Communicating Science in the Sputnik Era

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I hereby certify that this material, which I now submit for assessment on the programme of study leading to the award of Master's Degree by Research, is entirely my own work and has not been taken from the work of others save and to the extent that such work has been cited and acknowledged within the text of my work.

Signed: Tom Walsh ID No.: 99145219

Date: 31/10/01

Abstract

This research reveals the means and methods by which US and Soviet space physicists -- specifically the US team headed by James A. Van Allen and the Soviet team headed by Leonid Sedov -- were able to communicate and share theories, information and data during 1957-59, the earliest days of the "space race". This research shows that, despite US-Soviet political polarisation, suspicion and mistrust, these scientists established and sustained formal and informal communication strategies that allowed them to work cooperatively as an international space science community while exploring a "common frontier of ignorance". It is the author's conclusion that such communication was possible only as a direct result of personal and professional commitments by these scientists to ensure that science took precedence over politics, despite a Cold War and a heated arms race. Research methods included multiple personal interviews with Van Allen and extensive correspondence with Soviet space physicist Yuri L. Galperin. This research also involved extensive documentary review of primary source materials archived within the James A. Van Allen Papers and Related Collections of the University of Iowa Archives in Iowa City, Iowa, in the United States. This research reveals how these American and Soviet scientists established and maintained ongoing, direct and indirect channels of communication.

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Father Christmas, Western Union and the CIA

Well buried within the thousands of documents that constitute the James A. Van Allen Papers at the University of Iowa Archives is a brightly coloured holiday greeting card. The card is carefully die-cut so that, as it unfolds, it spills forth a scene of Father Christmas (in Russian, *Ded Moroz*) on a sled amid children, elves and animals dancing and playing in pine forest bathed in snowfall. Its printed greeting, in Russian, says: " *S novim Godom!* " Hand-scripted is the English translation of the same sentiment: "Happy New Year" (Van Allen Papers [VAP] Box 209 Folder 1 [209:1]).

The undated holiday greeting card, mailed from Moscow over 40 years ago to US space physics pioneer James A. Van Allen, is signed "Yu. I. Galperin". It was a personal greeting from Yuri L. Galperin, a space physics researcher within the U.S.S.R. Academy of Sciences' Institute of Physics and the Atmosphere. An experiment Galperin helped to develop was carried into space on May 15, 1958, aboard Sputnik III and contributed to the discovery of low-energy trapped electrons in the Earth's upper atmosphere (Galperin e-mail).

An equally curious document within the Van Allen papers is a copy of a Western Union telegram dated May, 18, 1960, and addressed to Professor Leonid I. Sedov, then president of the International Astronautical Federation and a prominent academician within the international space physics community. "Respectfully request telemetry code of new Sputnik", the telegram's message reads. "Will forward our magnetic tape recording to you if you wish". The message wired to Moscow was signed: J. A. Van Allen, State University of Iowa, Iowa City, Iowa USA (VAP 209:1).

A third telling document is a hand-written note attached to a simple business card and a typewritten list of questions. The note is dated September 11 and was written in 1959, soon after Van Allen returned to his laboratory on the University of Iowa campus from a space physics conference in Moscow. “Your secretary tells me that today is not the day to see you”, the note begins. “I came by to check on whether you had written your ‘trip report’ as of yet. ... If it is not written, we would be grateful if you could consider the enclosed questions when you prepare it”.

The typewritten list includes 10 questions, each seeking specific, detailed information about the “scope and quality” of “cosmic ray research in the Sino-Soviet Bloc countries”. The questions ask Van Allen to identify scientists and institutes involved in Soviet space research. One question also asks Van Allen to “note any incidents in which the Soviets appeared to be evasive or secretive about any of the aspects of their work”.

The hand-written note is signed “Scott Cohen”, the same name that appears on the simple business card, which shows a Chicago phone number and a Lake Shore Drive address in Chicago (VAP 209:8).

“He was CIA”, Van Allen said in a July 2000 interview. “Or at least that was my presumption”. This September 1959 visit by the CIA to Van Allen’s laboratory was not the first -- nor the last -- interaction between Van Allen and the American intelligence community, which was always eager to learn whatever it could about the Soviet space effort (J. Van Allen interview).

Collectively, these three documents capture the spirit -- as well as some of the realities -- of efforts by US and Soviet space scientists to communicate cooperatively as an international space science community. Their efforts to exchange insights and information about common research interests were complicated -- and in some cases precluded -- by US-Soviet political polarisation during the earliest days of international space exploration. Long-established, non-governmental, international scientific organisations, under the umbrella of the International Geophysical Year (1957-58), had proposed elaborate mechanisms for collecting and sharing scientific data, findings and theories about the earliest space science experiments involving rockets and satellites. But, in reality, many of these proposed informational exchange strategies would never be realized, at least not those associated with the earliest US and Soviet satellite missions.

Politically, space physics research involving rockets and satellites was about much more than science. With both the US and the USSR using adaptations of their most sophisticated ballistic missile systems to put space physics experiments into orbit, the earliest satellite launches were shrouded in secrecy and plagued by cumbersome limitations on exchange of information. It was a situation that prompted American and Soviet space scientists to devise and to rely upon their own strategies for professional collaboration.

In the earliest days of space science (1957-59), Van Allen and his Soviet colleagues relied on makeshift channels of communication built on personal and professional relationships. They communicated through papers presented at international conferences or published in long-established, international scientific journals. They discussed their work during politically sensitive visits to one another's laboratories. Infrequently, they met face-to-face and exchanged closely-monitored correspondence. More frequently, in their efforts to understand what each team was learning about the nature of the universe, they relied on translations of stories clipped from newspapers like *Pravda* and *The New York Times*.

"The possibility of doing things with satellites and rockets was a byproduct of military developments", Van Allen said in a July 2000 interview. "And it was always ambiguous whether what we were doing was classified of not. There was a haze of ambiguity that hung over our work. There was a fair level of security, and we were always strictly constrained in talking about the performance of our rockets and the telemetry and electronics involved. We were constrained as a matter of national policy. It was just understood that there were certain things not to be discussed -- the launch and delivery system -- and it was sort of an honor system" (J. Van Allen interview).

"Frontiers of ignorance"

In 1957, the year of Sputnik, scientists knew very little about the atmosphere surrounding Earth beyond a distance of a few hundred miles. What little was known was based on data collected by Van Allen and others, using basic instruments tethered to high-altitude weather balloons or carried to high altitudes by crude rockets incapable of breaking free of the Earth's gravitational pull. Scientists knew even less about the solar system and the other planets, their knowledge limited to best-guess interpretations of fuzzy images collected by Earth-bound telescopes. Only 50 years ago it was widely believed that there were seasonal changes on Mars related to some form of plant life. Some scientists were convinced there were civilised life forms on the red planet, while others envisioned Venus, always shrouded in clouds, as a planet of foggy swamps (Park 73-74).

With both the personal and professional demands of World War II behind them, James A. Van Allen and other space physicists worldwide were eager to get on with the business of learning all they could about the earth's outer atmosphere. Both in the US and in the Soviet Union, rocket vehicles originally engineered as weapon delivery systems were being adapted to scientific research as Van Allen and his Soviet counterparts began defining a new branch of scientific inquiry: space science.

"Space science is not a professional discipline in the usual sense of that term as exemplified by the traditional terms astronomy, geology, physics, chemistry and biology", Van Allen wrote in 1990:

> Rather it is a loosely defined mixture of all these fields plus an exotic and expensive operational style. The distinctive features of space science are the use of rocket vehicles for propelling scientific equipment through and beyond the appreciable atmosphere of the earth; the rigorous mechanical, electrical, and thermal requirements of such equipment; and (usually) the remote control of the equipment and the radio transmission of data from distant points in space to an investigator at a ground laboratory (Van Allen 1).

In 1946, while on terminal leave from the US Navy, Van Allen worked as a physicist at the Applied Physics Laboratory first established by Johns Hopkins University in 1942 in a large, rented Chevrolet garage in Silver Spring, Maryland. The laboratory's work then extended to the fields of cosmic rays, the solar ultraviolet spectra, high-altitude photography, atmospheric ozone and ionospheric currents. Among Van Allen's tasks were initiating and supervising development of a high-performance sounding rocket, the Aerobee (Van Allen 13).

Designed exclusively for scientific purposes, the Aerobee soon joined the German-designed V-2 rocket as a basic vehicle for high-altitude research (Burrows 63). Between 1946 and 1951, payloads of scientific instruments were carried aloft by 48 V-2s and 30 Aerobees. While most were launched from the White Sands Proving Grounds in New Mexico, Van Allen organised a series of successful Aerobee-firing expeditions aboard the *USS Norton Sound* as it traversed the Pacific Ocean between the Gulf of Alaska and the Equatorial Pacific, allowing high-altitude data to be collected at various geophysical locations.

The entire effort was overseen by a group called the "V-2 Rocket Panel" (later renamed the "Upper Atmosphere Rocket Research

Panel" and, still later, the "Rocket and Satellite Research Panel"). Beginning in the early 1950s, members of the panel became instrumental in promoting the concept of a 1957-58 International Geophysical Year (IGY) and in actively encouraging the use of scientific satellites of the earth as an important -- and, at that point in space physics research, unprecedented -- component of the IGY program (Van Allen 14).

"It is important to understand the context of the times", Van Allen, then 85, said in a July 2000 interview:

> In the late 1950s, the whole effort to use rockets and satellites for atmospheric research was well organised as an international effort in which the Soviets were active. Despite the Cold War situation, this was being done through non-governmental cooperation. The International Geophysical Year was a collaboration between national science academies and individuals. Our National Academy of Sciences was the primary participant for the US, but it was not a part of the federal government.
>
> We and the Russians had a common understanding of the state of the scientific field in which we were working. It was no surprise to me, or to anyone else I imagine, that we were doing the same things (in terms of research). We shared a frontier of ignorance about the upper atmosphere.

"More and more uncertain..."

Just how much there was to be learned about the physics of the upper atmosphere is blatantly apparent in a May 2, 1946, book-length report by Project RAND -- then active within the engineering division of the Douglas Aircraft Company in Santa Monica, California. Entitled "Preliminary Design of an Experimental World-Circling Spaceship", the report was commissioned by the US Navy and Major General Curtis E. LeMay, then deputy chief of the air staff for research and development. The first appendix of the report, written by G. Grimminger, is entitled "The Upper Atmosphere".

"In evaluating the performance of a very high altitude vehicle, such as that described in this report, it becomes necessary to have values for the physical properties of the upper atmosphere at extremely high altitudes, which heretofore were of little interest to the aeronautical engineer", Grimminger wrote:

> Conditions in these high altitude regions have received some attention, both theoretical and experimental, in the past 20 or 25 years by a relatively small number of investigators. However, the present knowledge of the physical state of the upper atmosphere is far from complete, and as will become apparent in the course of the discussion, at the high levels there is quite some differences of opinion as to what the conditions are; at still higher levels there are practically no data or opinions available at all. In short, the knowledge of the atmosphere becomes more and more uncertain and speculative with increasing altitude. ... In general, workers in the field appear to be in fair agreement as to the atmospheric properties from sea level up to 60 miles altitude. Above this altitude the knowledge and agreement is [sic] much less definite (Douglas 1-A).

The summary of this 1946 feasibility study, which was researched and written under a three-week deadline, concludes "modern technology has advanced to the point where it now appears feasible to undertake the design of a satellite vehicle" (Douglas i). The study's abstract goes on to put a pricetag of $150 million on the process of designing, constructing and launching a "satellite vehicle". The study further predicts "such an undertaking could be accomplished in approximately five years time" (Douglas viii).

Under that time line, the Douglas Aircraft Company was suggesting the United States could launch an earth-orbiting satellite in 1951 -- six years before the task would become the historic accomplishment of the Soviet Union.

The Dinner Party Origins of IGY

The idea for the 1957-58 International Geophysical Year emerged from a small dinner party held at Van Allen's home in Silver Spring, Maryland, on April 5, 1950 (Sullivan 20). Van Allen and other geophysicists in attendance attributed the idea to Lloyd V. Berkner, the scientist who subsequently spent years organising the international effort. Berkner's idea was both simple and profound: the common study of Earth by all nations for the benefit of all of mankind. The IGY would extend from July 1, 1957, through December 31, 1958. It was an 18-month time period selected to correspond with an anticipated period of maximum sunspot activity expected to generate geomagnetic "storms" that disturb the Earth's outer atmosphere.

It was an ambitious programme that would eventually attract the participation of some 60,000 scientists from 66 nations, working at observation stations established, literally, from pole to pole. After the fact, IGY would be described by one of its chief American architects, Hugh Odishaw, as "the single most significant peaceful activity of mankind since the Renaissance and the Copernican Revolution" (Sullivan 4).

The basic concept of an IGY was hardly new. In 1882-83 scientists from 11 nations collaborated in a scientific enterprise known as the International Polar Year. Its purpose was to study the geophysics of earth's polar regions, specifically the Arctic and its weather. The 11 nations involved mounted expeditions that established polar meteorological, magnetic and auroral observation centres that collected data for 12 to 13 months (Chapman 95).

The first International Polar Year was the 19th Century outgrowth of efforts begun in the 17th Century to create national academies of science that would promote the progress and prestige of scientific inquiry (Chapman 94). Visits and “friendly correspondence” linked this small network of national academies and their members to facilitate international exchange of scientific knowledge. Of particular interest was the earth’s magnetic field, as fluctuations played havoc with the mariner’s compass. Efforts to understand the earth’s magnetic changes prompted the formation of an international “Magnetic Union” under the guidance of Carl Friedrich Gauss, the German mathematician, astronomer and physicist. Magnetic observation stations established in several locations throughout the world recorded observations using a common methodology. While this effort continued only for a few years, it represented an important precedent in international scientific cooperation and data exchange.

Like magnetic fluctuations, weather affected maritime traffic as well. Throughout the 19th Century, one country after another in Europe and North America created weather services to observe, record and predict weather. As such services grew in number, their directors began to meet at occasional conferences, which resulted in international coordination of instruments and methods of observation. This standardisation resulted in a network of observing stations using organised means and codes for easy and quick interchange of meteorological information (Chapman 95).

The first International Polar Year was an extension of this co-operative weather research. “At first most of these weather services were in the countries of Europe and North America”, wrote Chapman, who would serve as president of the international committee that would organise the 1957-58 IGY. “Their domains surrounded the almost unknown Arctic region. It was natural to believe that this region might seriously influence weather changes in the surrounding countries. Hence it was judged important to study the weather over this region -- despite difficulties of access and inhospitable conditions. (It was) for this reason the conference of directors of weather services organized an enterprise called the International Polar Year" (Chapman 95).

Over the next 30 years, cartographers, seismologists and astronomers began organising their own international organisations. These groups sponsored and coordinated research requiring global observations. World War I (1914-18) disrupted many of these early international attempts at scientific cooperation. After the war an International Research Council was created by the national science academies of the victorious nations under language that excluded scientists of the defeated nations. The Council sponsored several "international scientific unions" covering a variety of scientific fields, including astronomy, geodesy, geophysics, radio science, seismology, meteorology, terrestrial magnetism and electricity, oceanography, volcanology and hydrology. Other unions were created for geography, pure and applied physics, pure and applied chemistry, biology and the history of science (Chapman 95).

The exclusionary nature of these unions was eventually addressed when the International Research Council was transformed in 1931 into a new organisation, the International Council of Scientific Unions (Sullivan 25). The various unions under its sponsorship removed exclusionary statutes, but many of the once-excluded scientists remained bitter, with some of their excluded national academies refusing to affiliate with the new Council.

Between World Wars I and II, the newly organised International Meteorological Organization took the lead in renewing the International Polar Year enterprise of 1882-83. A Second International Polar Year was organised for 1932-33 -- the 50th anniversary of the inaugural endeavor. The scope remained largely unchanged -- weather and magnetism -- with the important addition of observations of the Arctic ionosphere, a highly "electrical" region of the earth's upper atmosphere that was unknown at the time of the first International Polar Year. Most scientific unions suspended their activities during World War II, but the organisations persisted. After the war the establishment of the United Nations resulted in creation of an inter-governmental organisation for the advancement of education, science and culture, namely the United Nations Educational, Scientific and Cultural Organisation (UNESCO). By contrast, the international scientific unions and their sponsoring body -- the International Council of Scientific Unions -- were non-governmental, though affiliated with national science academies worldwide.

Late in 1950, Sydney Chapman worked with Lloyd Berkner to pitch the concept of a "third Polar Year" to the Joint Commission on the Ionosphere, an organisational link to three scientific unions associated with astronomy, radio science and geodesy and geophysics. The Commission endorsed the plan and recommended the project to its three affiliated unions and the International Council of Scientific Unions, which ultimately adopted the resolution and appointed a special committee to organise the project. When invitations went out to national academies worldwide, there was little enthusiasm. After the project was widened to include a scientific study of the entire planet, not only Arctic regions, there was better response. In 1953 the special committee -- now known as CSAGI (an acronym taken from the French title of the committee -- *Comite Special de l'Annee Geophysique Internationale*) -- decreed that the International Geophysical "Year" would include 18 months, from July 1, 1957, through December 31, 1958.

As president of CSAGI, Chapman was among those concerned that, by August of 1953, the Soviet Union had not opted to participate. An overview of the IGY organizational effort to date appearing over Chapman's signature in the prestigious journal *Nature* ended with this plea for Soviet cooperation:

> But the enterprise will not be fully successful unless all the major nations of the scientific culture participate in it. For this reason, at the request of the Special Committee, the International Council of Scientific Unions has formally invited the renewal in this enterprise of the valuable and effective cooperation given by Russia to the First and Second Polar Years; and also has requested that the USSR should cooperate in encouraging other nations to take part that have not yet agreed to do so (Chapman 327).

The US National Committee for the IGY (USNC-IGY) was established in February of 1953 by the National Academy of Sciences/National Research Council (NAS/NRC). As of March 1954, 28 nations had signified their intent to participate, but not as yet the Soviet Union. In response to a proposal by IGY organisers on October 4, 1954, that governments worldwide use earth-orbiting satellites in space research during the IGY, The Soviet Academy of Sciences named a blue-ribbon commission to "organize work concerned with building an automatic laboratory for scientific research in space ..." (Caidin 70-71). On July 30, 1955 -- 26 months before Sputnik and one day after a similar American commitment -- Moscow committed the USSR to satellite launches during IGY, with Leonoid I. Sedov, chairman of the Soviet Academy's blue-ribbon commission, then predicting the first Soviet launch within two years. Eventually, 66 countries would participate in IGY, but not China due to political concerns about the independent participation of Formosa.

<u>The role of satellites</u>

In August of 1955, the proposed US program for the IGY was submitted by the US National Committee for the IGY in a report to the NAS/NRC. In the "satellite measurements" section of the report the US Committee spelled outs its intention to develop and launch "an earth-circling satellite vehicle" that would make long-term observations possible.

On page 68 of that same report, the US Committee makes clear its intent to share information about satellite launches and scientific instruments carried into space:

> The satellite vehicle will orbit above the earth at altitudes between 200 miles at perigee and perhaps 800 miles at apogee. In encircling the earth, it will be observable by many countries and from many IGY stations being established for the overall IGY program. In order to realize the greatest possible benefit from this undertaking, complete information about the orbiting vehicle and its instrumentation will be made available to the nations participating in the IGY program so that those countries can take part in the observation and use of it (VA 236:6).

In a speech delivered before the American Rocket Society in Chicago on November 16, 1955, Dr. Joseph Kaplan, chairman of the US National Committee for IGY, outlined the importance of rockets and earth-circling satellites to atmospheric research. Kaplan told his audience that the indirect observations of earth-bound space scientists left "much yet to be observed and learned" (VAP 236:6).

Kaplan predicted in his speech that during the IGY the US would fire "hundreds" of rocket-based research vehicles of the type developed by Van Allen, all in an effort to collect basic data inaccessible to ground-based experiments:

> "Lacking these data, for example, most existing theories on the cause and formation of the aurora, or the changes and fluctuations of the earth's magnetic field are very incomplete. Even in the case of the ionosphere there is, as yet, no

> completely satisfactory theory. . . . The relations between the aurora, ionospheric currents, high-altitude winds and observed fluctuations in the earth's magnetic field are still to be clarified. ... These examples indicate but a few of the many and complex problems in the high atmosphere awaiting solution. A fundamental purpose of the rocket IGY program is to shed further light upon such questions as these.

Those questions extended across a wide spectrum of disciplines, he said, including atmospheric structure and composition, radiation studies, particle studies, and ionospheric and geomagnetic measurement. Beyond rockets, Kaplan said, earth-circling satellites would allow long-term observations not possible with short-duration rocket flights. It was Kaplan, in fact, who coined the widely-used expression "LPR" -- Long Playing Rockets -- to describe earth-circling satellites. "The basic techniques for the launching and instrumentation of an artificial earth satellite are now available", he said some 23 months before Sputnik, "and it is planned to launch a number of such vehicles as part of the US IGY program". He went on to say that the executive committee of the USNC-IGY had proposed a "minimum" satellite program of 10 "instrumented birds, with the expectation that at least five of the birds will be successfully launched into their orbits, circulating about the earth for a period of about two weeks, at heights of about 200 to 800 miles".

Kaplan noted that availability of raw data from rocket and satellite observations during the IGY constituted much of the "value" of the research effort. "The reception by scientists of the 40 or more nations which will participate in the IGY of the news of the proposed US satellite was a warm one indeed", he said. "In part, this reception was based in the knowledge that the value of the observations made during the IGY would be enhanced greatly by the availability of the direct data obtainable only by rockets and satellites".

Communicating data

Early in the 17th Century, Francis Bacon is said to have asserted that "experiments in concert" represented the most effective way to comprehend the world around us. And the history of the two polar years and IGY represented a culmination of a growing awareness of the validity of Bacon's assertion (Sullivan 4).

The logistics of IGY project data collection and availability were a key component of the international purposes of IGY. As proposed, two IGY World Data Centres (WDC) were envisioned as repositories for data and results submitted by IGY research scientists worldwide. The US-based WDC would collect and disseminate original data from studies conducted in North, Central and South America, while the Moscow-based WDC would perform an identical function for all other regions. Both Centres would exchange data so that each could serve as a scientific archive of all IGY research data collected world-wide.

An August 9, 1956, USNC-IGY report on the proposed US IGY WDC contained this description of how the Centre would operate: "It will provide continuous indexing and cataloging services available to all interested scientists, so that the receipt or scheduled receipt of data will be known within the interested scientific community. Upon request, the Center will provide copies of all desired data to scientists of all countries in the Western Hemisphere." (VAP 239:4) The report said data formats might include film or magnetic tape, summary tables, and pre-prints and reprints of scientific articles and published volumes of compiled data summaries. Monthly or quarterly exchanges were seen then as a "realistic minimum average plan".

The US Centre, as proposed by NAS/NRC in 1956, would oversee operations of eight regional data centers, each branch staffed by specialists equipped with an archive of pre-IGY data. The organisational blueprint showed regional branches throughout the U.S. with close ties to long-established space physics research centres, including a long list of universities. The proposal called for these "recognized research institutions" to accept "responsibility for archive and cataloging services for each scientific field of investigation during IGY", thereby providing a "mechanism of world-wide exchange and reproduction of data, paper storage and facilities for visiting scientists".

In late September 1957, CSAGI convened a Conference on Rockets and Satellites in Washington, DC. Minutes of the proceeding of the working groups that met during this conference indicate a high level of interest and priority in sharing data and observations among the international space physics community (VAP 240:1).

The meeting of the CSAGI Working Group on Rocketry involved two sessions, the first on October 2, another on October 3. In attendance were scientists representing the US, the USSR, the UK, Canada, Japan, Australia, Peru and Ecuador. At the top of this Working Group's agenda was the issue of "interchange of rocket launching data" and "international exchange of instrumentation and personnel" (VAP 240:1).

Specifically, this Group reviewed and refined language pertaining to launch data submissions to World Data Centres on rockets fired during the IGY. As a template, the Group used a "flight information summary" developed by US scientists. The two-page form was designed to be completed by launching groups. The general information requested included identification of the rocket used; the time, date and location of the launch; the objectives of the launch; preliminary flight information; a description of equipment flown and ground-based equipment used in tracking and telemetry; and preliminary results.

After deletion of what the proceedings of the meeting termed "non-essential portions" of the form, Soviet delegate A.M. Kasatkin agreed to use of the form "in principle" but requested 24 hours to review the form before giving final consent. The next day, Kasatkin indicated agreement to the amended form, but announced that, while the USSR would comply fully with regard to launching of meteorological rockets, only information on experimentation and containers would be supplied for geophysical rockets. In other words, data provided by the USSR on its satellite missions would be limited.

The Working Group stipulated in its final resolution that data compiled on the flight information summary form for rockets fired during the IGY be forwarded to every country participating in the IGY's worldwide rocketry program. The resolution also stipulated that the information be provided "within two weeks after each rocket firing". The same data, the resolution said, would be sent to each of two proposed IGY World Data Centres, one housed within the Academy of Sciences in Moscow, the other at the National Academy of Sciences in Washington, DC.

A subsequent Working Group discussion on exchange of raw data and other information not requested on the amended form resulted in agreement that dissemination of such data "be left to the discretion of the launching group". The proceedings also note that "dissemination of all processed data, other than the preliminary information appearing on the form, was to follow the normal procedures of publication in scientific journals".

During the Working Group's discussion of international exchange of instruments and personnel, Kasatkin endorsed the concept of exchange of visits to laboratories and "instrument preparation locations" and indicated that visits to the Soviets' Franz Josef Land launch site would "probably" be arranged "but he had no information regarding the arrangement of visits to the other launching sites". Further discussion centred on the value of using such exchanges to standardise experimentation. According to the proceedings, "It was generally felt that this would be a desirable aim of such exchanges". Ultimately it was resolved that a working group be formed to establish the details of a plan for implementing such exchanges “with a view towards the eventual establishment of standard measurements and their accuracies”.

At the same conference, the Working Group on Satellite Vehicles, Launching, Tracking and Computation met in sessions that spanned three days, October 1-3. In attendance at one or more sessions were representatives of the US, the USSR, India, Cuba, Ecuador, Canada, Japan, the UK, Australia and Iran, as well as CSAGI officials. Among the resolutions unanimously approved was Resolution Two, which “recommends” that the US and USSR “make arrangements for the rapid dissemination of information on satellite orbits, both immediate data including single observations prior to the establishment of orbit and subsequent data in the form of orbital elements from which the orbit may be computed”. This resolution specifically recommends that the US send data to a global interchange network and to the USSR Academy of Sciences. It also recommends that the USSR send data to the same global interchange network and to the Smithsonian Institution’s Astrophysical Observatory.

At a meeting of the Working Group on Satellite Internal Experiments and Instrumentation Program, Dr. H. Friedman presented a summary of the US satellite internal experiments. On the subject of telemetry, UK representative W.T. Blackband noted that a USSR satellite was of particular interest as it would pass over the UK. Blackband “stressed the need” for making full technical details available in sufficient time to facilitate advance preparation. Specifically, Blackband asked both the USSR and the US to provide telemetry details that included the number of channels, the characteristics of each channel, the information contained in each channel, and the criteria for establishing the value of recorded data.

In response, the Soviet delegation announced that the first Russian satellite would carry 20 and 40 Mc/s transmitters, but that any decisions on frequencies to be used in subsequent satellite launchings would be based on the degree of success of the first satellites “and recommendations of this conference”. The USSR requested that the recommendations of the conference be supported by “detailed and specific reasons”.

Meeting the next day (Oct. 2, 1957), the Working Group adopted the following resolution: “It is highly desirable that there be an exchange of publications, technical data, and scientific instruments pertaining to satellites, and it is recommended to the National Committees of both the United States and the USSR that they draw up and present to each other their specific proposals for such exchange”.

Also adopted was a resolution suggesting that organisation of a small but “permanent” group on rockets and satellites would be “very useful” for “coordination and exchange of information during the IGY and after”.

A Soviet surprise

The Conference’s final session was convened on the morning of Saturday, October 5, 1957, within hours of those attending having learned of their Soviet colleagues’ successful overnight launch of Sputnik I. Many had been guests the night before at a reception hosted by the Russians in the ballroom of the Soviet Embassy in Washington, as had Walter Sullivan, the chief science writer for *The New York Times*. In the midst of the reception, a Soviet Embassy official told Sullivan he had a phone call. The call was from *The New York Times*’ Washington DC news bureau, wanting Sullivan to be aware that Radio Moscow had just announced the successful launch of Sputnik I.

“At the conference ... the Russians had said they would make no advance announcement of their first attempt,” Sullivan said in his 1961 book-length history and analysis of the IGY (Sullivan 1). “They told their American colleagues, almost in so many words, ‘We will not cackle until we have laid our egg’”.

Sullivan hung up the phone and found Lloyd V. Berkner, the American scientist serving as chairman of the committee overseeing IGY activities. Berkner silenced the room by clapping his hands loudly and told the assembled guests of the historic Soviet achievement. The irony of the Americans making the announcement to the Russians in their own embassy was not lost on Sullivan, nor likely the Russians.

Before Sputnik, Sullivan said, IGY had been little more to the public than a curiosity attracting occasional news coverage. "The effect of this launching was not to give a great boost to the IGY and its noble goals of international cooperation in science," he wrote. "Rather it sent a shudder through large parts of the world. The fact suddenly became inescapable that the largest nation in the world, geographically, was also the strongest in a field critical to war-making -- rocketry".

Berkner opened the conference's final session by noting the historic announcement of the Sputnik and introducing A.A. Blagonravov of the Soviet delegation, who described "pertinent facts" about Sputnik. "He stated that a polished sphere was used in order to facilitate visual observation. This first satellite, he said, contained only a transmitter and a power supply and had four antennas mounted in the outside. He predicted a life of about two weeks for the power supply" (VAP 240:1).

Though the launch itself may have come as a surprise, the Soviet satellite programme was well-known -- and long-known -- to the international space science community. Van Allen recalls attending a seminar in 1956 at the University of Michigan in Ann Arbor at which the subject of the scientific uses of satellites was discussed. He was also involved with the technical panel that invited, reviewed and ranked proposals for research experiments involving earth-orbiting satellites. "In the circles in which I operated", he said in a June 1999 interview, "the successful launch of an earth-orbiting satellite was pretty well anticipated. The big question was what are we going to do with them"?

The existence of an official Soviet space-flight programme can be traced to a 1953 statement by Soviet Academician A.N. Nesmeyahov, who as president of the Soviet Academy of Sciences was familiar with all aspects of Soviet scientific progress. In his November 27, 1953, address to the World Peace Council in Vienna, as reported in the November 28, 1953, edition of *Pravda*, Nesmeyahov said, "Science has reached a state at which it is feasible to send a stratroplane to the moon, and to create an artificial satellite of the earth." Later, when a team of Soviet scientists was organized to build a Russian satellite, it was hardly a secret; the news was broadcast on Radio Moscow (McDougall 60).

In fact, many of the same IGY scientists in attendance that Saturday morning had also attended the IGY conference a year earlier in Barcelona, Spain, from September 9-14, 1956. At that conference, the Soviet IGY delegation outlined its plans for a satellite in "great detail", according to Van Allen. The Soviet delegation said in Barcelona a launch date was uncertain, but only a matter of time.

"There was one of these IGY meetings in Barcelona in 1956, at which we described what we intended", Van Allen said in a July 2000 interview:

> I was the chairman of what I think was called the 'satellite working group'. I presented the plans that we had, the scientific programme that we had developed, and the Soviets did the same thing, including presenting their plans for artificial satellites. Vanguard (the name given to the early US satellite programme) was very open in terms of scientific intentions. In terms of launch vehicles, I knew we were trying and hoped we would succeed.
>
> The primary means of exchanging information with our foreign colleagues were extensive international meetings at which each country presented plans for

> what it intended to do. That's why I wasn't really shocked by the Sputnik launch. The Soviets had made presentations at these meetings where they announced their intentions, but no one knew when it would happen. It wasn't announced immediately prior to the launch.

Early in 1957 an article spread over two issues of the respected Soviet journal *Uspekhi Fizicheskih Nauk* ("Progress in the Physical Sciences") included a full description of the "scientific tasks ahead" in what would later be the launch of Sputnik III on May 15, 1958 (Galperin, correspondence). Three weeks prior to the Sputnik launch, the Kremlin used September 17, 1957 -- the 100th anniversary of the birth of Soviet aeronautics pioneer Konstantin Tsiolkovsky -- to promise the world that a satellite was coming soon. Now, it was here.

Dr. John P. Hagen of the US Naval Research Laboratory, followed Blagonravov to the lectern and told the Conference attendees that the Minitrack observing network had detected Sputnik on its third or fourth orbit, and that further efforts were being made to to track the satellite. The network, he said, had been designed to track at 108 Mc/s, but that some of the stations were quickly being modified to track at 40 Mc/s as well (40 Mc/s was one of the two frequencies satellite indicated by the USSR at the Conference four days earlier, during the Oct. 1 meeting of the Working Group on Satellite Internal Experiments and Instrumentation Program). Hagen played an audio tape of Sputnik's telemetered signal, which had been recorded overnight.

The President of the US National Academy of Sciences, Dr. Detlev Bronk, attended the final session to congratulate the Conference on its achievements and to congratulate the USSR National Committee on the successful Sputnik launch. Dr. Bronk closed his remarks with this statement: "All scientists are fellow explorers on the frontiers of knowledge, who rejoice and benefit in the discoveries and achievements of their colleagues. And so we of the United States rejoice in yesterday's great achievement of our Russian colleagues and applaud their success" (VAP 240:1).

"The rascals outdid us"

In retrospect, Van Allen notes that the successful launch of Sputnik I helped to jump-start the American satellite effort. "The Soviet success provided a great impetus for our work", he said in a June 1999 interview. "The notion of putting up a satellite seemed trivial (to the US government) until the Soviets did it".

At the time of Sputnik, he said, the US government was engaged in "endless analysis" of competing satellite programmes being overseen by the US Army and the US Navy. Much of the debate, he said, centred on which launch vehicle would be utilised in a satellite launch, with the focus on technology with intercontinental ballistic missile applications. Although the IGY activities in which Van Allen and thousands of other space scientists were involved were non-military efforts, he does recall US government "observers" quietly keeping tabs on IGY proceedings.

Nearly 50 years later, Van Allen still finds intriguing the extent of "public trauma" prompted by Sputnik I in the America and elsewhere. In the context of the Cold War, "in which people were afraid of everything", Sputnik became "the essence of international trauma", he said in 1999:

> Sputnik was perceived as a fearsome object, flying overhead every 90 minutes, an object belonging to our sworn enemy. It reinforced our apprehension and tension about the Soviet Union and the notion that we were being outdone by a backward nation. The general perception of Russia was a huge, heavily populated, primitive culture characterized by a low standard of living and a scarcity of the material things important to our culture -- refrigerators, cars. I think

> there was some respect for their military prowess as demonstrated in World War II, but they were seen as not being in the technical epoch we were. And then, suddenly, the rascals outdid us.

Ironically, a follow-on paper released nine-months after the May 2, 1946, release of the Douglas Aircraft Company feasibility study on "an experimental world-circling satellite" indirectly predicted the social and political fallout of the Sputnik launch. "Since mastery of the elements is a reliable index of material progress, the nation which first makes significant achievements in space travel will be acknowledged as the world leader in both military and scientific techniques", wrote Jimmy Lipp, then head of Project RAND's missile division and one of the paper's contributors. "To visualize the impact on the world, one can imagine the consternation and admiration that would be felt here if the United States were to discover suddenly that some other nation had already put up a successful satellite" (Douglas Cover 3).

<u>A "very great thrill!"</u>

To his considerable dismay, Van Allen was thousands of miles from the Conference on Rockets and Satellites in Washington, D.C., where many of his space physics colleagues first learned of Sputnik. He was in the Antarctic, aboard the *USS Glacier*, where he was busy overseeing observations of cosmic ray intensity, using "rockoons" -- rockets tethered to high-altitude weather balloons, a device of Van Allen's creation. "I was pretty charged up", he said in a December 2000 interview. "We were following the news as best we could. We were plugging away in the south Atlantic, and we were just in the dark, afraid we would be left out of the system".

Van Allen's unpublished, personal diary of the events of October 4-5, 1957, shows that his initial interactions with Sputnik were those of a scientist well-schooled in the art of direct observation.

Though his excitement is clear in logbook entries heavily salted with exclamation points, most of his efforts were directed at communicating directly with the world's first artificial satellite, deducing what he could about Sputnik from radio signals received onboard the *USS Glacier*. Those signals, he said, were remarkably strong. "It was a very strong signal. Sputnik was putting out watts versus the US intention to use milliwatts".

"Yesterday night -- the 4th -- and early this morning were very exciting for me (as well as for the civilized world in general)", he wrote in his logbook on October 5, 1957:

> Just before dinner time Larry Cahill told me that
> news was just coming in on the ship's news circuit
> that the Soviet Union had successfully launched
> a satellite. Factual details as follows:
> Inclination of orbit 65 degrees to the earth's equator
> Diameter 58 cm. Weight 83.6 kilograms (Wow!)
> Estimated Height 900 kilometers (Perigee or apogee?)
> Period 1h 35m
> Transmitted signal: 20.005 mc/sec
> and 40.005 mc/sec with switching alternately from
> one to the other -- spending about 0.3 sec on each
> frequency.
> Would pass over Moscow at 1:46 AM
> and at 6:22 AM on the 5th Moscow time.
> (Moscow is -3 zone time from Greenwich)
> or rather +21
> Our Ship's Position 5 (degrees) 30 (minutes) N 92
> (degrees) W +6 zone time.

Van Allen's logbook provides virtually a minute-by-minute, highly detailed account of his activities during that historic evening, which began on October 4, 1957, with dinner, followed by what he remembers as a "very poor movie".

> After dinner ... I went up to the communications shack
> to see if there was any further news available (about
> 2120 ship's time (+6). As I walked in to look at the

teletype machine a young radioman [David Armbrust RM 3/c] wearing a pair of earphones & hovering over one of the ship's communications receivers turned to me and said - 'I think I have it!' This was at 2120 or 03282 Greenwich time on the 5th of October.

I listened to the phones and heard a repetitive Beep-Beep-Beep-etc. of an audio frequency tone -- loud and clear. The r.f. frequency was very nearly 20.005 mc/sec. I had earlier considered using our Clarke receiver but recalled that 55 mc/sec was their lowest frequency. Then I briefly considered the ship's capabilities but (too hastily) discarded this possibility on the general impression that the signal would be quite weak a la US plans and that the ship's communications gear would be inadequate in basic noise level.

However Mr. John Gniewek (formerly B.A. from Syracuse Univ.), young civilian employee of the US Coast and Geodetic Survey, who was a passenger on the Glacier going to the Antarctic to operate a magnetometer station there for the coming year, had been up to the communications shack earlier and had inquired if they could receive it. Armbrust had started looking with first success at ~ 0320 Z. He had also run a receiver calibration and had been listening & searching assiduously for some minutes.

My first reaction was: Could it possibly be true that this was the satellite transmission? (not a spurious effect of some kind -- or something from W.WV at 20.000 mc/sec, etc.)

> At about this time Gniewek came up. He listened, also excitedly. It immediately occurred to me that we should make a recording! I thought of our Ampex in (the) rockoon lab but was somewhat discouraged of hauling it up to the comm. shack because of its weight and the way in which it was "built in" to Cahill's apparatus! I remarked on this to Gniewek! He immediately responded that he had a small magnetic tape recorder in his room which he could easily bring up. I said fine! and rushed down to our rockoon lab to bring up my small Tectronix (Type 310) oscilloscope to look at the signal visually.
>
> I first noted the time as 0329 Z on the clock in the comm. shack. Within about five minutes we were both in operation! I immediately found the following appearance on the scope.

Van Allen's logbook notes then include his sketches of the oscilloscope pattern. "This began to look conclusive", he wrote beneath the sketch. "I had never heard a similar signal before! Very great thrill!"

Van Allen's notes continue for pages, detailing the night's observational activities, both his own and those of others. Toward the end of the logbook entry is a section he entitled "Items" in which his astonishment at the Soviet milestone is clear. It includes the following notations:

1. Brilliant achievement !
2. Tremendous propaganda coup for USSR -- also coming during CSAGI Rocket & Satellite Conference i in Washington.
3. Vehicle must be ~ 184/22 = 9 times as heavy as Vanguard throughout if of same propulsive efficiency! ~ 100 times gross launching weight

(Also guidance accuracy!)

4. Confirms my disgust with the Stewart Committee's decision to favor NRL (Naval Research Laboratory) over the Redstone proposal of Sept. 1955 !!
5. May lead to intensified US effort -- our five year plan!
6. Causes me to be very sorry to miss the inevitable reconsideration & perhaps marked changes of the US program.
7. May be a genuine loss of opportunity for us at SUI [State University of Iowa] to assume a larger role in the future! By TWX news today the CSAGI proposed the setting up of an international committee of not to exceed six men for the coordination of rocket and satellite programs!
7. [sic] Very sensible choice of frequencies for ionospheric information and radio amateur interest.
8. Evidently rather high power. Probably Radiated Power ~ or > 10 watts. Perhaps as much as 100 watts.
9. Assume 10 watts & 50% efficiency = 20 watts consumed. Assume, out of total weight announced of 184 lbs. that 150 lbs. are batteries giving 40 watt-hr/lb = 6000 watt hr. or 300 hours of operation or ~ 2 wks operation! May have been solar batteries, though there has been no hint of this in the announcement and I judge their inclusion to be somewhat out of character with the simple, brute-force approach of the Russians!
10. ?? Where do we stand now on Vanguard?
11. The decision ~ 2 months ago to 'regroup' the Vanguard program and Townsend's hint in Cambridge of Security Council action = advance knowledge in U.S. of status of the Russian program!
12. The pompous character of the White House

announcements!

13. The feebleness of the optical approach to tracking to the radio approach strongly demonstrated as I have urged for some time.
14. 'Our' high-brow choice of 108 mc/sec and why weak signal out of reach of most amateurs and the average population.
15. The astute choice by U.S.S.R. of frequencies which literally millions of persons can hear directly!

Van Allen confirmed his shipboard observations with an October 5, 1957, cable from the *USS Glacier* to the IGY office in Washington, DC. In the cable message, Van Allen credits Radioman Third Class David Armbrust with the "discovery" of the Sputnik signals and indicates they were "confirmed and recorded" by Iowa scientists aboard.

Hardware exchanges proposed

Among the resolutions drafted amid the excitement of the CSAGI Rocket and Satellite Conference of Sept. 30-October 5, 1957, was this one: "It is highly desirable that there be an exchange of publications, technical data, and scientific instruments pertaining to satellites, and the Conference recommends to the National Committees of both the US. and the USSR that they draw up and present to each other their specific proposals for such exchange".

Within a few weeks of the Conference -- only 10 days before the US successfully launched Explorer I on January 31, 1957 -- an IGY working group developed a list of possible hardware exchange items, which included a US Aerobee rocket, a Soviet meteorological rocket and a short list of instruments, including spectrographs, magnetometers, satellite data links and solar power supplies in use and under development by both American and Soviet space scientists. Specifically, those items included:

USA items	USSR items
Aerobee rocket	Meteorological rocket
Mass spectrometer (NRL)	Magnetic magnotometer
Electron beam magnetometer (NRL)	Spectrographs, 30-300A & 600-500A with electronic telemetering
Satellite data links: recording and SUI counter Telemetering system	X-ray coronoagraph
Proton precession magnetometer	Proton precession magnetometer
Solar power supplies	Solar power supplies

In a letter written three days after the successful launch of Explorer I, Herbert Friedman, chairman of the IGY ad hoc committee on exchange of instrumentation, forwarded the list of proposed hardware exchange items to Hugh Odishaw, the executive secretary of the US National Committee for the IGY, encouraging him to "obtain approval of US Government authorities for the proposed exchange". In his letter Friedman notes that the upcoming CSAGI Conference scheduled for August 1958 in Moscow "will offer an excellent opportunity to implement the CSAGI exchange resolution" (VAP 240:1).

Friedman notes in his letter that "The Russian delegation to the CSAGI Conference indicated a definite interest in obtaining items listed in the USA column below". Van Allen said in December 2000 that, to his knowledge, no hardware exchange ever occurred.

Curiously, one American scientist attending a space physics conference in Leningrad in November of 1957 -- a month after Sputnik I -- brought home a small piece of Soviet space hardware, quite by chance. Herb Friedman, a pioneer of radio astronomy affiliated with the US Naval Research Laboratory, was en route to the conference when Sputnik II was launched on November 3, 1957. Upon his arrival he asked his Russian hosts about the instruments on board, and they took him to a trade fair where a cutaway replica of the satellite was being displayed. The instruments, he saw, included a tape recorder, a radio transmitter and two glass Geiger tubes used to detect radiation. Friedman made a note of the tubes' serial numbers.

The next day, while wandering the streets near his Leningrad hotel, Friedman passed a store that sold laboratory equipment to schools. He noticed in the window a Geiger tube identical to the one in the Sputnik II cutaway. A clerk inside the store said the tube was in stock. Friedman bought two for one ruble and put them into his coat pocket after the clerk wrapped each in newspaper. Upon his return to the US, he was questioned by a naval intelligence agent about what he had learned while in Russia of Sputnik II. The CIA, Friedman was told, had learned nothing. Friedman found his coat and retrieved the Geiger tubes from his pocket, still wrapped in pages from *Pravda*. The astonished agent promptly borrowed them (Park 74).

"Too general to be workable"

Nine months into the space race, the international space science community gathered in Moscow for the fifth meeting of the CSAGI held from July 31 to August 9, 1958. According to a report prepared by William W. Kellogg of the RAND Corporation, the "most urgent matters" involved "the organization of programs for international cooperation which would continue the work of the IGY in many fields of geophysics" (VAP 237:3).

The meeting also represented the first review of geophysical and astrophysical research by US and Soviet satellites. By then, the Soviets had successfully launched three Sputniks, while the US had successfully launched three Explorer satellites and Vanguard

I. At the meeting 77 scientific papers were presented. Twelve of those papers were selected for publication in *The Journal of Planetary and Space Physics*, and all eventually appeared in the *Annals of the IGY*.

At the meeting, the CSAGI Working Group on Rockets and Satellites continued its efforts to finalise a plan for international coordination of research and the efficient and rapid exchange of observations and results. Among the nations actively represented in the Working Group were the US, the USSR, the UK, Japan, Australia and South Africa.

The results were, according to Kellogg, not entirely successful:

> Although some progress was made in obtaining a better understanding of the achievements and aims of the various programmes in each of the countries represented, (acting) Chairman (Dr. Homer E.) Newell (Jr.) was forced to admit, in his address to the closing plenary session, that the international agreements which had existed were too general to be workable, and that the Working Group had not been able to arrive at more detailed agreements in the area of rocket and satellite research.

Kellogg notes in something of an aside that hope remained for international cooperation: "The fact that satellites, by their very nature, cross national boundaries and signal their messages to all parts of the world makes them uniquely international -- a sort of symbol of worldwide scientific endeavor. So it seems inevitable that the working arrangements for the international use of these scientific tools will eventually be made".

Kellogg also notes that his summary of the meeting, by necessity, focuses on "the subject matter being studied rather than the vehicle".

A trip to Moscow

Work on Explorer IV and V and other satellite projects precluded Van Allen from being among the 227 space scientists who gathered in Moscow for the fifth and final CSAGI meeting in 1958. "I was up to my ears in work on Explorer 4 and 5 and on the Argus test," Van Allen said in a December 2000 interview. In his place, he sent a University of Iowa post-doctoral student, Ernest Ray, who reported the first Explorer I and Explorer III findings.

A year later, Van Allen was able to accept an invitation to participate in another, post-IGY space physics meeting in Moscow. Before leaving for Moscow in July of 1959, Van Allen was approached at his laboratory in Iowa City by, he presumes, an agent of the US Central Intelligence Agency, who asked him for help in gathering specific information about the Soviet science community and its research.

"The first time it happened to me, it was sort of amusing", Van Allen said in a July 1999 interview:

> The CIA must have a branch office in St. Louis, and this person from there, who described himself only as a "representative of the U.S. government", showed up one day, unannounced, at my office. He wondered if I would help by finding out the names of persons involved in the Soviet space program. He was also interested in my assessment of the quality and scope of the Russian space program and the location of Russian launching sites. He was particularly interested in getting names of important people. I support the US government; I told him I would find out what I could.
>
> When I got back, I was in Washington, DC and was approached by three agents, who wanted to know if I could make an "oral report" on my trip. They

> interviewed me in a hotel room in DC, which apparently they had rented for the purpose. I don't know if they thought the place was bugged, but I remember they were playing music on the radio during my report. I had inspected a lot of stuff in the labs there (Moscow), and I told them what I learned and my assessment of Soviet capabilities and the quality of their work. I would receive subsequent visits about once a year for the next four or five years. I never knew anything worth mentioning, but I was happy to collaborate. I like the US government.

When he arrived in Moscow, Van Allen found his Soviet counterparts eager to discuss his findings, and their own, he said in a July 1999 interview:

> I was prepared for a lack of candor and a fair amount of secretiveness, but what happened was I couldn't get them to stop talking. They were very proud of what they had done, and they seemed to be laboring under an international inferiority complex. I thought that to give so many papers at their own meeting was a bit ungracious. But they were dying to tell us what they were doing, and were apparently free to do so.
>
> While I was there, Leonid Sedov (a prominent Soviet space physicist) asked me if I would be willing to go out to the Soviet Academy (of Sciences). They whisked me out there in a car, and I attended a meeting of 12 to 15 people. Through an interpreter (Soviet space physicist Yuri Galperin) I did a two-hour seminar with a lot of slides. They asked some very searching questions. Some were real killers. One of them was: "How did you know that the radiation you discovered wasn't the result

> of a burst from a US nuclear weapons test"? I had the benefit of the Argus observations (a top-secret US experiment involving the detonation of low-yield hydrogen bomb in space), and the answer was that the energy of the particles was quite different. Argus had shown us that it was quite easy to distinguish between fission electrons and those that were naturally produced.

Yuri Galperin, in a December 12, 2000, letter to Van Allen, recalls the meeting and his involvement as a participant and translator as Van Allen and colleague Paul Kellog described the results of the Argus experiment. "You cannot imagine the preparations for this meeting in the Academy", Galperin wrote:

> It was decided by somebody that the quantity of Soviet participants will be equal to that of Americans. While I already had some experience in space research, published papers on particle measurements in space and the main mechanism of the inner belt formation of the radiation belt, the choice of myself as interpreter was obviously aimed also to reduce the amount of people who hear and contact you. The main hall of the Academy, which is usually filled with chairs and tables for Academy meetings (or only with chairs), was emptied, with only a table in the center with 'a chair per person'. I was young and impressed by the visible importance of the meeting, so my translation was far from good -- I wanted to translate most exactly and repeatedly asked questions for clarification.
>
> It was an example of good will and scientific cooperation spirit, which was very important at that rather hard time, and not less now... But I am sure we all -- the Soviet participants -- were impressed by the generosity of the American

> side in sharing the geophysical data of such a specific experiment.

Galperin said in e-mail correspondence to the author on February 18, 2001, that Soviet scientists relied heavily on scientific journals, and even newspaper coverage, for information on space physics research in the US and other countries. "We had all the main scientific journals at hand, as all the Soviet sciences (did) at the time", he wrote. "Actually there were not so many (nor were they) so expensive as now".

Direct correspondence between Soviet space physicists and their international colleagues was rare, Galperin said. "Letters to foreign scientists were already not in mode, as (corresponding) was in the last century and earlier when no -- or (only) a few --- regular journals were in use. ... Also at the time newspapers were interested in space science, so some new results sometimes were first seen there, and it kept us oriented, what paper to search urgently".

Galperin notes in e-mail correspondence to the author on January 22, 2001, that international cooperation was then the rule, not the exception, but also notes that things have changed over the last 40 years.

"Science, especially natural sciences, was always a school of international cooperation, a unique area of mutual helping in understanding Nature", he wrote:

> And personal relations to some extent, despite obvious difficulties in language, in traditions, in many other things, in a way reflected that basic similarity between the scientists in the competing countries. I can tell you that I count among my good friends such outstanding American space scientists as Tim Donahue, Carl McIlwain and the late Bill Hanson, and I am very proud of that.

> At the same time (there was) some sportive-like competition: Who was the first to find, measure, understand, to publish, (which) was and is quite natural, a typical thing in science. And the glory of the country evidently enters here. Unfortunately I see during my rather long life a significant change in the mood of some American scientists, especially among younger ones, not to cite the Russian papers even when they are certainly aware of them or even have read them. I have heard that such citations can create difficulties in getting grants in the US ... We in our country had the same during Stalin time (before World War II and till the mid-fifties), so we are sensitive to such non-objectivity, sometimes reaching immorality.

Galperin said in his February 18, 2001, correspondence with the author that, like Van Allen and his US colleagues, the activities of Soviet space scientists were being monitored by the Soviet equivalent of the CIA, the KGB:

> Certainly there was some monitoring and censorship as were connected with rockets, satellites, (and) classified industries. I considered it normal in the time of cold war. However, in the physical results we were free to discuss and publish what we want(ed), if there was nothing which could be connected with weaponry. For example, I had unique measurements from the two satellites, Kosmos-3 and especially Kosmos-5, during (the) American nuclear high-altitude explosion "Starfish" in 1962. It took some time to treat and understand these data, but already in 1965 I presented the main results (at an) open conference, and they were immediately published in the proceedings of the conference in the same year, and no difficulties with the publication were met. (Additionally), there were other publications on

> this rather hot subject in our journal *Cosmic Research* (as well as) my report on the COSPAR Conference in London in 1967.

Van Allen's experiences in Moscow left him impressed by his Soviet counterparts and provided direct insight into the quality of their research.

"Their instrumentation was pretty primitive, and I was impressed by the lack of miniaturization", Van Allen said. "They were still using vacuum tubes and equipment with heavy chassis, while we were miniaturizing and developing technology that was all low-weight. They could get away with that, because they had big rockets".

Van Allen and Sedov became friends. Before leaving Moscow, Van Allen offered to submit a paper about early US findings for publication in a Soviet scientific journal. When he did so, Sedov was delighted. In a September 14, 1959, letter written in Russian and addressed to "Deeply esteemed colleague", Sedov thanked Van Allen for his submission and said he had forwarded the paper to the editor of the journal *Progress in Physical Science* and that it would be translated and published in that journal. Sedov also told Van Allen he could expect to receive an honorarium for his work -- "probably a small sum" (VAP 209:1).

In that same letter, Sedov responded to an invitation from Van Allen to visit his space physics laboratory at the University of Iowa. "In the event of my going to the USA, it would please me very much to meet with you and become acquainted with your observations".

<u>The Russians Are Coming</u>

Sedov did travel to the US -- two months later as part of a Soviet delegation attending a Washington D.C. meeting of the American

Rocket Society. With Sedov already in America, Van Allen dispatched identical telegrams simultaneously to the Soviet Embassy in Washington and to the Russian Desk of the US State Department on November 18, 1959:

> Have invited Soviet scientific party of Professor Leonid Sedov and four others now at the American Rocket Society meetings in Washington to visit this University on 22, 23 and 24 November ... Suggest visit to our laboratories on Monday and Tuesday. Would be grateful if Professor Sedov would give general University lecture on Monday evening on space research in the Soviet Union and Professor Krassovsky a colloquium for department of physics and astronomy on Tuesday afternoon. ... I consider this visit of considerable international value and would appreciate your assistance in making it possible" (VAP 209:3).

Despite the short notice, Sedov and his four colleagues extended their visits to America to travel to Iowa City. Though Sedov was known to Van Allen both personally and professionally, neither Van Allen, nor anyone else apparently, knew much about some of the other Russians in the entourage.

A document informally titled "Some Biographical Details" in the Van Allen Papers (VAP 209:3) showed that Sedov, then 52, was the newly-elected president of the International Astronautical Federation and, since April of 1955, had been the chairman of the USSR National Academy of Sciences' interdepartmental Commission on Interplanetary Communications, described in the biographical notes as a "group of 27 (that) includes 8 academicians (the academy had 152 academicians, according to another notation) and seems to be the equivalent of the US NAS (National Academy of Sciences) Science Board, but with broader powers including some of those of our NASA".

The Soviet delegation would also include Antoli A. Blagonravov, then 65, a "ballistics and armaments specialist" who had been awarded the Stalin prize in 1941 for work on "The Principles of Planning Automatic Weapons". The notes show that Blagonrav headed the 1957 Soviet delegation to IGY's Washington DC Conference on Rockets and Satellites and had authored an article entitled "Investigation of the Upper Layers of the Atmosphere by Means of High-Altitude Rockets" in the June 1957 journal of the USSR National Academy of Sciences.

Also coming to Iowa City was Valerian I. Krassovsky, who was identified in a page-eight article in *The New York Times* of November 17, 1959, as chief of the department of research in upper atmospheric physics as the Institute of Atmospheric Physics in Moscow. Van Allen's biographical notes indicate a long list of research interests in astronomy and geophysics, including cosmic ray research.

The group would also include Professor V.G. Kostomarov, identified in Van Allen's holographic notes as a "linguist & interpreter" and Dr. Y. Galkin, about whom there was "no information".

Van Allen oversaw an ambitious 12-hour schedule of activities for the Soviets on Tuesday, November 24, 1959. It included an orientation to the Van Allen team's work, tours of various University of Iowa space physics laboratories, and a lecture to physics students by Valerian I. Krassovsky, entitled "Radiation Observations with Soviet Satellites and Cosmic Rockets". Dinner with faculty and spouses Tuesday evening was followed by L.I. Sedov's public lecture, entitled "Space Research by the Soviet Union". That event was followed by a 9:30 p.m. press conference.

Van Allen recalls discussing with Sedov while meeting with him in Iowa City the socially and politically pervasive impact of Sputnik I on American culture, and on Van Allen's own work. "I remarked how Sputnik helped jump-start space research in the U.S.", Van

Allen said in 1999. “Sedov smiled and said, through the interpreter: ‘Yes. Yes. It works both ways’”.

Upon his return to Moscow, Sedov sent Van Allen a letter, hand-written in English, thanking him for hosting the visit to Iowa City. “We wish you all successes in life and your interesting researches”, the November 28, 1959, letter says in part. “Please convey our best wishes to your nice family and members of your department. We hope we’ll have other opportunities of meeting you” (VAP 209:1).

“They were as open as we were”

Throughout the early days of space science exploration, Van Allen and his colleagues within the US space community relied heavily on international meetings and on papers published in a range of scientific journals for insights into new findings and theories. Personal contacts between US and Soviet scientists were limited, even in the form of correspondence, Van Allen recalls:

“We learned what the Soviet scientists were up to through IGY annals and meetings”, he said. “I thought they were as open as we were, and, in the scientific culture, I expected this. We got to be mutually respectful, but there was not much contact, except at these meetings. I wrote some letters (to Soviet counterparts) and basically never heard back from them, although, when I saw them later, they said they got the letters. I don’t think it was possible for them to get a letter out. I think there was very strong censorship”.

In one of his infrequent face-to-face encounters with his Soviet counterparts outside an international conference, Van Allen compared scientific notes with Sergi Vernov. A highly regarded Soviet space physicist, it was Vernov who might have “discovered” the Van Allen Radiation Belts months before Van Allen, if not for the in-flight failure of a crucial data recorder aboard Sputnik III (Harford 136), or, as Van Allen put it: "The rascals did themselves in with scarce data".

"Vernov came to the States in 1960, and I met him at the Cosmos Club in Washington, D.C.", Van Allen recalled in July 2000. "We had dinner and talked about what each of us was doing. We met alone, without translators and, as far as we were aware, no KGB or CIA presence. He knew enough English that we were able to meet just together, alone. The language issue made conversation a little slow, but as far as the content was concerned, it was not a problem".

Journals and annals of international scientific organisations were a principal source of information and communication for the world's space scientists, Van Allen said, although the logistics or acquisition and translation often dated content:

> The International Astronomical Union was a very prestigious organisation of astronomers from around the world, including the Chinese, who did not participate in IGY. The proceedings of the IAU allowed free exchange of information. In fact, the catalog of asteroids, where astronomers would record their discoveries of asteroids and their locations and movements, was published in St. Petersburg (Russia). In that era (the late 1950s) the IAU was flourishing, and it served as a medium of exchange and acquaintanceship.

Van Allen's papers contain copies of two New York-based commercial publications -- *Physics Express* and *Soviet Highlights* -- that provided translations of Soviet scientific papers. Volume 1, Number 1 of *Physics Express* appeared in June 1958, billing itself as a "new comprehensive digest of current Russian literature dealing with physics topics". In a message from the publisher -- International Physical Index, Inc. -- the journal promised "extensive coverage" of material gleaned from 68 Russian journals, claiming "about half of these journals have, to our knowledge, never been available to American engineers, at large, in English". The publication also promised "timely publication" through editorial procedures designed to report on Russian research and development work "many months faster than is possible by other means now available". The first issue included translations of nine complete articles, 29 excerpts in the authors' own words and 65 abstracts. The subject of the first volume's lead article is "cosmic rays and elementary particles".

Van Allen said his team relied heavily Ernest Ray, a postdoctoral student at the University of Iowa and later an assistant professor, for quick translations of Russian papers and other documents:

> Ernie had learned to read Russian, and he became our department's principal translator. The (University of Iowa) library also subscribed to *Pravda*, and he would go through that and would translate. *Pravda* had a lot of coverage of science, and he and I would sit down and read those science reports together. We also received Russian journals. The Russians used to publish their journals in English, but then after the war (WW II), there was a great wave of nationalism and they went to publishing them in Russian. We hired a young man from the (University of Iowa) Russian department to do the translations. The problem was there was about a year of delay between publication and arrival of the journals and the translation. It was 1960 before we got translations of papers first issued in 1958 and 1959.
>
> The substantive side of what I learned about their research came out of the IGY, journals and *Pravda*, which devoted a lot of space to science and space. These stories would not reveal a lot of things, but I remember there was a big article on Sputnik III that was amazing for its detail. There was a language

> barrier with these publications, and there was delay in getting them, and what you really needed to assess the work were the numbers, the exact information. Even if you hear an oral paper, you can't take it all in. If you really want to work with something you need the paper and the figures (data), and those were so slow in coming along. But all along we knew what we needed to do and how we would do it. At no time were we dependent on the Russians. The competition just highlighted the whole thing.
>
> You should understand that, while these papers were of interest, we knew what we wanted to do and how we would do it. At no time were we dependent on the Russians. The rivalry between the two countries was essential to the opportunity to do the work, but the science was totally independent. If the Russians hadn't existed at all we would have done the same things.

When Van Allen and his team were ready to publish data from their Explorer I and III instruments, they chose the British journal *Nature* for publication in a conscious effort to minimize any delays in sharing their findings with the international space physics community. "It was an international journal and was very speedy in terms of turn-around time between acceptance and publication", Van Allen said in a December 2000 interview. "They were very fast -- 30 days versus six to eight months with some journals. They were very courteous and very prompt".

Van Allen said he was not required -- nor did he -- have the article reviewed by any US intelligence agency. "I don't remember that any formal review was required", he said. "The paper was sent (to *Nature*) directly from Iowa City".

Analysis

Sarah Van Allen was a "very frightened" six-year-old girl on the day in 1959 when she first heard that her father -- American space physicist James A. Van Allen -- would be traveling that summer to Russia to meet face-to-face with Soviet space scientists. "I had this impression that he was going somewhere very dangerous", she said 42 years later in an April 2001 interview:

> It was the time of the Cold War, and for a child it was an environment that was very scary, all this talk of bomb shelters and hiding under your desk at school. I was so frightened by the idea of him going to Russia. I remember thinking they might steal things out of his briefcase, and I remember asking my father why he was going to Russia and asking him wasn't he scared.
>
> I remember him telling me that the fears that I was expressing were unfounded. He explained to me that, in the scientific community, Americans and Russian cooperate, that scientifically they are not competing, that what they do transcends what's going on in the political arena. He told me it isn't like war because the scientific community worked together in terms of sharing ideas and data. And when he explained it to me that way, my fears were totally abolished. The Cold War never seemed as cold to me after that (S. Van Allen interview).

What James A. Van Allen never has told his youngest daughter is that he was apprehensive, too. "I had no trouble navigating central Moscow, and I was able to master the subways by myself and got around without any problems", he recalled in an April 2001 interview:

> But I must admit I was apprehensive when I was invited to give a lecture at a meeting of the Soviet Academy, which involved getting in a car and traveling by myself to the outskirts of Moscow. I was uneasy about the prospect of disappearing. So I talked two of my colleagues who had also made the trip into going along with me. My thinking was, if three of us disappeared, somebody would notice" (J. Van Allen interview).

Van Allen and his two colleagues returned safely from their visit to the Soviet Academy. In fact, the visit had afforded the American scientists a chance to put faces to names of scientists whose work they had followed in hastily translated Soviet physics journals. It had been an opportunity to formalize personal and professional relationships. Some of those relationships, despite the inherent complications of language, geography, Cold War politics and the passage of decades, are ongoing.

This early, direct communication with his colleagues in Moscow left Van Allen impressed by his Soviet counterparts and by the quality of their research: "I found that the power of their (Soviet) intentions, and their corresponding capabilities, were very high", he said. "They had a feeling for the spirit and the power of the work, and they were not kidding around. They were in the big leagues in this business. Science absolutely transcends politics, and they seemed like our kind of folks" (J. Van Allen interview).

Principle meets politics

This research explores the means of methods of the communication strategies employed by US and Soviet space scientists at the literal dawn of the "space age". In the author's multiple personal interviews with American space physicist James A. Van Allen and frequent correspondence with Soviet counterpart Dr. Yuri Galperin, both scientists repeatedly recalled their personal and professional commitments to free and open exchange of information. Both discussed their efforts to adopt communication strategies that were underpinned by a conscious disregard for the political polarity then dividing the United States and the Soviet Union. Both Van Allen and Galperin embraced then the principle -- an absolute principle in their shared views -- that science transcends politics, a view they continue to share nearly 50 years later.

The eagerness of Van Allen's team and the corresponding Soviet team that included Galperin to share data, theories, methods and insights related to their experimental observations of the Earth's upper atmosphere illustrates two related corollaries both expressed and implied by both of scientists: scientific inquiry transcends nationalism, and the results of scientific inquiry have no ownership, but are instead the "property" of the human race in its quest to make sense of the nature of nature.

These earliest commitments to open and frequent communication transcended the "us-versus-them" mentality of the Cold War. While school children in the United States -- among them Van Allen's own daughter -- were being drilled in taking cover during a nuclear (translates: Soviet) missile attack, Soviet and American scientists were exchanging experimental data as colleagues, not competitors, and certainly not as enemies. Because their common involvement in space physics research required the involvement of rocket technologies developed by the US and Soviet governments as weapons delivery systems, formal and informal efforts by these American and Soviet scientists in establishing and maintaining open channels of communication were complicated by security concerns on the part of the governments that were, by necessity, participating in these research efforts as co-investigators.

This author's interviews with Van Allen and Galperin and two years of related research show unequivocally that both the American and Soviet space science communities understood the importance of pursuing space science as an international scientific endeavor, despite "official" government security concerns. They also reveal how strongly these principals collectively embraced the understanding that, as Van Allen puts it, "science absolutely transcends politics".

Nonetheless, as illustrated by both Sarah Van Allen's apprehensions and those of her father, the efforts by these space physics pioneers to insulate their infant specialty of "space science" from politics were undertaken amid the backdrop of a virtual fire storm of social, political and economic turmoil kindled by the Soviet's successful launch of Sputnik. Their activities did not take place in either a professional or political vacuum, and it should be noted that their insistence on open exchange of information characterises only their own experiences as both the US and the Soviets entered the space age.

While this research illustrates that open communication was the norm of space science between 1957 and 1959 -- the period under review here -- it needs to be remembered that the work of the Van Allen and Galperin teams was the only pure science high-altitude research underway at that time. In 1957 and 1958 there were no other space physics experiments being carried into Earth orbit except those these teams had devised; the total sum of knowledge being accumulated -- and communicated -- was the result of the earliest Sputnik and Explorer launches. These inaugural missions "invented" the specialty of space physics. And the inventors -- Van Allen, Galperin and their immediate colleagues -- set the tone for unrestricted, non-proprietary exchange and access to data in this new field of science. The extent to which this approach endured as space science evolved is beyond the scope of this research.

The Politics of IGY

Despite their noble intentions, any suggestion that the activities of

Van Allen, Galperin and other space physicists of this era were a-political would ignore the political and economic realities that underpinned the International Geophysical Year and the space science inherent in this global research effort. While the specific agendas for the ambitious array of IGY research were set by international committees of scientists, the funding for these projects -- more than $2 billion by one estimate (Merrill Lynch 10) -- came, directly and indirectly, from the 66 governments involved and from the United Nations. This government involvement, by definition, made IGY a political affair, and there is ample evidence that a variety of US governmental agencies -- not the least of them the Department of Defense (DoD) -- was both interested in IGY research and actively involved in funding and assisting such research (Killian 136).

It must be noted, too, than Van Allen was no "babe in the woods" when it came to the political context of physics research. Van Allen came to space physics research from his ordnance research as a US Naval officer. During World War II, Van Allen helped perfect a proximity fuse that triggered detonation of anti-aircraft artillery shells as they "sensed" targets nearby. After the war, Van Allen's work with high-altitude rockets for a research group at the Applied Physics Laboratory of Johns Hopkins University involved instruments developed by the US Naval Ordnance Laboratory and included launchings of rockets at a US military base (White Sands, 1948) and from the decks of US Navy ships in the eastern Pacific in 1949 and the Gulf of Alaska in 1950 (VAP 236:1). In short, Van Allen's earliest research was the product of defence appropriations in an era when rockets were perceived as munitions rather than a means of placing pure science research instruments into low-earth orbit. His loyalties to the US Navy extended beyond his wartime commission, and, as this research reveals, Van Allen was not averse to occasional interactions with the US Central Intelligence Agency.

Van Allen is fond of noting that his experiment was selected for the first US satellite mission because, in his words, he was "lucky to be in the right place at the right time". In reality, luck was never involved. As the US Army-backed Project Orbiter/Redstone rocket development team headed by Wernher von Braun was competing against the Viking rocket designed by US Navy, Van Allen was busy in his laboratory at the State University of Iowa, designing and building an instrument payload that would fit the spatial and weight requirements of either booster system (Burrows 79).

Setting the IGY agenda

US involvement in IGY was coordinated by the National Academy of Sciences (NAS), a civilian agency with the broadest scientific responsibilities in the US federal government. In creating the NAS the US Congress included in its mandate the responsibility to assume leadership in sponsoring basic scientific research and coordinating broad scientific programmes that involved multiple agencies, institutions and scientific organisations. In February of 1953, the NAS appointed a National Research Council, which in turn appointed the US National Committee for the International Geophysical Year. That committee's members were selected for their "scientific capabilities" from various public and private institutions (VAP 236:2). It was this committee that ultimately approved the research agenda for US scientists involved in IGY activities, including rocketry.

The US DoD and the US State Department both took a keen interest in IGY research activities. In the spring of 1954, proposals for US involvement in IGY research were circulated by the National Science Foundation to various US governmental agencies, soliciting comments on proposed research and associated budgets. In a March 19, 1954, letter from Donald A. Quarles, assistant secretary of defence, to Joseph M. Dodge, director of the US Bureau of the Budget, the DoD makes its position clear:

> From a scientific point of view the Department of Defense has definite interest in certain elements of the program. There is no doubt that the results of a coordinated world-wide effort in the main fields of atmospheric physics can be expected to yield basic information not only of general technical value but of value to our national defense problems. Of particular importance to us would be basic information relevant to radio and weather predictions and the properties of the upper atmosphere. Advances in these fields require investigation of several phenomena including the ionosphere, aurora, geomagnetism, solar activity, cosmic rays, and atmospheric winds. Many of these observations can be obtained only by the rocket probing capability developed by the Department of Defense (VAP 236:2).

In a more detailed DoD analysis of the US IGY program dated May 19, 1954, a report from the Department's Coordinating Committee on General Sciences notes that US activities involving rockets could not be pursued without direct DoD involvement:

> The capability to execute the IGY program using rockets as a probing device resides altogether within DoD laboratories or their contractors. It has been determined that each department can fire a number of rockets or other vehicles over and above its proposed program and, in toto, Defense can accomplish the number of firings specified in the IGY program for both ground and air launched vehicles. Therefore, the IGY program will be carried out as an above-normal effort by DoD agencies (VAP 236:2).

The US State Department offered its assessment of IGY to Alan T.

Waterman, director of the National Science Foundation. A "for the Secretary of State" letter sent on April 20, 1954, to Waterman from Deputy Under Secretary Robert Murphy reads in part:

> As to the Department's views on the American part in the IGY, this proposal is consistent with the objectives of our foreign policy. Since World War I the Department has encouraged and supported American participation in the International Council of Scientific Unions and its affiliated scientific unions. It has followed this course because the scientific knowledge these organizations develop is essential to our national interests in navigation, communication, commerce, and other important fields of a global nature. The American program for the IGY, together with the programs of the other participating countries, constitute a real opportunity for accelerating the accumulation and refinement of such knowledge (VAP 236:2).

The same letter speaks to the US government's endorsement of the IGY goal of encouraging international scientific cooperation:

> The Department of State itself has traditionally fostered international cooperation. The IGY can be regarded as an instrument for such cooperation. The proposal will afford many occasions for scientists of different countries to work together for great common ends in fields of endeavor in which, from a scientific point of view, international boundaries are not significant -- and scientists in these modern days must be looked upon more and more as an important and influential element of society. In this context the proposal can contribute much to stimulating friendly international relations (VAP 236:2).

Follow the money

Initial financial support for IGY, outside the International Council of Scientific Unions, came from the United Nations (UN) through its United Nations Educational, Scientific and Cultural Organization (UNESCO). The UN organization provided a grant of $1,400 to subsidise the costs of CSAGI's plenary meeting in Brussels in October of 1952, plus an additional $1,000 for "preparatory work" for IGY. Another $2,000 in UNESCO funding was provided for the second CSAGI meeting in Rome in October of 1954. UNESCO also approved a $5,000 allocation to CSAGI for establishment of a permanent secretariat, which was followed by a subsequent grant of $15,000. The UN organisation also gave the IGY committee an additional $15,000 in 1956 for the maintenance of the permanent secretariat (Buedeler 23).

Beyond this initial UN seed money, funding for IGY came from the governments of the countries involved. A February 1958 analysis of IGY funding by the Wall Street investment firm of Merrill Lynch, Pierce, Fenner and Beane puts the total, worldwide cost at $2.5 billion:

> Funds for the IGY are paid through the National Science Foundation, a Federal agency established by Congress in 1951 to provide support for basic research. So far Congress has granted the agency $39,000,000 for the IGY program with half the cash tagged for the satellite and rocketry section. The IGY committee does no contracting: instead, its asks US universities and laboratories to submit programs for work they are equipped to do or would like to tackle (Merrill Lynch, 8).

The same analysis -- published within a week of the successful launch of Explorer 1 and presumably written prior to that event --

notes that the cost of the US satellite program has climbed “like the Sun at dawn”:

> The earlier-than-expected Sputnick [sic] II launching not only brought sharp pressure to speed up US satellite development but also created extra costs connected with the tracking and data collection of the Sputniks. Case in point: Smithsonian Astrophysical Observatory was granted $3,300,000 to organize and operate the optical tracking program but admits it will not be able to carry its work to the end of IGY, partially because it doubled its IGY-paid personnel to 70 several months earlier planned (Merrill Lynch 8-9).

The Merrill Lynch analysis also notes that the Eisenhower Administration’s budget for fiscal year 1959 allocates $150 million to the National Science Foundation, three times its appropriation for the previous budget year. “Part of the Foundation appropriation will undoubtedly be used to swell IGY funds, especially the satellite and rocketry program,” the analysis says on page nine.

The report also quotes IGY organiser Lloyd Berkner’s estimate of the cost of US participation in IGY as “in the neighborhood of $100,000,000” and world-wide costs to “much closer to $500,000,000” (Merrill Lynch 9). The report contrasts Berkner’s IGY cost estimates with those of John A. Simpson of the Enrico Fermi Institute, a physics laboratory near Chicago. Simpson’s estimate predicts $250 million to $300 million would be spent for scientific equipment and salaries and that participating nations would spend an additional $1.8 billion for “direct logistical support.” Another $250 million to $500 million, Simpson predicted, would be required for data collection, handling and analysis and for the costs of IGY observations in “remote regions” under study. “This comes to a grand total of around $2.5 billion,” the Merrill Lynch report states (Merrill Lynch 10).

Beyond financial considerations, the Merrill Lynch analysis of IGY also comments on the political context of the effort, linking the Soviet Union's involvement to the death of Josef Stalin:

> The death of Stalin in early 1953 and the subsequent reshuffling of certain Soviet tactics came early enough in the preparatory period [for IGY] to enable the Iron Curtain nations to participate actively. Whatever the Soviet's political motives, most scientists hail this activity as a hopeful sign of improved international cooperation -- at least in the scientific field (Merrill Lynch 5).

The Merrill Lynch report also makes note of the military implications of IGY:

> While scientists consider it a concrete example of international cooperation, IGY nonetheless cannot escape certain military associations. Much data on the nature of outer space, exact geographic locations, weather and communications have military interest; Antarctic scientific programs may lead to the establishment of permanent bases; satellites can develop into reconnaissance vehicles and possibly even weapons carriers, while launching and guidance apparatus is related to the missile field.
>
> Scientists remain confident all basic data will be promptly released (and) say Soviet release of scientific information would amaze the uninformed outsider. But problems of secrecy (at least in closely related scientific endeavors) persist. While everyone agrees strictly missile information must be properly guarded, failure to release the basic scientific information could seriously interfere with the IGY objective and hamstring research needed for both

US peacetime prosperity and military security (Merrill Lynch 5).

Experiments in concert

The seminal role played by the IGY in encouraging international scientific cooperation cannot be over-emphasized. Van Allen and his Soviet counterparts were among 60,000 scientists from 66 nations who staffed thousands of observation stations, literally from pole to pole, while undertaking IGY experiments and observations (Sullivan 4). As the superpowers were busy obsessing over the throw-weights of rocket systems that could be outfitted with heavy nuclear warheads, this cadre of international science talent was busy following the 17th Century advice of Francis Bacon, who encouraged scientists to pursue a global scientific method grounded in “experiments in concert”.

It should be noted, too, that more than a few of the formal informational exchange strategies proposed for the IGY never materialised during the 18-month observation period. These included two proposed IGY World Data Centers, envisioned as archival repositories in which all data collected during IGY would be cataloged and made available to scientists around the around. Similar centers were later established and continue to function, but the concept was not immediately embraced. Minutes of IGY planning sessions contained within the Van Allen Papers clearly show that efforts to formalise IGY information exchange and communication protocols were undermined by Soviet government concerns about free exchange of information revealing specifics of the launch vehicle and the telemetry technologies used to orbit Soviet scientific payloads.

It is also interesting to note that James A. Van Allen’s first efforts to grasp the significance of Sputnik were grounded in his own direct observations, an approach one might expect of an advocate and veteran of scientific method. As this research reveals in some detail, America's preeminent space scientist was, quite literally, half-a-world away from the "action" when his international space physics colleagues, who were gathered together in Washington, DC for the Conference on Rockets and Satellites, first learned of the successful launch of Sputnik on October 4, 1957. His logbook entries on that historic date reveal not only his excitement over the news, but his immediate efforts to capture the satellite's radio signal and to study its properties with the crude equipment at hand. His logbook contains page after page of detailed notes and sketches pertaining to his observations of the 95-minute orbital passes that he and others aboard the USS Glacier tracked throughout Sputnik's first day in space.

As a final observation, it is important to note that Van Allen and his Russian counterpart Galperin both feel the commitment to international scientific cooperation and open communication of data, methods and theories that was embraced by IGY organisers and participants has been eroding. As Galperin noted in e-mail correspondence with the author:

> Unfortunately I see during my rather long life
> a significant change in the mood of some American
> scientists, especially among younger ones, not
> to cite the Russian papers even when they are
> certainly aware of them or even have read them.
> I have heard that such citations can create
> difficulties in getting grants in the US.

Van Allen agrees: "I think there is a lack of meaningful collaboration these days", he said in a May 2001 interview.

> Not overtly, in the sense of saying, 'We're not
> going to cooperate with those damn Russians',
> but, while the activity has stayed high, international
> cooperation has not. There's a lack of

> collaboration now to the point where American space physicists aren't even collaborating with each other. A lot of the current papers I read are repeating work published 10 or 20 years ago as far as physical results are concerned, some of that work my own, without citation. And, when I mention this, I'm told by young scientists that today there is no real interest in any of the literature that is more than five years old.
>
> This is supposed to be an objective business. But there almost an element of gamesmanship involved, where some work is ignored, or scientists will cite the papers of their friends or close colleagues in a sort of a you scratch my back and I'll scratch yours approach, with the expectation that they will turn around and cite their work.

"I'm no longer in the mainstream of things, but I respect Dr. Galperin's impressions", Van Allen said.

> I see almost no citation of Russian work, and I don't see many Russian scientists traveling to conferences in the U.S. or getting posts on academic faculties in the U.S., which at one point was quite common. I can't remember the last time the Russians had a planetary mission, and I haven't seen NASA involving any Russians in any of their international programmes. I get the impression that there's this general feeling that the US is now superior in their techniques and that the Russians are in the backwater of the thing.

Which is exactly how the Russians were being viewed in 1957, is is not?

"Yes", Van Allen says with a smile. "I think that's right".

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List of acronyms

CIA	Central Intelligence Agency
CSAGI	*Comite Special de l'Annee Geophysique Internationale*
IAU	International Astronomical Union
IGY	International Geophysical Year
KGB	(Soviet) Committee of State Security
Mc/s	Megacycles per second
NAS/NRC	National Academy of Sciences/ National Research Council
NASA	National Aeronautics and Space Administration
NRL	Naval Research Laboratory
RAND	Research and Development
SUI	State University of Iowa
UNESCO	United Nations Educational, Scientific and Cultural Organisation
USNC-IGY	United States National Committee for the International Geophysical Year
USSR	Union of Soviet Socialist Republics
USS	United States Ship
VAP	Van Allen Papers
V-2	*Vergeltungswaffe*-2 (early German rocket)
WDC	World Data Centres