had become barely [illegible]
natural radiation at the altitudes [illegible]

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

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

The immense body of observa[illegible]
pretation by a large number of pers[illegible]
now are satisfactory account[illegible]
scientists. From these obse[illegible]
examples:

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

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

The directness and clarity of [illegible]
provided a sound basis for interpre[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 planned [illegible] with its other programs, to make the scientific results [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 [illegible] at its annual meeting on April [illegible]