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Chapter 12

Assessing Space Program Impacts of the IGY*

Å. Ingemar Skoog† and Stephen E. Doyle‡

Abstract

Since October 2008 the International Astronautical Federation (IAF) Advisory Committee on History Activities (ACHA), including participation by IAF, International Academy of Astronautics (IAA), and International Institute of Space Law (IISL) personnel, has been studying the impact of the International Geophysical Year (IGY) on the development and emergence of national space programs and international space cooperation. This study, "The International Geophysical Year—Initiating International Scientific Space Co-Operation," was completed in 2010. An international working group contributed research, bibliographical data, writing, and critiques of the study effort as it progressed. This chapter presents a précis of the study's scope and content and a presentation of the conclusions and observations resulting from the study.

Much has been written about the scientific values, accomplishments, and consequences of the IGY, with thousands of papers generated throughout many years assessing and reporting on the collected and integrated scientific data. To date, there has not been a concerted effort to assess the impact of the IGY as a stimulant of both national space programs and international cooperation. The

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ACHA IGY study shows that there is a useful and informative story to be told concerning this aspect of the IGY's impact.

Although there were 67 participating countries in the IGY, not all of them contributed to, or played a part in, the rocket launching or satellite operational aspects of IGY programs. This study examines the records of 39 countries, which are considered in some detail, focused on the Rockets and Satellites Program of the IGY, some pre-IGY activities, and some post-IGY developments. There were nine countries found with significant space activities in process before the IGY. Twenty countries appear to have initiated or became involved in space activities for, or during, the IGY. At least 10 countries initiated significant national space programs in the immediate wake of the IGY. Bilateral and multilateral cooperation has been identified and analyzed, and resulting international organizations for space cooperation reviewed.

Introduction

Following an agreement to establish a joint advisory committee on history activities among the Presidents of the IAF (James V. Zimmerman), IAA (Edward S. Stone), and IISL (Nandasiri Jasentuliyana), during the 2005 International Astronautical Congress in Fukuoka, Japan, a Charter for the roles and functions of the IAF/IAA/IISL ACHA was jointly approved. The IAF Bureau, at its meeting in March 2006, approved the new committee and issued the following Terms of Reference:

> The IAF/IAA/IISL Advisory Committee on History (ACHA) advises the IAF on possible activities—including symposia and publications—that could be pursued to help preserve and increase awareness of the history of the IAF and the history of international space cooperation. Since many of the members of this committee will be IAA and/or IISL members, the IAF Bureau decided that this new committee should be a joint IAF/IAA/IISL committee.

The purpose of the Committee is to identify/propose projects, identify possible tasks, means of execution (workshops, seminars, and study groups), and means of publication, scheduling, and participants. The Committee Chair and Committee members will assist the IAF, IAA, and IISL Secretariats in implementing projects that are approved to proceed.

ACHA Committee members during 2010 included Å Ingemar Skoog (Chair), Oleg Alifanov, Gérard Brachet, José M. Dorado, Stephen E. Doyle, Vladimir Kopal, Roger D. Launius, John M. Logsdon, Johannes Ortner, and

Luboš Perek. Ex-officio members included Karlheinz Kreuzberg, Yasunori Matogawa, and Scott Hatton.

The ACHA members conducted an iterative process in 2006–2007, during which clear priority was given to a proposed first study project: "The International Geophysical Year—Initiating International Scientific Space Co-operation." After presentation to and the adoption of the study plan by the IAF Bureau, this project was initiated in 2008 under the study management of Stephen E. Doyle. The results of the study were submitted to the IAF Bureau in a final draft on 1 September 2010.[1]

Study Scope

This study was undertaken to examine the role of the IGY as an initiator or stimulant of national space programs and international cooperation in space activities. Consequently the study concentrates on the Rockets and Satellites Program of the IGY and of participating countries and later development of rocketry and satellite programs, which appear to have been stimulated by the IGY. The scientific programs and results of the IGY are well and fully reported in a variety of sources.[2] The plan of this IAF study was to identify for countries involved, to the extent possible and appropriate, relevant science background, rocketry background, satellite background, IGY space-related activities (including ground-based satellite tracking and observation), and post-IGY space activities. The study involved 39 countries and several related international organizations.

The study did not elaborate on the scientific results or science technology developed during the IGY, rather it focused on the institutional consequences of the IGY, and its effects on national and international cooperative space programs. The time frame of this study is primarily the third quarter of the 20th century (1951–1975), because the IGY planning began early in the 1950s and the subsequent expansion of spaceflight activity, including space science and applications developments, occurred rapidly during that quarter century. For the most part, national space programs, which began during the IGY or in the wake of the influence of the IGY during the third quarter of the 20th century, are identified and briefly described. Not included in this study is the space activity expansion continuing, even into the 21st century, as reflected in new and expanding national programs.

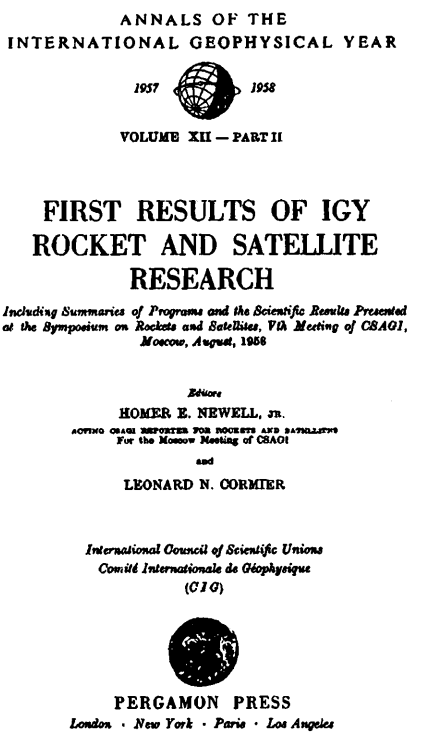

Figure 12–1: *Annals of the International Geophysical Year*, volume 12: First Results of IGY Rocket and Satellite Research, Pergamon Press, 1960. Credit: Pergamon Press.

Analyzed Countries

The Study Group segregated the 39 examined countries into two groups: Group 1—those with space programs predating the IGY; and Group 2—those that initiated space activities as part of, or soon following the IGY.

Group 1

To Group 1 belonged a number of countries, which had well-developed, space-related programs prior to 1957; although they were without designated, operational national space organizations. These countries include Australia, Canada, The People's Republic of China, the Federal Republic of Germany (FRG), France, Japan, the Union of Soviet Socialist Republics (USSR), the United Kingdom (UK), and the United States of America. In some cases there were cooperative international programs in place, usually for use of launch facilities in one country by another country, or for location of tracking stations of one country in other countries. These are identified in the study.

At the end of the 20th century all the Group 1 countries were fully committed participants in several global organizations operating and regulating space activities. They were all participating and contributing members of the United Nations Committee on the Peaceful Uses of Outer Space (COPUOS). Although the IGY was not the initiator or source of astronautical activity in the Group 1 countries in this study, the IGY served as an important stimulus and focal point for development of the astronautical industrial infrastructure, bringing special attention to space sciences, promoting and demonstrating space tracking and telemetry, heightening national attention to the capabilities and possibilities of the uses of space applications systems, and stimulating increased international cooperation. In general, the countries exhibiting early space capabilities enjoyed strengthened industrial development, increased space science, and significant international prestige from their participation in, and contributions to, the IGY program.

Group 2

Countries that responded to the IGY program proposal by initiating space-related programs, or establishing space-related activities shortly thereafter, included 12 in Western Europe: Austria, Belgium, Denmark, Finland, Ireland, Italy, The Netherlands, Norway, Portugal, Spain, Sweden, and Switzerland.

There were two countries in Eastern Europe, Czechoslovakia and Romania, and six countries in the Middle East and Africa: Ethiopia, Ghana, Iran, Israel, the Federation of Rhodesia and Nyasaland, and the Union of South Africa. Finally, there were six Latin American countries: Argentina, Brazil, Chile, Ecuador, Mexico, and Peru; and four nations from the Far East and Pacific Basin countries: Burma, India, Indonesia, and the Philippines.

There is also an unexamined group of countries that was not considered in this study, and that is the group with no significant established and sustained space activity or program as of 1975, although some countries have developed significant national space programs since that time.

IGY Supportive Programs

In the context of the IGY, numerous programs and projects were established in coordination with, directly relevant to, or supporting the activities of the IGY, or as clearly related consequences of it. These programs involved participants in several countries.

The Minitrack Network

The Minitrack Network, established to track Project Vanguard satellites, predated the National Aeronautics and Space Administration (NASA). Minitrack was the first U.S. satellite tracking network, becoming operational in 1957. The Minitrack Network was a chain of stations located generally along the 75th meridian, which is a longitudinal line that extends southward from the North Pole across the Arctic Ocean, North America, the Atlantic Ocean, the Caribbean Sea, South America, the Pacific Ocean, the Southern Ocean, and Antarctica to the South Pole.

Optical Observation with Baker–Nunn Cameras

Part of the planned satellite tracking system to be employed by the United States included a precision tracking phase, expected to consist of 12 observation stations, set up around the world. Each station was to have a high-precision Baker–Nunn camera and associated clock. Data obtained from these installations would permit the calculation of definitive orbits for use in correlating with satellite-borne and ground-based experiments, thus providing valuable scientific information. In the end, 12 optical stations were established.

Project Moonwatch

Project Moonwatch, also referred to as Operation Moonwatch or the Moonwatch Program, was an amateur science program established and organized by the Smithsonian Astrophysical Observatory in 1956 as support for the IGY. The project enlisted amateur help to track globally the first artificial Earth satellites.

Rockoons

The rockoon concept goes back to March 1949. The basic idea was to penetrate the dense atmosphere with a large balloon in the Skyhook class, carrying a suspended sounding rocket. Once high enough, the rocket was fired by radio command straight up through the balloon. The rockoon was, and still is, a simple, inexpensive way of getting high-altitude data without special facilities. Professor James A. Van Allen first put rockoons to practical use when his group from the University of Iowa fired several from the U.S. Coast Guard Cutter USCGC *Eastwind* during its cruise off Greenland in August and September 1952. Many rockoons employing Deacon, Loki, and Hawk rockets were fired between 1952 and 1960, and the technique was used in several countries. As high-altitude sounding rockets became more available, rockoon use declined.

The UN Committee on the Peaceful Uses of Outer Space

As the IGY was concluding its initial data collection in December 1958, the United Nations General Assembly (UNGA) established the ad hoc Committee on the Peaceful Uses of Outer Space (COPUOS), composed of representatives from Argentina, Australia, Belgium, Brazil, Canada, Czechoslovakia, France, India, Iran, Italy, Japan, Mexico, Poland, Sweden, the Union of Soviet Socialist Republics, the United Arab Republic, the United Kingdom of Great Britain and Northern Ireland, and the United States of America.

Formation of International Organizations

The IGY had a significant impact on the formation of international organizations, and also stimulating significant international cooperation in astronautics. International institutional results of the perceived value of the IGY were: (1) the 1957 creation of the Scientific Committee for Oceanographic Research (SCOR); (2) creation of the Special Committee for Antarctic Research, which became the Scientific Committee for Antarctic Research (SCAR); (3) the 1958 formation of the Special Committee for the Inter-Union Cooperation in Geophysics; (4) the establishment by the International Council of Scientific Unions (ICSU) in 1958 of a permanent Committee on Space Research (COSPAR), and (5) to build on work initiated by the IGY, ICSU inspired additional programs, such as the program for the International Year of the Quiet Sun (IQSY, 1964–1965). The establishment of a World Data Center Network also survived the IGY and is maintained today.

National Implications

Group 1 Nations

The Group 1 nations show a very homogenous response to the IGY. All nine nations had started scientific space research and developed launch vehicles or sounding rockets before the IGY. The nations in this group were very active during the IGY, and they all had nationally built satellites in orbit within 10–12 years after the IGY. No fewer than six nations had, by 1971, a functioning satellite launch capability and had launched their own satellites, even if today only four nations (China, Japan, Russia, and the United States) in this group maintain their own national launch capabilities, and two more (France and Germany) were

to become involved in multinational ELDO/ESA* launch vehicle development. They have also all advanced into participation in manned space programs.

It is reasonable to assume that these nine countries would have had a space program even without the IGY, but maybe on a slower pace. However, the strong U.S.–USSR competition, during and after the IGY, certainly triggered a faster build-up of space research and science capabilities in the other countries. The geopolitical situation, with two major space nations, also fostered international cooperation in the form of extensive multinational sounding rocket campaigns after the IGY. Bilateral cooperation was also, in this period after the IGY, a major element of space activities. The two major space nations were to help other nations to access space (for example, the United States launched the first national satellites for Australia, Canada, Germany, and the United Kingdom, while the USSR provided launcher technology to China).

Group 2 Nations

The study recognizes that emergence of space programs following the IGY cannot, in all cases, be directly related to an impetus received from the IGY, although it is equally difficult to conclude that the IGY had no influence.

The large number of Western European countries in Group 2 is a consequence of a strong and relatively broad astronautical tradition in Western Europe and the stimulation of European space programs by the emergence of the ESRO,† ELDO, and eventually ESA. In this group, seven nations were to join ESRO, together with France, Germany, and the United Kingdom out of Group 1, and later all 12 Group 2 Western European nations were to become members of ESA (some of these nations joined ESA after the timeframe of this IGY study, that is, the third quarter of the 20th century). Clearly an organization such as ESRO (and later ESA) helped the smaller countries in this group embark on space activities after the IGY, despite limited financial capabilities. All 12 nations were, during the IGY, involved in ground-based space science and satellite tracking, but soon after the IGY several of the countries became engaged in bilateral sounding rocket projects with their own national payloads (for example, Italy, Norway, Sweden, and Switzerland). Italy also established a national satellite launch capability using U.S. Scout rockets.

Clearly the Western European countries in this group were triggered by the IGY to continue and increase space activities and to undertake them in many co-

* European Launcher Development Organisation / European Space Agency.

† European Space Research Organisation.

operative programs during the years to come after the IGY and, in particular, the founding of ESRO/ELDO, later ESA.

The two Eastern European countries in this group, Czechoslovakia and Romania, performed no rocket or satellite activities during the IGY, but became members of the USSR–initiated Interkosmos program in 1965. They later established national space programs in cooperation with the USSR. Like the other European countries, the IGY had a certain influence on their establishing space activities.

If the European participants of the IGY show a homogenous pattern for future space activities, and the integration into cooperative activities, the non-European countries show a very different picture:

- Out of the six Middle East and African countries, only Iran and Israel continued space activities after the IGY and established a national space program, including a satellite launch capability, although this emerged at a point in time long after the IGY.
- South Africa embarked on a development of military rockets, in a program now ceased and totally separated from any IGY activities.
- Of the six Latin American countries, only Argentina, Brazil, and Mexico undertook initiatives to continue space activities after the IGY. They all developed sounding rocket programs, but in the end only Brazil and Mexico have had a sustained space program with their own satellites and a satellite launch capability in Brazil long after the IGY.
- Out of the four Far East and Pacific Basin countries, only India and Indonesia established national space programs, whereby Indonesia soon concentrated its efforts on application satellites.
- All other countries in this group (Ethiopia, Ghana, Rhodesia and Nyasaland, Chile, Ecuador, Peru, Burma, and the Philippines) terminated their space activities after the IGY for the time period analyzed.

With the exception of India, no single Group 2 country pursued sustained development of launch vehicle technology to the point of offering internationally competitive launch services, although many of them developed an industrial astronautical support infrastructure, and provided materials or services in support of space programs, continuing even today. India is among the most remarkably developed of the Group 2 countries, considering that prior to the IGY, Vikram Sarabhai's Institute for Atmospheric Studies was a leader in the Indian capabilities in space. Today India is among the top 10 countries in the world active in space science, space applications, launcher and satellite development, and conducting expanding space activities. An essential element of the build-up of the initial Indian space program was bilateral cooperation with the USSR.

Another country with satellite launch capabilities today is Brazil. The first launch of Brazil's indigenous sounding rocket family occurred in April 1965, and scientific sounding rocket missions have been continual since then. Brazil also established an orbital launch capability later. The space program of Brazil emerged in the last four decades of the 20th century, but it had little relationship to the IGY, except to the extent that its scientific sounding rocket programs were significant for, and added to, the accumulated databases of the IGY.

Some countries in this group sustained their initial interests and activities and continued active participation in national, regional, or global space applications organizations. In a few cases the national space activities faded and ceased to be pursued.

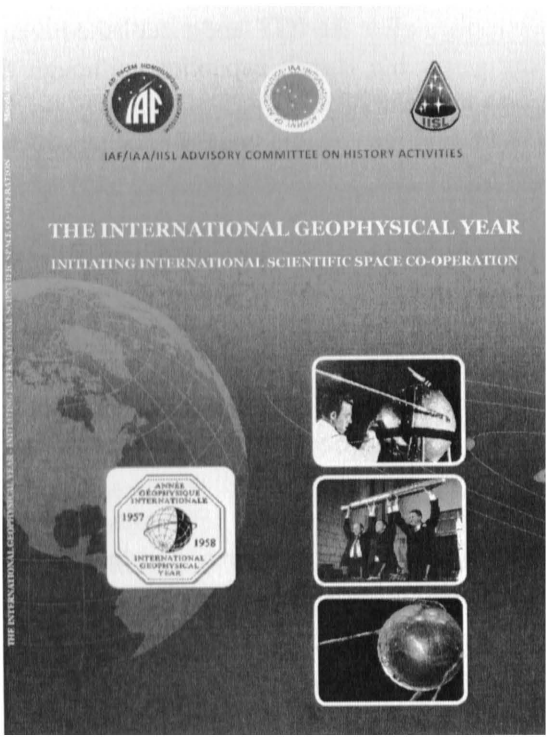

Figure 12–2: The cover of the IGY–ACHA study as published. Credit: IAF.

Conclusions

The study includes a series of conclusions and observations drawn from the assembly of the historical data. The single most noteworthy observation to be made is that the IGY stimulated an unprecedented scope and depth of interna-

tional cooperation in science. An important result in this connection was the stimulation of several nations' interest in the continued use of sounding rockets to add to the understanding of the upper atmosphere and the Sun/Earth relationship. There was also a significant stimulation of interest and membership in the numerous international scientific unions. As noted above, important standing committees were established, supporting international scientific cooperation. The original and emerging national space programs have now sustained their support for, and contributions to, the numerous international scientific programs.

A number of international cooperation's emerged from the IGY and are still existent today, for example, ESA, Interkosmos, COSPAR, UNCOPUOS, and Intelsat. Others, however, were shorter-lived, like the very extensive sounding rocket cooperation's in the early 1960s.

In the end, all the data collected during the IGY or assembled from later programs and activities now have a permanent home in the well-established and widely supported World Data Center network.

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[1] S. E. Doyle, editor, "The International Geophysical Year—Initiating International Scientific Space Co-Operation," final draft for the IAF Bureau, IAF/IAA/IISL Advisory Committee on History Activities, 1 September 2010. The study final report, *The International Geophysical Year—Initiating International Scientific Space Co-Operation,* was published by IAF in March 2012 and is accessible for download at: http://www.iafastro.com/uploads/pdf/Publications/IGY-ACHA-Study.pdf.

[2] See especially the multivolume *Annals of the International Geophysical Year*, in 37 volumes, Pergamon Press, London, and reports produced by many of the involved national committees.