THE INTERNATIONAL GEOPHYSICAL YEAR 1957/58

By M. NICOLET

Rationale and conception

From 1946 to 1950, the years following the Second World War, scientists and scientific circles generally were preoccupied with resuming their international activities. Geophysicists were particularly keen to renew contacts, because a joint approach and close consultation were prerequisites in their particular field which knows no national boundaries.

Thus, the International Union of Radio Science (URSI) had already met in Paris by the summer of 1946. In 1947 the Gassiot Committee of the Royal Society invited research workers investigating airglow and the aurora to come to London for an international meeting, asking them to submit their unpublished findings. Similarly, the French National Centre for Scientific Research invited researchers to Lyons for a meeting on solar-terrestrial relationships. In July 1948 the dozen scientists making up the ICSU Joint Commission on the Ionosphere met in Brussels to examine the various problems of the ionosphere. For the first time in 10 years, the International Union of Geodesy and Geophysics (IUGG) again brought geophysicists together in an international forum, held in Oslo in August. This was followed immediately afterwards by an assembly of the International Astronomical Union (IAU) in Zurich.

At the Conference of Directors in London in March 1946, the IMO had dissolved all its standing commissions, including the International Commission for the (second) Polar Year and so the International Meteorological Committee (Paris, July 1946) had set up a Liquidating Commission to continue the work of assembling and publishing the data begun by Dr D. la Cour (see page 222).

Here it should be noted that the chairman of the Liquidating Commission was Dr John Fleming, president of the International Association of Terrestrial Magnetism and Electricity from 1934 to 1948, and director of the Department of Terrestrial Magnetism of the Carnegie Institution, Washington, D.C. Thanks to Fleming's renown geophysicists had every reason to look ahead with optimism to the promotion and development of geophysics in its various domains. The extension of meteorological observations through the use of radiosondes, the expansion of ionospheric research through the introduction of ionospheric probes, and the first scientific results from rocket launches made it especially important to tackle the third dimension, namely atmospheric studies as a function of altitude. In any case, the completion of work on the second IPY results, set for December 1950, made scientists think about their next objectives.

It was in this kind of atmosphere that in January 1950 I found myself at the Department of Terrestrial Magnetism and the National Bureau of Standards in Washington, D.C., before going on to California. It was clear to me, since I had taken part in all the above-mentioned post-war scientific meetings, that intense thinking was going on to discover how results from new techniques could be correlated with each other in time and space. This was the reasoning behind a suggestion of Dr Lloyd Berkner, made at a private meeting at Professor James Van Allen's home, to follow up the second Polar Year with a third, but after 25 years instead of the 50 years which had separated the first and the second IPYs. The scientific aspects of the idea were discussed during a meeting in May 1950 at Inyokern, China Lake, in the Californian desert. At that meeting, where some 20 scientists came together (see photo facing p. 24), discussion centred on how to put forward the idea of an international year to the Joint Commission on the Ionosphere due to meet in Brussels from 4 to 6 September 1950. The formal proposal to hold an international polar year in 1957/58 (when solar activity would be at its greatest) was made at this Brussels meeting which was under the chairmanship of Sir Edward Appleton. The proposal was then transmitted directly to the unions responsible for the Joint Commission on the Ionosphere, namely URSI, IAU and IUGG. These bodies accepted and extended the proposal, and WMO was invited by ICSU to take part in developing projects in collaboration with the unions, an invitation which was immediately accepted by the WMO Executive Committee. Thus by 1951 acceptance of the idea had become general, and a consensus had gained ground for the adoption of a worldwide international geophysical year programme, rather than a third polar year extending into lower latitudes. A Special Committee for what was to have been the third International Polar Year had already been approved by the ICSU Executive Committee and the ICSU Bureau duly created the CSAGI in May 1952. The members appointed by the unions were Berkner and W. J. G. Beynon (URSI), J. Coulomb and V. Laursen (IUGG), N. E. Nørlund and myself (IAU), and J. M. Wordie (IGU), with E. Herbays acting as secretary. J. Van Mieghem was later co-opted as member representing WMO. The first official meeting of the CSAGI, attended by Berkner, Coulomb and myself, took place in Brussels on 13 October 1952. Through Herbays, our acting secretary representing ICSU, this group of three appealed for collaboration by national members of ICSU, the various scientific unions and WMO, and at the same time called on Unesco for financial support.

Now that the preliminaries had been completed, the preparation of plans for the International Geophysical Year could be set in motion.

Planning and preparation

Preparation of a programme for the IGY was a long and painstaking process involving WMO, the various ICSU unions with their associations or commissions, and the national IGY committees of the countries taking part. The two IPYs had shown that in order to study geophysical phenomena there was a need for extensive international collaboration. Moreover, by 1950 research tools had multiplied, providing new technological means for studying the subject. Finally, the economic crisis of the 1930s which had reduced effective participation in the second IPY was now only a bad dream, even if the international political crisis below the surface was often to complicate the smooth working of the scientists faced with organizing a global undertaking.

The Special Committee for the International Geophysical Year (CSAGI) had its first plenary session in Brussels from 30 June to 3 July 1953, by which time at least 30 national academies had responded positively to the idea of an international undertaking to cover the entire surface of the Earth. The scientific unions had already embarked on preliminary work while the WMO Commission for Aerology was stressing that within meteorology, priority had to be given to programmes which only international co-operation was capable of tackling. This was why WMO's Executive Committee decided in October 1953 to participate officially in the IGY; an internal working party had already been entrusted with the task of detailed preparation of part of the programme.

To draw up the final programme successive meetings of CSAGI were held in 1954, 1955 and 1956 in Rome, Brussels and Barcelona respectively. While the desire was to deal with all the different problems on a planetary scale, it was not practicable to try and cover the entire surface of the globe. Anyway the project would have to be much less extensive if it was to last for a period of only 18 months. When the first proposals had been received in Brussels in 1953, the CSAGI Bureau had considered in fact that the programme should be broken down into sub-programmes covering the

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Illustrations on opposite page and overleaf:

1 Scientific aspects of a possible third International Polar Year were discussed for the first time at a meeting in May 1950 at Inyokern, near China Lake in California (USA). Seated around the table are Drs D. R. Bates (*nearest the camera*), M. Nicolet, R. Penndorf, A. B. Meinel, B. Gutenberg, F. Rogers, Jr., J. Kaplan, M. O'Day, F. L. Roach, O. Wulf, L. V. Berkner, S. Chapman, and J. L. Greenstein. Seated under the window (*left to right*): Drs E. V. Ashburn, M. H. Nichols, G. I. Weissler, C. T. Elvey and W. N. Arnquist. Drs J. A. Van Allen and M. A. Tuve are not on the picture.

2 Sir Edward Appleton (*left*), president of the Mixed Commission for the Ionosphere, and Dr Nicolet on the occasion of the meeting in Brussels in September 1950 when the idea of a third International Polar Year was first officially put forward.
(Photo: AP)

3 The IGY Special Committee (CSAGI) Bureau members in the committee's headquarters in Brussels in February 1958. *Left to right:* Drs V. V. Beloussov, L. V. Berkner, M. Nicolet (Secretary-General), J. Coulomb and S. Chapman (Chairman).
(Photo: Life)

4 A brilliant display of aurora australis at the Japanese Antarctic base of Syowa.
(Photo: R. Sato, J.M.A.)

5 View towards the SW from the Canadian Arctic base of Resolute on Cornwallis I. The cables from the radiation sensors are carried in the elevated wooden trough. The presence of ice crystals in the surface layer of the atmosphere causes a mock sun in front of Cape Martyr, about five kilometres distant.
(Photo: I. A. Asbridge, A.E.S.)

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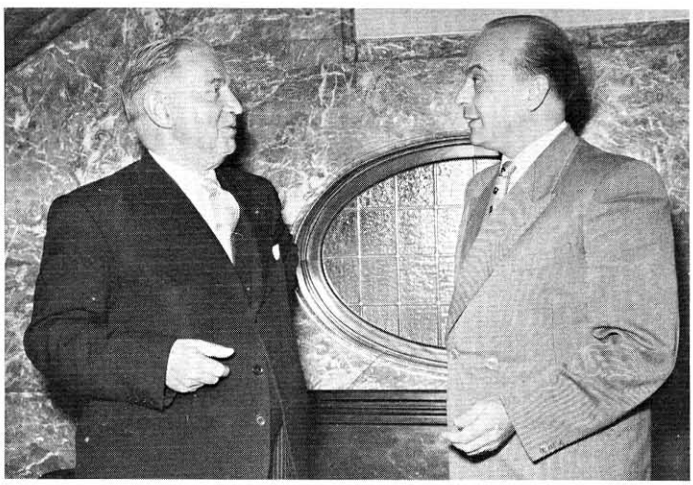

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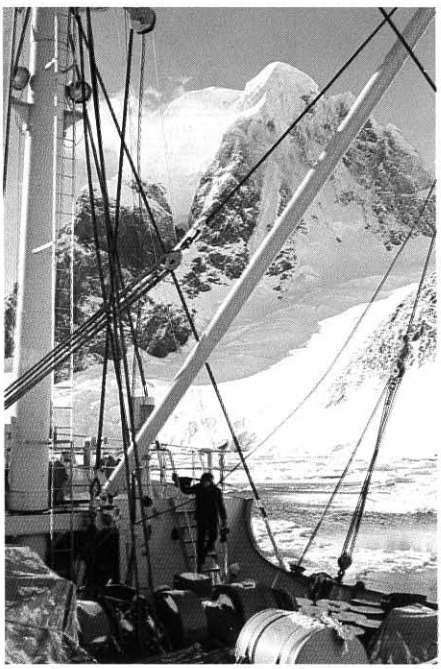

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1957
1958
INTERNATIONAL
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YEAR

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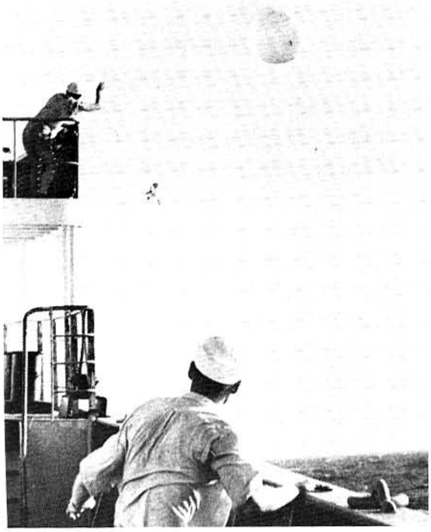

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different scientific disciplines. When the IGY programme first began to be drawn up, agreement was reached on efforts to collate data on problems relating to the upper atmosphere. But because emphasis had to be placed on matters which would help to determine variations in phenomena on the global scale, simultaneous and world-wide observations were in any case required. Likewise, the technical equipment of each scientific discipline had to be taken account of. Finally, geomagnetic and geographic factors had to take their place in the establishment of the programmes.

Given the limitations in manpower and equipment and the budgetary ceilings to be observed in many cases, the first step to be taken was an overall selection of observation stations so that the entire surface of the Earth would be covered as well as possible. In other words it had to be decided how to make a minimum number of observations produce a maximum yield in terms of scientific information. It was decided not to distribute stations uniformly across the surface of the Earth, but to concentrate on areas which would at one and the same time give an overview of most phenomena, and lead to new information on major ones in particular circumstances. In this respect three major areas were immediately picked out: the Arctic and Antarctic regions and the equatorial zone, which corresponded to the geographical and geomagnetic areas of interest to all disciplines. To these three basic regions were then added three meridians for regions corresponding to the American continent (70-80°W), the Euro-African continent (10°E) and a region covering the Far East with Asia and Oceania (140°E). This geographical concentration along defined parallels and meridians made it possible to add additional observation stations to the proposed lists and in some cases helped avoid duplication of effort, and provided data that were representative of most geophysical phenomena.

To cover a complete year of observations in both hemispheres, it was decided that the IGY would last for 18 months, from 1 July 1957 to 31 December 1958. One reason was that the polar expeditions could only reach and establish the bases during the northern and southern summer seasons respectively.

Illustrations on preceding and opposite pages

6 The sun will soon reappear after the long winter night at the base of the Swedish-Finnish-Swiss IGY expedition near 80 degrees N in Nordaustland (Spitsbergen).
(Photo: P. Wasserfallen)

7 Drilling to measure the sea-ice thickness. Unusually low temperatures in 1958 required the improvisation of an extension to the drill.

8 The mountainous west coast of the Antarctic Peninsula from the Royal Research Ship *John Biscoe*, one of the two vessels which resupplied bases maintained by the United Kingdom in that sector at the time of the IGY.
(Photos: R. M. Perry)

9 The first automatic weather station in Antarctica was installed by Australia at Lewis Islet, Davis Bay, in January 1958. It was a modified version of a type originally designed to operate in the Sahara! An Adélie penguin critically surveys the operations.
(Photo: Australian Antarctic Division/P. G. Law)

10 The symbol chosen for the IGY gives prominence to the orbiting artificial satellite, the terminator and the Antarctic.

11 Arrangements were made for radiosonde ascents during the IGY from a Finnish ship plying regularly between Helsinki and Rio de Janeiro.
(Photo: Finnish Meteorological Institute)

12 A sledge journey from Syowa during the first Japanese Antarctic Research Expedition in 1957.
(From a drawing by N. Murakoshi)

Since 1953 the CSAGI Bureau had been making its plans banking on the launching of scientific satellites during the IGY. The IGY logo, with its meridians, parallels, clear demarcation between day and night, Antarctic latitudes prominently featured and the representation of a satellite, is a very clear visual symbol of the International Geophysical Year.

Finally, a certain number of Regular and Special World Days were decided upon. The Regular World Days consisted in principle of three days at every new moon when certain synchronized observations were made at very close intervals. The Special World Days were selected in accordance with solar activity. For these, a forecasting service in the USA would contact all observers by telex and radio and alert them to periods of intense solar activity.

It was only the particularly flexible organizational structure of the IGY and the active participation of not only the major scientific unions and WMO but of their most eminent representatives as well, that made it possible to develop such sophisticated arrangements. World famous scientists in their respective disciplines came together to assist in developing and carrying out the IGY programmes. Such an undertaking would never have been possible without the constant efforts of the scientists both at home in their own countries and actively participating in international meetings. In addition, Unesco made a substantial financial contribution (US $100 000) to the IGY which made it possible to establish in 1953 a permanent secretariat in Brussels that continued its work right through to 1959. The CSAGI secretariat also received generous assistance (US $200 000) from several of the committees taking part in the IGY. In my role as Secretary-General, I was assisted in my voluntary task by this secretariat which initially consisted of Philip Mange and Delphine Jehaulet, and was later joined by Paulette Doyen, 'Mike' Baker, Francine and Maurice Hautfenne and Jean Palange, ably backed up by the Co-ordinator of IGY Operations, Sir Archibald Day, and finally by the Editor of CSAGI, Sir Harold Spencer Jones, based in London.

Finally, assistant scientific secretaries to the CSAGI had accepted the difficult task of arranging international conferences relating to each of the various IGY regions. Preparatory conferences on the Antarctic under the chairmanship of G. Laclavère were held firstly in Paris in July 1955, then in Brussels in September 1955, in Paris in August 1956 and again in Paris in June 1957. Problems of the Antarctic were also discussed at a regional conference in Stockholm in May 1956 under the chairmanship of S. Chapman. A conference on the American region was held in Rio de Janeiro in July 1956 under the chairmanship of E. O. Hulburt, and one for eastern Europe met in Moscow in August 1956 under the chairmanship of J. D. Boulanger. Another regional conference, to co-ordinate the national committees of countries in Africa south of the Sahara, was held in Bukavu (Zaire) in February 1957 after preparation by the assistant secretary for that region, T. E. W. Schumann. One other regional meeting, for the western Pacific, took place under the chairmanship of M. Hasegawa in Tokyo at the end of February 1957.

This was the basic groundwork for the actual preparation of the various IGY scientific programmes.

The various kinds of geophysical observations with enhanced and special programmes

From the outset, the CSAGI, made up of representatives of the scientific unions with WMO participating, had to turn the various domains of geophysics into representative activities. For this reason CSAGI steadily grew in numbers and in sub-branches of geophysics until it consisted of some 30 members.

The members of the Bureau were: S. Chapman (United Kingdom), President; L. Berkner (USA), Vice-President; M. Nicolet (Belgium), Secretary-General; J. Coulomb (France) and V. Beloussov (USSR). Rapporteurs were responsible for separate scientific areas. The following list of names and subject area gives an idea of the different programmes: A. H. Shapley (World Days), J. Van Mieghem (meteorology), V. Laursen (geomagnetism), S. Chapman, with F. Roach and C. Elvey (aurora and airglow), W. J. G. Beynon (ionosphere), Y. Öhman (solar activity), J. A. Simpson (cosmic radiation), A. Danjon (longitude and latitude), J. M. Wordie (glaciology), G. Laclavère (oceanography), L. V. Berkner (rockets and satellites), V. V. Beloussov (seismology), P. Jejay (gravimetry). A fourteenth area, nuclear radiation, was mainly included under meteorology.

Each subject area was developed by IGY committees set up by WMO and the various scientific unions or associations affiliated to ICSU. After the preliminaries, the overall programmes were co-ordinated through international CSAGI assemblies, the various regional conferences and conferences under the separate programme headings. Thus working groups met on oceanography (Göteborg, January 1957), nuclear radiation (Utrecht, January 1957) and rapid geomagnetic and telluric variations (Copenhagen, April 1957). The CSAGI conference on rockets and satellite problems held in Washington, D.C. from 30 September to 5 October 1957 coincided with the launching of the first artificial satellite, *Sputnik-1*.

It is not possible here to go into all the work carried out in all the disciplines. Each rapporteur was responsible for having instruction manuals in his disciplines drafted by experts, and a dozen of these were distributed to the various committees participating in the IGY and published before observations began. In addition, each international union involved in organizing the IGY had the basic components of its own programmes distributed to its members.

As early as 1956 WMO published, under the co-ordination of Professor J. Van Mieghem, a general survey of the meteorological programme of the IGY (WMO-No. 55) where, after setting forth the guiding principles for various studies, the entire programme of observations was described. In addition to the usual observations forming part of synoptic and dynamic meteorology, detailed provision was made for measurements of solar radiation and atmospheric ozone. Finally, analysis of the geographical distribution of the network of observation stations raised the problem of telecommunications and the distribution of IGY information.

The case of ozone may be cited as a good example of study, analysis and investigation. Although observations using the Dobson ozone spectrophotometer had begun 25 years earlier, there had never been any real international co-ordination in this. It was only as a result of the combined efforts of WMO and CSAGI that a proper international network began to operate. The same careful attention was paid to each subject area. For example, specialists in the ionosphere possessed a manual that enabled them to standardize observations to obtain a coherent synoptic overview on the planetary scale.

One of the goals of the IGY was a more thoroughgoing investigation than ever before of the way the sun exercises its influence on terrestrial phenomena. The task here was to observe all the various manifestations of solar activity and to identify the disturbances caused by such activity, particularly in the upper layers of the atmosphere. To make sure that no solar phenomenon went unobserved, the sun was to be monitored 24 hours a day through a chain of observatories girdling the Earth. The information obtained was to be transmitted by radio to the geophysicists.

Following suggestions made either by the committees taking part in the IGY or by the scientific unions, the CSAGI felt that advantage should be taken of so many stations in rarely-visited areas and logistic missions to faraway locations to study certain geophysical phenomena such as seismological events or variations in gravity. This explains the presence of these two disciplines in the list. Glaciology was included because it was felt worthwhile for world-wide baseline data to be drawn up for the future study of long-term trends.

Finally, the rocket programmes put forward by the USA, the USSR, the United Kingdom and Japan introduced *in situ* observations in the upper atmosphere. At its Rome meeting in 1954, the CSAGI requested the development of a rocket programme to study solar ultraviolet and X-ray radiation, cosmic radiation, the Earth's magnetic field, the physical structure of the upper atmosphere and, in particular, the ionospheric regions together with determinations of auroral emissions and airglow. But it also added a recommendation which had great impact, namely the launching of satellites carrying scientific instrument packages during the IGY. The first response came during the early morning of 29 July 1955 when I received by special messenger, in my capacity as Secretary-General of the CSAGI, a letter from the United States Academy of Sciences. This contained an official announcement that a scientific satellite would be launched as part of the programme of the IGY. The announcement of the event was not made to the press until later the same day in the *Palais des Académies* in Brussels, so as not to precede the official announcement in Washington, D.C., due to take place at 14.00 hours and simultaneously in some 40 capitals of other countries taking part in the IGY.

During the next few months the President and Vice-President of the CSAGI, with myself as Secretary-General, considered the various matters posed by the problem of launching satellites under the IGY. After numerous deliberations, at the beginning of 1956 I requested the USSR IGY Committee to see if it could participate not only in the rocket programme (with which it was not yet associated), but also in the launching of scientific satellites. Our request met with a favourable response, although no official reply came until the General Assembly of the CSAGI in September 1956 when the USSR IGY Committee, through its president, Academician Bardin, informed the members that the USSR intended to launch an artificial satellite to carry out scientific observations during the IGY and that launching preparations were already under way. With this the international scientific preparations for the IGY had more or less been completed, but it still remained for the different national committees to make their preparations so as to be on an operational footing by 1 July 1957.

Participating countries and data-management arrangements

This was the first international scientific enterprise on a really planetary scale, and the CSAGI's structure grew up in such a way as to operate effectively under the existing political conditions, often side-stepping bureaucratic bottlenecks. It was one of my functions as Secretary-General to deal with such difficulties and to ensure that the scientific basis of the IGY as originally conceived in 1950 and as developed in each scientific field was not lost sight of. It was also important that the enthusiasm of the rapporteurs engender a like enthusiasm at the national level so that scientists all over the world would become actively involved. For this reason an IGY Advisory Committee had been set up in 1955 consisting of one delegate from each committee taking part. This made possible better contact when considering the actual conditions under which different types of observations would be made, and co-ordinating programmes among countries taking part in such efforts as observations in the Antarctic.

As regards the major question of the publication and dissemination of the observational data collected during the IGY, the desiderata for each discipline were taken account of, and in early April 1957 a meeting of the World Data Centres took place at the IGY secretariat in Brussels. Three World Data Centres were set up. Centres A and B were located respectively in the USA and the USSR, where data from all the different disciplines were collected, while the C Centres collected data for each discipline separately and were located in different countries, for example, WMO Secretariat (Geneva) for meteorology, Denmark and Japan for geomagnetism, Sweden and the United Kingdom for auroral observations and so on.

There is no space here to describe the contribution provided by each country to the arrangements for the IGY. We can get some indication from the accompanying table showing the date at which each national IGY committee joined. It was the first time that such a large number of countries (totalling 67) had come together in free association for the successful completion of a project.

Appraisal of the results

One of the earliest tangible results of the IGY was the way it brought together many thousands of men and women from all over the world to take part spontaneously and freely in a common undertaking. It was a venture which was not responsible to any government organization yet had the support of governments, was not linked with military dispositions yet had logistical support from the armed forces of different countries, was not organized in an internationalized institution yet relied on the collaboration of scientists drawn from 67 countries.

The IGY thus assured continuity in the establishment of permanent observation stations. Many of the 2000 stations originally set up for the IGY are still in operation. More than 10 000 meteorological rocket-sondes have been launched so far, and all the results filed in the archives. It should be stressed that one of the primordial contributions of the IGY was to gather together results, collate and publish them. Also, many groups originally set up in connexion with the IGY are now well-established national bodies. The same is true for the international scene. Although the President and myself decided in 1959 that our administrative tasks could be discontinued and the CSAGI dissolved, it nonetheless proved possible to establish an International Committee for Geophysics (CIG) which went on to publish some 36 volumes of observational data from the various IGY disciplines.

The CIG thus continued the activities embarked on under the IGY (when solar activity was at a peak) until the period of the quiet sun in 1964. In fact in its seven years of official existence, from 1960 to 1967, the CIG published 48 volumes of the *Annals of the International Geophysical Year** covering the birth of the IGY with its original terms of reference, and recording its gradual evolution, its formalization, structure, development, progress and, last but not least, its results. The CIG's activities were appropriately rounded off by the publication of a bibliography.

The sun obligingly marked the opening of the IGY in July 1957 with a series of remarkable solar flares, and went on to display extraordinary activity in the course of the next 18 months, in fact the most pronounced since sunspot records began.

The launching of the first USSR and USA satellites brought an unhoped-for contribution to the advancement of science so intensely desired by the promoters of the IGY. Success was such that, after some initial hesitation, the proposal to establish a

* Pergamon Press (London, New York, Paris) 1959.

IGY Committee	Date of Participation					
	Before July 1953	July 1953-Sept. 1954	Oct. 1954-Aug. 1955	Sept. 1955-Aug. 1956	Sept. 1956 June 1957	After June 1957
Argentina		×				
Australia	×					
Austria	×					
Belgium	×					
Bolivia			×			
Brazil	×					
Bulgaria				×		
Burma						×
Canada		×				
Ceylon					×	
Chile			×			
Colombia				×		
Cuba						×
Czechoslovakia	×					
Democratic People's Rep. of Korea					×	
Denmark	×					
Dominican Republic					×	
East Africa						×
Ecuador					×	
Egypt				×		
Ethiopia				×		
Finland	×					
France	×					
German Democratic Rep.		×				
Germany, Federal Rep. of	×					
Ghana					×	
Greece		×				
Guatemala					×	
Hungary			×			
Iceland		×				
India	×					
Indonesia				×		
Iran				×		
Ireland		×				
Israel	×					
Italy		×				
Japan	×					
Malaya					×	
Mexico		×				
Mongolia					×	
Morocco		×				
Netherlands	×					
New Zealand	×					
Norway	×					
Pakistan		×				
Panama					×	
Peru		×				
Philippines		×				
Poland			×			
Portugal				×		
Rhodesia and Nyasaland					×	
Romania				×		
Spain	×					
Sweden	×					
Switzerland	×					
Taiwan					×	
Thailand						×
Tunisia		×				
USSR		×				
South Africa	×					
United Kingdom	×					
USA	×					
Uruguay				×		
Venezuela				×		
Viet Nam (Democratic Republic)					×	
Viet Nam (Republic)						×
Yugoslavia	×					

Scientific Committee for Space Research under the auspices of ICSU was taken up as soon as the CSAGI was dissolved. Today, some 22 years later, COSPAR is an agency well-known in international research administration.

This lasting impact of the IGY, demonstrated by the way it turned from a temporary study into permanent research, has been felt not only in the domain of space research but in other programmes as well.

The Scientific Committee on Oceanographic Research (SCOR) was created in 1957, followed by the Scientific Committee on Antarctic Research (SCAR) in 1958. Many of the stations set up in Antarctica for the IGY have become permanent, and the formulation of a scientific co-operation programme in the Antarctic led to the signing of the Antarctic Treaty. Working groups under SCAR, such as those on biology, human biology and medicine, meteorology, physics of the upper atmosphere, or Earth sciences all continue to play a prominent part in scientific development. Moreover the Antarctic is now beginning to form an integral part of studies on climate trends.

Scientific activities on a global scale are nowadays a regular occurrence. For example, the Scientific Committee on Problems of the Environment (SCOPE), established in 1969, is designed to take into consideration every new factor that industrial development introduces into the human environment. The ICSU Middle Atmosphere Programme (MAP), with which WMO is closely linked, is another good example of continuing scientific co-operation.

To sum up, thanks in no small part to the active participation of WMO, the IGY proved to be a sort of melting-pot from which emerged clear indices for future geophysical research. Such research, by its nature, depends on a spirit of international co-operation, and even if the present generation of scientists may be unaware of the origins of the collaboration, they accept it as natural in the common quest to push back the boundaries of human knowledge.