The birth of the International Geophysical Year

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In his essay "Six Cautionary Tales for Scientists," Freeman Dyson warns against "the game of status seeking, organized around committees." (Dyson, 1992). It is not that committees are the root of evil, he writes, but that when presented with a choice between incremental, practical solutions and grand schemes that attract attention, committees have every incentive to choose the latter—even if the choice has a high probability of failure. Often the committees present the grand scheme as the only choice, an all-or-nothing proposition.

It is tempting to look back on the International Geophysical Year of 1957–58 as an audacious plan launched by a small committee of prominent scientists—an organized campaign that would involve planes, ships, and rockets. Walter Sullivan's thorough account of the IGY is called, appropriately, *Assault on the Unknown* (1961). Visible legacies of the IGY include the launch of the first artificial Earth-orbiting satellites, the Antarctic Treaty, the World Data Center system, the discovery of the Van Allen belts, and the monitoring of atmospheric carbon dioxide and glacial dynamics. The IGY also led to the establishment of Earth sciences programs in many developing countries. Surely this was a grand scheme in a world that was still recovering from a devastating world war.

Yes and no. The IGY represents the largest set of coordinated experiments and field expeditions to be undertaken during the cold war. East met West, North met South, and all the physical sciences concerned with the atmosphere, continents, and oceans were represented. Today we talk about multidisciplinary efforts, global science, and the importance of integrating research with education. The people who planned and carried out the IGY did not use those phrases but put them into practice. Nevertheless, a glimpse at the historical record shows many incremental decisions made by many groups of people guided by general principles of conduct and a few specifics. A plurality of cross-cutting interests and responsibilities constituted a sprawling ediface that was international and interdisciplinary. The tens of thousands of scientists from the 67 countries that participated in the IGY—not to mention all the volunteers, teachers, and students who took part—may not have known how each of their projects contributed to the overall national programs that were presented as tidy packages for funding. Eventually, they probably understood that they were part of something big and extraordinary.

Figure 1. *Alaska's McCall Glacier was one of the objects studied during the International Geophysical Year, 1957–58. Here glaciologist Robert Mason measures ice temperature with a portable galvanometer. (Courtesy of the National Academies Archives.)*

Cold war rivalry. The IGY developed in part out of the national interests of participating nations, but also out of scientific interests. It is difficult to see where one began and the other ended, for World War II, still burning in individual and collective memories, had demonstrated the power of science and technology well before Hiroshima and Nagasaki. The proximity fuze, according to some, was the single most important innovation in the U.S. arsenal. But rocketry, submarines, and acoustics also benefited from important developments. Nuclear weapons loomed in the early cold war. Understanding, detection, and development of the new threat drove crucial national-security and scientific campaigns whose success required studying everything from the atom to human health to the geography of and, as illustrated in Figure 1, the geophysics of snow and ice. Of course, not all scientific programs were explicitly linked to nuclear weapons, but the atomic age was a backdrop.

One can see why the Arctic, for example, acquired new importance as a geographic region marked for intensive study. As polar geographer Paul Siple put it to a U.S. Army colleague, "The Arctic affords a straight line of attack to the Eurasian centers of our potential enemy, and because of that if for no other reason, we must give full consideration to the best [scientific] exploitation of the polar regions," (1948). The U.S. Navy anticipated that the decisive fighting of a future war would take place at the Soviets' access points to the Atlantic Ocean—for example, the Norwegian Sea and the Barents Sea. Therefore the navy needed reliable data and the ability to operate in sea ice (Hamblin, 2007).

The properties of the upper atmosphere intrigued both military and civilian scientists. Research conducted immediately after World War II opened up possibilities for understanding the relationships among magnetic storms, cosmic rays, and solar activity. The military was interested in very-high-frequency scatter technology for reliable low-capacity communication that could avoid the disruptions caused by solar emissions, magnetic storms, and auroras. Polar observations were essential to understanding those space perturbations, which emanate from high latitudes.

The Antarctic was also subject to cold war rivalry and scientific interest. Competing claims to Antarctica had existed for some time. The Palmer Peninsula, for example, had three claimants: Argentina, Chile, and the U.K. Although the U.S. officially did not recognize any claims and refused to make a claim of its own, the navy noisily prepared a scientific expedition called Highjump II that was to occur in 1949 and would "explore, occupy, and develop the Antarctic Continent . . . to strengthen the position of the United States in regards to claims or jurisdiction of Antarctica under international law," (Fechteler, 1948). The expedition was canceled, but the plans certainly attracted international attention. In response to the perceived American aggression, the Soviet media played up the 1819–21 Russian expedition under the command of Fabian Gottlieb von Bellingshausen, who had pushed deeper into Antarctic waters than any previous

Figure 2. *Lloyd Berkner (1905–67) joined Vannevar Bush in 1946 to serve as executive secretary of the U.S. Research and Development Board. Four years later he and colleague Sydney Chapman hatched the idea of a third international polar year. (Blackstone Studios, courtesy of AIP Emilio Segrè Visual Archives.)*

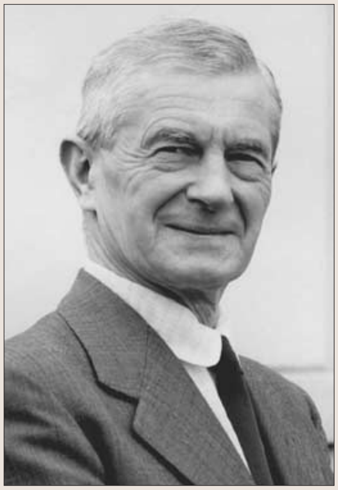


Figure 3. *Sydney Chapman (1888–1970), a British geophysicist, came to the U.S. in 1950 at the invitation of Caltech. His observation that 1957–58 would be a period of maximum solar activity fixed the time frame of the International Geophysical Year. (Courtesy of AIP Emilio Segrè Visual Archives.)*

explorer. The Soviets saw the Russian voyages of the early 19th century as a legitimate basis for asserting a claim if necessary. By 1950 the stage was set for using science to lay claim to the frozen continent (Hamblin, 2007). For both East and West, the need for geophysical data reached well beyond territorial boundaries, covering the planet from pole to pole.

An IGY incubator. After World War II the challenge of mobilizing U.S. science in service to national security was handed to Vannevar Bush, president of the Carnegie Institution of Washington. Bush had led the Joint Committee on New Weapons and Equipment during the war. He was now asked to lead the newly developed Joint Research and Development Board, which was renamed the U.S. Research and Development Board in 1947. The R&D Board consisted of a civilian chairman and two representatives from each service: the army, the navy, and the newly independent air force. The board reported to the secretary of defense. Its primary duties were to prepare an integrated military R&D program, coordinate R&D among the services, and allocate responsibilities for programs. The R&D Board conducted its work through committees, which formed panels and working groups. Each committee, panel, and working group comprised military and civilian members; together they provided hundreds of forums for civilian–military interactions that encompassed all the physical, medical, biological, and geophysical sciences.

The committees and the groups they formed became the battlegrounds, treaty rooms, and think tanks for scientific problems. Which service would take on a particular task? Where would the money come from? In the committee on geographical exploration, for example, the army proposed to set up its own program to coordinate all snow, ice, and permafrost research. Not surprisingly, the navy objected. The ensuing battle and compromise gave the navy responsibility for sea ice, while the army was in charge of the land-based snow and permafrost. The lengthy discussions may have been tedious, but the questions of allocating responsibility and obtaining funding forced military and civilian members alike to take stock, share knowledge, and develop interservice collaborations on projects such as ice coring.

The voluble and expansive executive secretary for the R&D Board, Lloyd Berkner (Figure 2), did much to enliven the discussions. Allan Needell's biography, *Science, Cold War, and the American State: Lloyd V. Berkner and the Balance of Professional Ideals* (Harwood Academic, 2000), much of it based on recently declassified material, prompted more than one IGY participant to admit to having no idea what Berkner had been up to at the time. Berkner had both adventure and science in his background. With expertise in radio engineering, he went on Richard Byrd's 1928–30 Antarctic expedition. He worked with well-known scientists on ionospheric research. During the war Berkner joined the navy's bureau of aeronautics to improve radar systems for naval aircraft. After the war Bush tapped him as the executive secretary for the R&D Board.

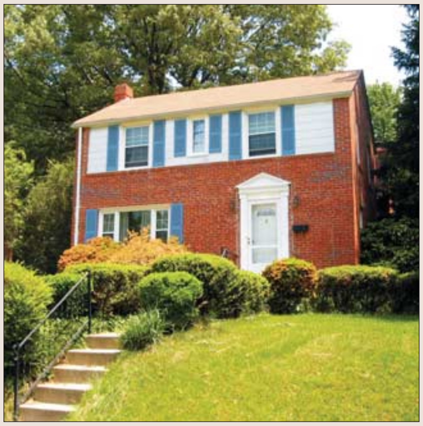
Berkner also consulted for the U.S. Department of State on top-secret psychological warfare and communications. While performing that work, he spoke out in favor of using technological breakthroughs and scientific ideas to shape solutions to global problems. He wanted government to rely on scientists rather than the other way around. Although he did much of his consulting for the Truman administration, his politics of engagement—for example, using international scientific meetings to gather information about the state of knowledge in the Eastern bloc—probably found a more comfortable home with the Eisenhower administration's policies of negotiation and accommodation with the Soviet Union; those policies emerged following Joseph Stalin's death in March 1953 and the detonation of the first Soviet thermonuclear device five months later (Mitrovich, 2000).

Under Bush and Berkner, the R&D Board became an incubator. Every topic that would be studied during the IGY had a board panel or working group that had looked into it 5 to 10 years earlier. As an example, consider the Committee on Electronics' panel on antennas and propagation, chaired by Henry Booker, Berkner's former collaborator in radio propagation. In late 1950, the panel reported that the inadequate worldwide distribution of observing systems resulted in a lack of knowledge about the ionosphere. As a solution, it recommended a north–south chain of observing stations near 75° W longitude to link Canadian and U.S. facilities with those along the west coast of South America. Two years later, international plans for the IGY included two additional meridians for ionospheric observations, one through Europe and the other through the Far East. Moreover, not only were IGY topics anticipated by the R&D Board, many of the people who consulted for or who were members of the panels and working groups would later take their places on IGY committees.

The R&D Board could not operate without foreign expertise, although that collaboration did not extend to the Eastern bloc. Working with colleagues across the Atlantic, on the other hand, was seen as beneficial not only to the U.S. but also to the postwar reconstruction of Western Europe. In this spirit, Caltech invited British geophysicist Sydney Chapman to Pasadena in 1950. Caltech had organized a meeting, funded by the armed services, concerning the upper atmosphere.

On his way to California, Chapman, shown in Figure 3, visited the Applied Physics Laboratory at Baltimore's Johns

Figure 4. In this Maryland home, James and Abigail Van Allen hosted the dinner where the idea of the International Geophysical Year was born.



Hopkins University and spent the day with James Van Allen. Van Allen headed a high-altitude group whose work at first used V-2 rockets but later used the American Aerobees whose development Van Allen had overseen. The Aerobees, smaller and cheaper than the V-2s, would become the mainstay for U.S. upper-atmosphere research. On the evening of 5 April 1950, Van Allen and his wife, Abigail, hosted a dinner for Chapman at their home in Silver Spring, Maryland. According to James Van Allen, theirs was "a modest little house" on Meurilee Lane (Figure 4). Berkner was there, along with J. Wallace Joyce, Ernest Vestine, and S. Fred Singer. After dinner—topped off with Abigail Van Allen's fantastic chocolate layer cake, which, according to her husband, was the real basis for the IGY—Chapman and Berkner seized on the idea of another polar year. Chapman observed that 1957–58 would be a time of maximum solar activity, so the time frame was settled (Shoemaker, 1997).

"This grand cooperative race." The IGY began as the Third Polar Year. Data gathered during the First Polar Year of 1882–83 and the Second Polar Year of 1932–33 led to important discoveries in geophysics. The First Polar Year was truly interdisciplinary; beyond the planned auroral, magnetic, and meteorological observations, its investigations extended to botany, ethnology, geology, and zoology (Baker, 1982). The Second Polar Year was affected by the worldwide economic depression, but it nevertheless yielded important results and benefited from developments such as radiosondes (meteorological balloons with instruments and radio transmitters), improved magnetic instruments, ionospheric sounders, and special cameras for photographing auroras. Data archiving and publication of results suffered, however, due to the outbreak of World War II. After the war, archiving and publication resumed. But by then, new technology, such as the rockets used by Van Allen's group, was available to probe even higher into the atmosphere (Chapman, 1960).

In the month following the Van Allens' dinner, the Third Polar Year proponents took their idea from Meurilee Lane to the Caltech meeting on the upper atmosphere. There they joined another 20 or so geophysicists, among them the Belgian aeronomist Marcel Nicolet. The idea was presented to an even larger group at the Conference on the Physics of the Ionosphere, organized in July 1950 at the Pennsylvania State University. From there, the plan went to an international group, the Mixed Commission on the Ionosphere, comprising scientific unions in radio science, astronomy, and geodesy and geophysics. The unions, in turn, presented the proposal to the larger umbrella group, the International Council of Scientific Unions.

Some international societies preferred a worldwide, rather than a polar, study. Chapman agreed and suggested renaming the program the International Geophysical Year. The ICSU approved the change and set up a special IGY committee known as CSAGI; the initials are taken from the French name Comité Spécial de l'Année Géophysique Internationale. In the fall of 1952, the ICSU sent letters to the World Meteorological Organization, the interested scientific unions, and the national organizations adhering to the ICSU, inviting them to participate in the IGY. The invitations identified the upper atmosphere as the main research focus but welcomed other ideas. By the time CSAGI organized the first international IGY meeting in spring 1953, the proposed scientific program would include 26 countries and practically the whole of Earth, ocean, and atmospheric sciences (Nicolet, 1984).

The Soviet Union was not among the 26 countries. Indeed, the Soviet Union did not adhere to the ICSU, although it belonged to one of the ICSU unions, the International Astronomical Union, and to the World Meteorological Organization. The U.S. National Committee for the IGY worried about whether the Soviet Union and its allies would participate. If not, how could the program claim to be international? An invitation went to the Soviet Union in 1953, but 18 months passed before a positive response came. By then, plans for the IGY had moved well along, and the U.S. had outlined a massive program based on proposals from several hundred scientists at universities, government agencies, and private research institutions.

Soviet scientists attended the Rome meetings of the International Union of Geodesy and Geophysics and of CSAGI, held in late September and early October 1954. There they listened in silence as the U.S.-sponsored plan to put artificial satellites into orbit during the IGY was approved. At home, Soviet scientists were working on developing artificial satellites, and after the Rome meeting the USSR Academy of Sciences paid more attention to that work (Siddiqi, 2000).

At the following CSAGI meeting, held in Brussels, Belgium, in 1955, the Soviet Union presented its IGY program. It was just as comprehensive as the U.S.'s and, in some disciplines, more far-reaching. In oceanography, the Soviet delegation offered to provide 15 of the 48 ships planned for the IGY. In seismology, the Soviet delegation revealed plans to establish three new permanent seismic stations in the Arctic. In glaciology, Soviet plans to include all aspects of the cryosphere—including sea ice, permafrost, and hydrology of run-off and river discharge in the Arctic—prompted the U.S. to enhance its own data-collection plans in the Arctic and Antarctic.

The only area of science in which the Soviet delegates remained silent was rockets and satellites. In July 1955 the White House issued a joint announcement by the National Academy of Sciences and NSF that the U.S. would launch an IGY satellite. Some months earlier the Soviet news media had reported the establishment under the USSR Academy of Sciences of a commission devoted to "interplanetary communications." That commission, consisting of well-known scientists, was led by Leonid Sedov. However, Sedov did not come to Brussels. As Peter H. Wyckoff, chief of the atmospheric physics lab at the air force's geophysics research directorate, noted in his report,

> It was quite significant to all the members that the representative from the U.S.S.R., N. Pinus, and his interpreter Zabrodin, joined the group as observers only. Not one comment was made by the U.S.S.R. throughout the meeting. In view of Soviet publicity on a satellite program, it is

inconceivable that there should be no IGY rocket or satellite program for the U.S.S.R. . . . Pinus gave the impression at the working group that he spoke no English. I met him at the U.S.S.R. Embassy reception . . . and remarked that it was nice of his countrymen to have invited us. He replied in perfect English, "I am glad you could come." He walked away and appeared not to want to continue the conversation (International Geophysical Year Collection, 1955).

In fact, Soviet First Secretary Nikita Khrushchev had not yet approved of launching a satellite for science, and it took intensive lobbying before the Soviet satellite program could be announced at the next CSAGI conference, held in Barcelona, Spain, in 1956. There participants in the working group on rockets and satellites agreed that both the U.S. and Soviet satellite programs would use mutually compatible equipment for radio tracking. Subsequent to the Barcelona meeting, the Soviet reluctance to share information about its satellite plans permitted only partial cooperation at best. The launch of Sputnik 1 in October 1957—just when the working group on rockets and satellites was convened in Washington, DC—shocked the western attendees. As Chapman, head of the IGY, summarized in his closing comments, "Thus is settled the identity of the first winner in this grand cooperative race to enrich geophysical knowledge by means of earth satellites." The U.S. and the USSR, he said, "worked in their different ways—on the one hand keeping the world informed of much of their plans, their progress and setbacks—on the other hand, in silence until and unless their declared aim had been accomplished," (Sullivan, 1961).

Political tension and cooperation. The satellite launches of the IGY were among the most visible results of the participating countries' decisions to partially demilitarize science and participate in an open, civilian science program. True, Khrushchev only agreed to the satellite program after he had been assured that the satellite would not distract attention or resources away from its carrier rocket, the intercontinental ballistic missile R-7 (Khrushchev, 2000). Nevertheless, the satellite programs were a huge step toward sharing scientific and technical information for peaceful purposes.

The idea of demilitarization was also applied to the Antarctic. In preparation for the IGY, governments agreed to lay aside political and legal arguments for sovereignty so that science could proceed. Although politics was never quite removed from Antarctic expeditions, the IGY provided a framework for negotiating the Antarctic Treaty, whose first article begins, "Antarctica shall be used for peaceful purposes only," (Beck, 1986).

The World Data Center system reflects the decision to engage in an open, civilian, international science program. The organizers of the IGY faced a postwar situation in which many geophysical measurements remained classified. They designed the IGY to prioritize observations over the entire planet, with the condition that the measurements be standardized as much as possible and the data freely available. The U.S. volunteered to host a world data center, and the Soviet Union followed. In practice those proposed centers devolved into several repositories distributed throughout the host countries. A third data "center" was distributed throughout Europe and Japan.

Multiple data sets in different parts of the world were encouraged so as to insure against catastrophic destruction of a single center and to make the data accessible to researchers everywhere. Although the national IGY committees were responsible for delivering timely and accurate data, the data centers were responsible for the data's safekeeping, reproduction, cataloging, and accessibility. Anyone engaged in research was to be given access. If you could get yourself into the host country and up to the door of the data center, you could not be turned away. Such was the ideal. But was it enforced uniformly? Did all IGY data reach every center? Indeed, there were gaps, and the satellite program made apparent the limits of East–West cooperation (Bulkeley, 2000). Nonetheless, the rules of the game were in place, establishing norms of behavior that lasted well beyond the IGY.

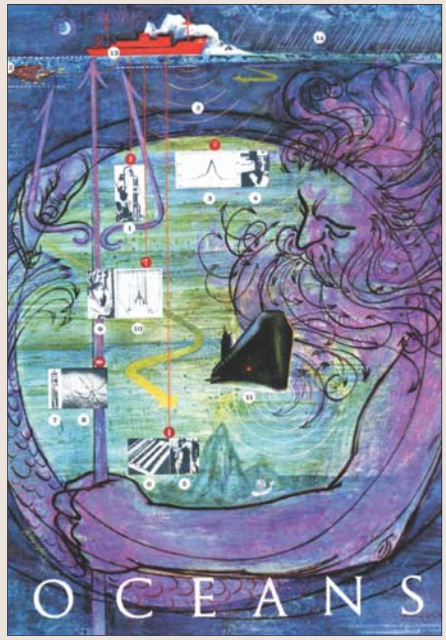


Figure 5. "Oceans" was one of six posters around which the National Academy of Sciences' International Geophysical Year committee created its 1958 booklet Planet Earth. The numbers on the poster identify points discussed in the booklet. (National Academies Archives, 1958).

From the beginning, the IGY was envisioned as extending beyond the scientific community. A vast component of the IGY was dedicated to informing the public and encouraging teachers to incorporate IGY lessons in their classrooms. Films and other instructional materials, such as the poster shown in Figure 5, complemented the suite of articles in the popular press that outlined how the science was done.

CSAGI held five plenary meetings between 1953 and 1958. In addition, regional meetings were held for the Arctic, Antarctic, the Americas, Eastern Europe, Africa, and the western Pacific. Committees met separately as needed. Representation on CSAGI was not by country but rather by discipline. Each discipline had an international committee that detailed program plans on the basis of projects put forward by the national IGY committees. As the IGY expanded to cover many fields, membership in CSAGI grew from a small group of five individuals to 30 representing various international scientific societies. Representation based on science rather than nationality was a revolution in scientific governance. In many developing countries, official geophysical programs were in the hands of the military. The success of the IGY structure of governance convinced more than one military organization to leave science to the scientists.

Perhaps the most amazing meeting of CSAGI was the last, held in Moscow in 1958 (Figure 6). Political tensions that had not been resolved rose to the surface. First, the U.S. and the Soviet Union agreed to disagree on what satellite data would be exchanged. Second, the Chinese delegation from Taiwan apparently did not receive their visas, and the U.S. State Department urged the American scientists to walk out. Several years before the launch of the IGY, the State

Figure 6. Moscow State University's Great Hall was the site of the 1958 International Geophysical Year plenary meeting. Seated at the dais are members of the CSAGI (Comité Spécial de l'Année Géophysique Internationale) bureau. (Courtesy of Juan Roederer.)

Department had encouraged the participation of Taiwan and discouraged the participation of mainland China.

Such political discomforts did not derail the conference or impair the cooperation that had already been achieved. On the contrary, delegates generally agreed that the scientific programs begun during the IGY should continue. The Soviet Union proposed extending the IGY because a number of projects, especially those in Antarctica, had only begun. The Soviet delegation needed the IGY designation to continue the projects and the international exchanges that had been achieved under the IGY umbrella. The U.S. national committee, on the other hand, had promised Congress that the IGY would be a limited program ending in 1958, and that no additional appropriations would be sought. As in the satellite discussions, the two delegations agreed to disagree, though ultimately the two nations devised a pragmatic solution—the U.S. called the IGY extension of 1959 the "International Geophysical Cooperation" while the Soviet Union continued to refer to the science program as the IGY.

In other ways, too, the cooperative mechanisms of the IGY continued. The Committee on Space Research, the Scientific Committee on Oceanic Research, and the Scientific Committee on Antarctic Research all emerged from the IGY as international coordinating bodies. Programs carried out after the IGY, such as the Upper Mantle Project, the International Indian Ocean Expedition, and the International Years of the Quiet Sun (Odishaw, 1964) benefited from the lessons learned through the organization of CSAGI and the data-exchange principles established during the IGY. In general, small groups planned and carried out discrete projects, but large committees negotiated guidelines for observations, instrumentation, and data management, and established and enforced rules of conduct for maximum productivity.

The grand scheme of the IGY was an overlay, a reminder to the world of a unique assault on the unknown. Fortunately, enough people had sufficient belief in the scheme to support it, document it, and share their enthusiasm for the business of science, committees and all.

Suggested reading. *From Eros to Gaia* by Dyson (Pantheon, 1992). Memorandum to Robert B. Simpson by Siple (Record Group 330, U.S. National Archives and Records Administration, 1948). "Mastery of landscapes and seascapes: Science at the strategic poles during the international geophysical year" by Hamblin (in *Extremes: Oceanography's Adventures at the Poles*, Science History, 2007). Memorandum to the Secretary of the Navy by Fechteler (Record Group 330 U.S. National Archives and Records Administration, 1948). *Undermining the Kremlin: America's Strategy to Subvert the Soviet Bloc, 1947–1956* by Mitrovich (Cornell, 2000). J. Van Allen, interview by Shoemaker, 18 November 1997, transcript, Oral History Collection, Ohio State University, Columbus. by Baker (*Interdisciplinary Science Review*, 1982). "From polar years to geophysical year" by Chapman (*Studia geophysica et geodaetica*, 1960). "The international geophysical year (1957–1958): Great achievements and minor obstacles" by Nicolet (*GeoJournal*, 1984). "Korolev, Sputnik, and the international geophysical year" by Siddiqi (in *Reconsidering Sputnik: Forty Years Since the Soviet Satellite*, Harwood Academic, 2000). U.S. delegates' reports of the Brussels meeting (International Geophysical Year Collection, Series 10, CSAGI Assemblies, Third, Brussels, Working Groups, General, National Academies Archives, 1955). *Assault on the Unknown: The International Geophysical Year*, by Sullivan (McGraw-Hill, 1961). "The first Earth satellite: A retrospective view from the future" by Khrushchev (in *Reconsidering Sputnik: Forty Years Since the Soviet Satellite*, Harwood Academic, 2000). *The International Politics of Antarctica*, by Beck (St. Martin's Press, 1986). "The Sputniks and the IGY" by Bulkeley (in *Reconsidering Sputnik: Forty Years Since the Soviet Satellite*, Harwood Academic, 2000). *Research in Geophysics*, by Odishaw, ed., (MIT Press, 1964). IGY Planet Earth Posters and Booklet, National Academies Archives,*http://www7.nationalacademies.org/archives/IGYPlanetEarthPosters.html*, 1958. TLE

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