

The International Geophysical Year (1957–1958): Great Achievements and Minor Obstacles

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Abstract: A short survey is given of the circumstances in which the First and the Second Polar Years were held: (1882–83 and 1932–33). This is followed by an account of the main events relating to the original conception of the International Geophysical Year and to the development and execution of the scientific programme. Attention is drawn to the willing cooperation, in many different disciplines, of scientists throughout the world.

A talk on the International Geophysical Year, on the occasion of its 25th Anniversary, must necessarily begin with a backwards look at its origins. The thousands of pages contained in the 50 volumes of the *Annals of the International Geophysical Year* present an account of the enterprise which is available to everyone. However, the Secretary General of the *Special Committee for the IGY*, usually referred to by the initials of its title in French (CSAGI), is in a privileged position, because he possesses in his personal archives many of the original documents. He is able, therefore, to spend some time trying to recreate the atmosphere surrounding the events that took place during the climacteric period from 1953 to 1960, but which are not fully described in the *Annals*. On rereading such documents, with hindsight, it is now easier to appreciate the various factors that had a bearing on the preparations for the IGY: factors relating not only to scientific matters, but also to political and economic considerations.

When writing the history of an enterprise, it is interesting to begin by recalling past events that may be analogous to those of the present. Thus, just 200 years ago in 1782–83, the brothers Etienne and Joseph Montgolfier, Directors of a paperworks near Lyon, launched their first two experimental hot-air balloons: nowadays often called “montgolfières”. The first had a silk envelope of 5 m diameter, and it rose to about 20 m after its launch at Avignon in

November 1782. The second was launched from Annonay on 5 June 1783; it was made from linen, had a diameter of 35 m and it reached a height of 2000 m. But on 21 November 1783, at the Château de la Muette in the Bois de Boulogne, a hot-air balloon rose up carrying with it Pilâtre de Rosier and the Marquis d’Arlandes who, on 19 September, had organised the launch of a montgolfière carrying a cock, a duck and a sheep. Finally, before the end of the year, on 1 December 1783 the physicist Jacques Charles and one of the Robert brothers were the passengers in a balloon, filled with hydrogen, which rose into the sky in Paris. Today, two centuries later, modern montgolfières can cross the oceans in the southern hemisphere and make in situ measurements in the stratosphere. A new type of montgolfière, launched by the National Centre for Space Research (CNRS) in France, recently made a complete circuit of the Earth in 53 days.

In the context of the history of science, it is worth recalling the origins of the IGY from its conception, in the USA in 1950, to the first meeting of the Special Committee (CSAGI) in Brussels in 1953. Here too, there is an analogous event in the past; in 1850 Matthew Fontaine Maury, Director of the Naval Observatory in Washington, proposed an international agreement on the coordination of meteorological observations made at sea. The proposal was favourably received and a *Maritime Conference* was held in Brussels

*Internationale
Polar-Konferenz.*

I. Sitzung Am 1. Oktober 1879 .

Die Sitzung wird eröffnet um 11 Uhr Vormittags durch Herrn Dr. Neumayer, der mit wenigen Worten, indem er die Wichtigkeit dieser Konferenz für die Kenntniss der Physik der Erde betont, die anwesenden Mitglieder begrüßt. Anwesend waren die Herren:

- Herr Prof. Buys-Ballot delegirt von dem „Waterstaat-Kantel-ou-Specieel-Ministerium“, für Holland.
- „ Hpt. Hoffmeyer del. von Königl. Dänischen Marine-Ministerium für Dänemark.
- „ Prof. Long del. von der Kaiserlich Russischen Geographischen Gesellschaft zu St. Petersburg.
- „ Prof. Mascart del. vom Ministerium des öffentlichen Unterrichts in Frankreich.
- „ Prof. Mohr del. vom Königlich Norwegischen Unterrichtsministerium für Norwegen.
- „ Prof. Neumayer und
„ Hpt. zur See von Schläinitz } del. von der Kaiserlich Deutschen Admiralität für Deutschland.
- „ Linienschiff-Lieutenant Dr. Weßjuchel, mit Vollmacht vom Kaiserlich Russischen Seekriegsministerium, den Sitzungen beizuwohnen und

i. z.

del. von Grafen Wölphel.
Herr Prof. Wjtkander del. von der Königl. Akademie der Wissenschaften zu Stockholm, für Schweden.

Herr Neumayer verliest die eingeleiteten eingegangenen Schreiben, welche auf die Betheiligung bei dem Kongress zu einem Bezug haben. Diese Schreiben waren:

Eine Anzahl von Herrn Scott, beziehungsweise von Herrn Toyne an ihn gelangten Schreiben, darunter Erklärungen wegen Nichtbetheiligung bei diesen Verhandlungen von Seiten Portugal's, Englands, Spaniens, Belgiens, Bayerns, Sardens u. s. w.

Gleichzeitig legt derselbe einige Mittheilungen von eingeleiteten Mitgliedern der Konferenz, angehörender Gebirgsvereine vor. Er wird dies folgende Vertheilung:

1. Dr. Köpfer, Denkschrift über eine Gradmessung in Böhmenland
2. Buchman, u. letter addressed to the Office.
3. General Major. Brief an Lt. Weßjuchel.
4. Dr. Müny, Brief
5. Akademi med. Dr. Neumayer, Denkschrift über Luftdruckverhältnisse
6. - Exemplar von dem Bericht über die im Jahre 1875 abgehaltene Deutsche Polar-Konferenz
7. Lt. Weßjuchel, die Aufgabe der magnetischen Forschungen in dem Polar-gegenden
8. - Programme der travaux d'une expedition polaire internationale.

Herr Neumayer proponirt die Konstituierung der Konferenz und der Bureau's derselben und schlägt als Vorsitzenden Herrn Buys-Ballot vor.

Herr Hoffmeyer glaubt, dass Herr Neumayer als Vorsitzender weiter fungiren solle.

Nach dem einstimmigen darauf bezüglichen Beschlusse

Fig 1 The two first pages of the report on the First International Polar Conference held in Hamburg in October 1879. The Director of the Deutsche Seewarte, G. Neumayer, was the first Chairman of this conference. A decision was taken at this Conference by the delegations from Austria-Hungary, Denmark, France, Germany, Netherlands, Norway, Russia and Sweden to have at least eight stations in the Arctic for a whole year. The firm plans were adopted at St Petersburg in August 1881, and the First Polar Year started on 1 August 1882.

from 25 August to 8 September 1853, 100 years before the First General Assembly of the CSAGI. Representatives from 10 countries attended: Belgium, Denmark, France, Netherlands, Norway, Portugal, Russia, Sweden, UK and USA.

The views of the Brussels Conference are clearly expressed in the Proceedings and in the Resolutions. I would like to quote one or two examples from the original text, and I would invite you to imagine the views expressed adapted to the context of 1953, or even of the present time. First, this extract:

“That an instrument so rude and so abundant in error, as is the marine barometer generally in use, should in this age of invention and improvement be found on board any ship, will doubtless be regarded with surprise; and it will be wondered how an instrument so important to meteorology and so useful to navigation, should be permitted to remain so defective that meteorologists, in their investigations concerning the laws of atmospheric pressure, are compelled in great measure to omit all reference to the observations which have been taken by them at sea. The fact will it is believed afford a commentary upon the marine barometers now in

use, which no reasoning or explanation can render more striking”.

The second extract is equally uncompromising in its tone:

“With regard to thermometers, the Conference does not hesitate to say that observations made with those instruments the errors of which are not known, are of little value, and it is therefore recommended, as a matter well worth the attention of cooperators in this system of research, whether some plan may not be adopted in different countries, for supplying navigators, as well in merchant-men as in men-of-war, with thermometers, the errors of which have been accurately determined”.

Finally, I must refer to a quotation of a completely different character which, in an updated form, reflects the ideas that inspired those who organised the IGY. “Lastly the Conference feels that it would but inadequately discharge its duties, did it close this report without endeavouring to procure for these observations a consideration which would secure them from damage or loss in time of war, and invites that inviolate protection which science claims at the hands of every enlightened nation; and that, as vessels on discovery or scientific research are by consent suffered to pass unmolested in time of war, we may claim for these documents a like exemption, and hope that observers, amidst the excitement of war, and perhaps enemies in other respects, may in this continue their friendly assistance, and pursue their occupation, until at length every part of the Ocean shall be brought within the domain of philosophic research, and a system of investigation shall be spread as a net over its surface, and it become rich in its benefit to commerce, navigation and science, and productive of good to mankind”.

Alas, geophysicists are well aware of the fact that, although scientific ideas have greatly influenced human behaviour, they have not yet succeeded in controlling it. In spite of this, the two Polar Years of 1882–83 and 1932–33, and also the IGY in 1957–58 have, together, and in different ways, made important contributions to present-day achievements in geophysics. If one were to try to describe each of these three events by a single word, appropriate choices would be: *sublime* for the First Polar Year, *courage* for the Second Polar Year, and *audacity* for the International Geophysical Year.

It is worth recalling the remarks made in August 1881 in St. Petersburg by H. Wild, the President of the Commission for the First Polar Year, at the last meeting before the beginning of observations: “Yes, Gentlemen! Weyprecht’s idea was an excellent and a happy one. In fact it has survived the disasters of war, disagreements between nations, the obstacles caused by human jealousy and even the death of its author”. This event was the first and is still an outstanding instance in the history of the science of multidisciplinary international cooperation; but Carl Weyprecht had been obliged, over a number of years, to defend his ideas and



Fig 2 Carl Weyprecht (1838-1881). The First International Polar Year must be attributed to the determination of Karl Weyprecht “Linienschiffslieutenant” of the Austran Navy. With the support of Count Hans Wilczek, Austrian aristocrat, the collaboration of Julius Payer of the Austran Army, and also with the foresight of scientists such as Dr. Georg Neumayer, Director of the Deutsche Seewarte, who was President of the First International Polar Conference held in Hamburg in October 1879, the imaginative concept of Weyprecht on polar scientific research was accepted when the Third International Polar Conference took place in St. Petersburg in August 1881. The conference specified 1 August 1882 as the definite date for the First International Polar Year; Weyprecht, who was not present, had died four months earlier, on 29 March, 1881.

to encourage their acceptance’ It was not until a year after his death that several geophysicists succeeded in launching this first great peaceful enterprise, and in spite of the Balkan War of 1877. This enterprise can well be described as sublime, especially when one recalls that scientific recording instruments usable in the polar regions did not yet exist. It is easy to imagine the problems associated with noting the variations of thermometers, following the erratic fluctuations of magnetometers, and describing the visual aspects of the aurora when one remembers that these operations were carried out in the arctic night and winter and usually under very difficult living conditions. The Dutch expedition

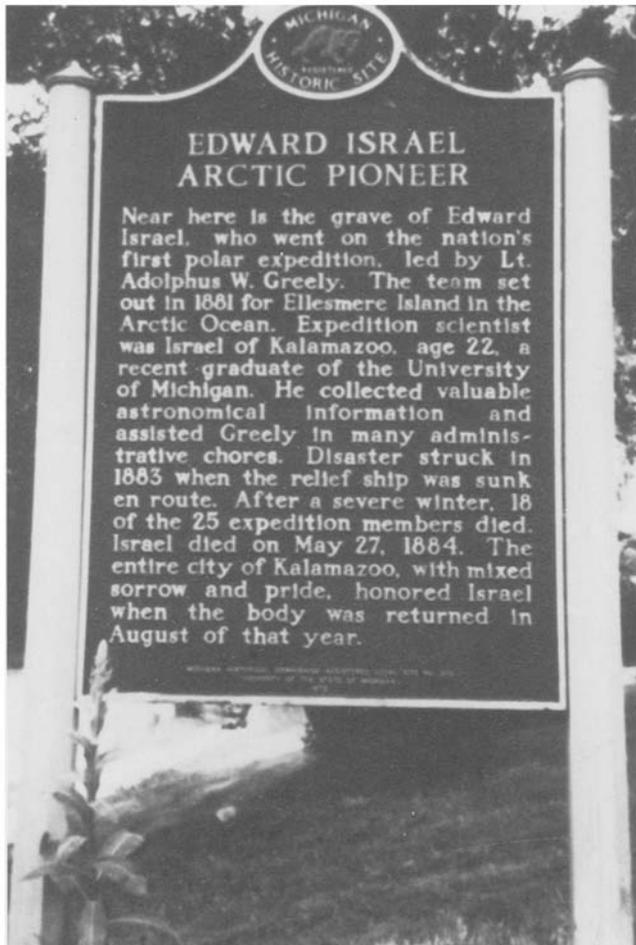


Fig 3 Edward Israel (1862-1884). Memorial dedicated to the memory of Edward Israel, a member of the United States expedition to Lady Franklin Bay during the First International Polar Year (1882-1883).

This memorial, erected at Kalamazoo (Michigan), recalls the sacrifice made by the young men who died after suffering the rigours of a third unplanned Arctic winter. The expedition of 25 men left for Lady Franklin Bay (83°N) in June 1881 and made observations up to August 1883, the end of the International Polar Year. The six survivors landed at New York in August 1884 and brought with them their scientific documents in three sealed boxes.

was obliged to return home after its ship, the *Varna*, had been crushed in the pack-ice, and after continuing to make scientific observations for a time from a camp on an ice-floe. After having survived three arctic winters, the American expedition to Lady Franklin Bay ended in disaster; of the 25 participants, only seven survived death by hunger and were able to return with all the scientific data.

Perhaps it would be worth mentioning another present-day link with the First Polar Year. During the present IUGG Assembly, particular attention will be given to the volcano El Chicon in a series of talks relating to various explosions.



Fig 4 The *Varna* (and the *Dymphna*) on 21 January 1883 of the "Nederlandsche Pool-Expeditie" during the First Polar Year (1882-83).

The Expedition was bound for Port Dickson. The photograph shows the situation on 21 February 1883. The *DYMPHNA* (right), a Norwegian steamship, and the *VARNA*, a Danish ship chartered by the Dutch Expedition with the aid of private funds, have been icebound in the Kara Sea since 22 September 1882. The *VARNA* has suffered irreparable damage from the pressure of the ice; the rudder has been broken, and the engine room is being flooded. On the left can be seen the observatory and living quarters already constructed on the ice.

This volcano, in the State of Chiapas in south-east Mexico, erupted on 28 March 1982 and again more actively on 3 and 4 April. El Chicon had a famous predecessor which exploded on 27 August during the First Polar Year: Krakatoa, situated in the straits between Sumatra and Java. The explosion was of such a magnitude that it caused anomalies in barometric pressure and sea level which were recorded by the French expedition at Cape Horn and the German expedition on South Georgia: anomalies which could not be accounted for at the time by the observers' It was only after their return home that the association was made between these anomalies and the explosion which, in modern terminology, had the strength of a 100 Megaton bomb. The sea-level observations on 27 and 28 August at Cape Horn showed, besides the small variations due to the sea swell, an abnormal series of waves of amplitude about 50 cm, and a period of half an hour; these had been transmitted through the ocean, with a velocity of 150 ms^{-1} , and their origin was the explosion on Krakatoa on 26 August.

After the heroic epoch of the First Polar Year, there were important developments in instrumentation, and communications across and between the continents became commonplace. In this new set of circumstances, in November 1927, the meteorologist J. Georgi, suggested that the 50th anniversary of the First Polar Year should be marked by a repetition of the event. Under the auspices of the International Meteorological Organisation (IMO), a special Commission was created including, as Chairman, Dan la Cour who was Director of the Danish meteorological service and who became the king-pin of the Second Polar Year



Fig 5 The Dutch Expedition on an ice-floe in New Holland (9 July 1883).

Since October 1882, a stock of food and other supplies from the VARNA have been collected, first on an ice-floe which was given the name SAN SALVADOR. In December, another ice-floe, thicker and nearer to the VARNA, was selected for the establishment of the station. It was called NEW HOLLAND and on it the technical and scientific facilities intended for Port Dickson were set up.

(1932–33). The programmes showed great promise, for la Cour had introduced new magnetometers, and besides this it had become easy to measure the heights of auroral displays; moreover, the meteorological radiosonde had appeared, and the miniature Jaumotte meteorographs had proved to be of great value. Finally, the recently invented ionospheric sounder had already made it possible to investigate the ionised regions of the upper atmosphere.

Unfortunately, owing to the deteriorating world economic situation and the serious crisis of the 1930's, the wisdom of continuing with the plans was questioned on several occasions. It is for this reason that it seems appropriate to associate the word *courage* with the Second Polar Year.

The International Research Council, which had been created in Brussels in 1919, was replaced by the present International Council of Scientific Unions in 1931. Four of the Unions had been active since 1919: the Unions of

Astronomy (IAU), of Geodesy and Geophysics (IUGG), of Pure and Applied Chemistry (IUPAC) and of Radio Science (URSI). In 1922 and 1923 the Unions of Pure and Applied Physics, of Geography and of Biological Sciences were added to the original members.

The IUGG finally entered into the discussions concerning the proposed Polar Year and decided to encourage the strongly held views of Dan la Cour, and to give him practical support. Two of the Associations (Terrestrial Magnetism and Meteorology) were particularly active. The former had financed the photographic Atlas of auroral forms; it was now ready to purchase spectroscopes and special cameras, and to share the cost of establishing archives of magnetic observations. The Meteorological Association decided to assist with the purchase of radiosondes, in the preparation of daily synoptic charts and in the publication of the results.

Sadly, the outbreak of World War II in 1939 led to the interruption of normal international relations between

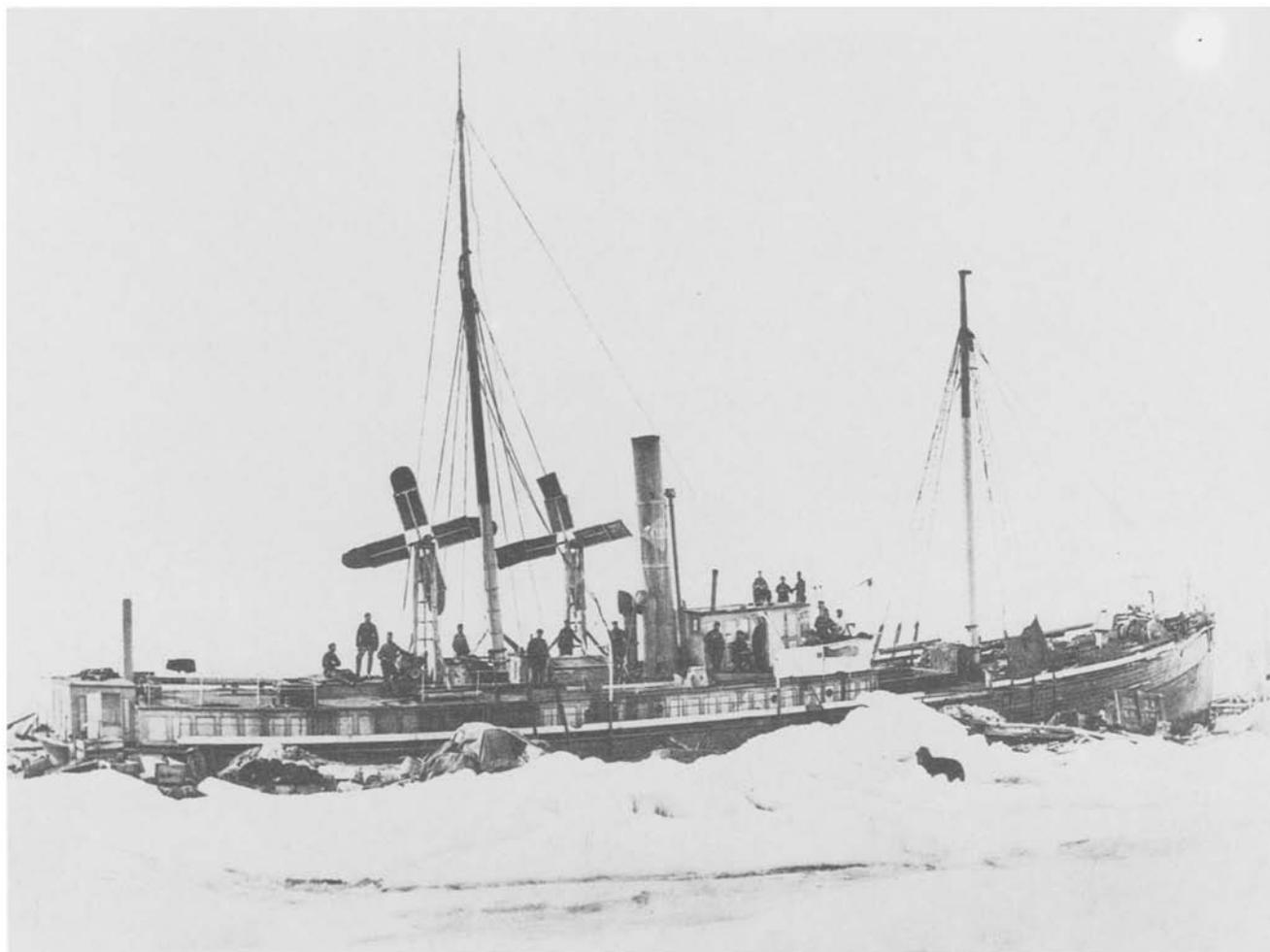


Fig 6 The last visit of the members of the Expedition to the VARNA, 22 June 1883.

The VARNA was held by the ice until the early Summer of 1883. As the ice melted, the ship settled by a few centimetres each day and finally sank on 24 July at $71^{\circ} 4' 8''$ N, $6^{\circ} 51' 6''$ E. The members of the Expedition and the crew of the VARNA set out on 1 August, by sledge and canoe, and reached Cap Grebeni ($69^{\circ} 39' N$) near the Jungor Straits. There they were picked up on 1 September by the NORDENSKJÖLD which was returning from the Kara Sea.

scientists, and saw the unexpected death of Dan la Cour, the key figure during the Polar Year. After the end of the War, the Conference of Directors of the IMO met in London in March 1946 and decided to dissolve all the existing Commissions. However, in Paris in July 1946, the International Meteorological Committee created the Commission for the Liquidation of the Second Polar Year. Its terms of reference were to continue the work already begun before the War, and to complete it by December 1950. This task was admirably carried out by Viggo Laursen to whom much is owed by the scientific community. Thus, in the end, courage had triumphed in spite of many obstacles.

The completion of the work of this Commission in December 1950 had attracted the attention of several geophysicists in the USA, including that of its Chairman,

John Fleming, who had been 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 in Washington, DC. Given the established reputation of Fleming, the geophysicists were encouraged to consider in what ways a new impulse could be given to the development of their discipline. The many new techniques that had become available, including already the first scientific rockets, led to suggestions pointing in all possible directions including the third dimension.

It was in January 1950 that I visited the Department of Terrestrial Magnetism and the National Bureau of Standards in Washington before passing six months in California. I noticed at once that the ionospheric physicists were parti-

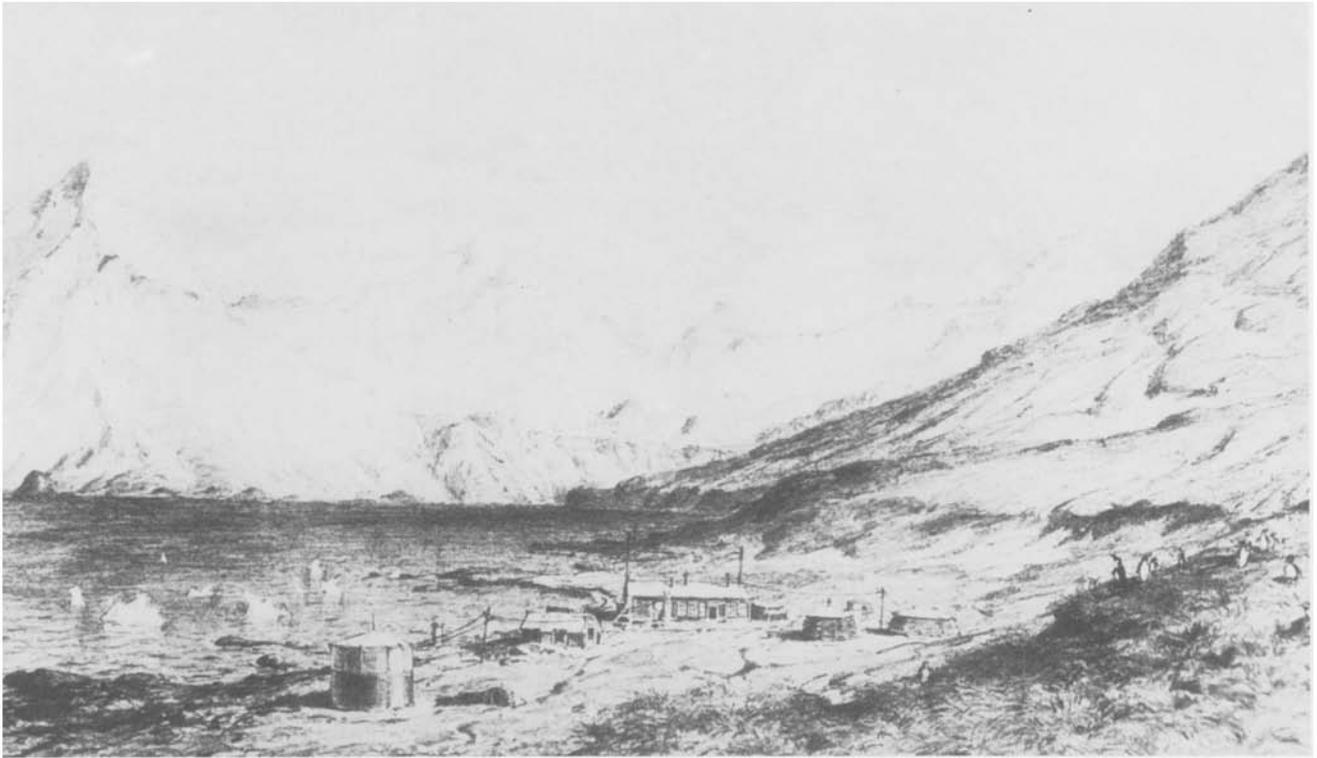


Fig 7 The German Expedition of the First International Polar Year to South Georgia.

The South Georgia group as well as the French Expedition to Cape Horn were equipped with self-registering tideimeters; with these they observed, on 27-28 August 1883, the tidal waves due to the volcanic eruptions of Krakatau which began on 25 August 1883 and reached their height during the nights of 26 and 27 August. At both stations the recordings of the sea level showed distinctly the onset of the Krakatau eruption on 27 August 1883.

cularly anxious to demonstrate their dynamic approach by making many suggestions for the future and, on 5 April 1950, Lloyd Berkner put forward the idea that the Polar Years should be repeated at intervals of 25 years. Scientific aspects of this suggestion were discussed in May 1950 during a meeting held in the Californian Desert at Inyokern, China Lake. Several of the 20 or so participants considered how best to introduce the subject of a possible third Polar Year to the international scientific community, and it was suggested that this should be done through the *Mixed Commission of the Ionosphere* in which the interested Scientific Unions were represented.

The question was further discussed at other meetings and, in particular, at the *Conference on the Physics of the Ionosphere* organised in late July 1950 by A. Waynick at the Ionosphere Laboratory of the Pennsylvania State University. The opinion of a number of those present was that a proposal for the organisation of a third Polar Year should be submitted to the Mixed Commission, which was due to hold a meeting from 4 to 6 September 1950 in the Palace of the Academies in Brussels. The Chairman of the Commission was E. V. (later Sir Edward) Appleton, who was Presi-



Fig 8 V. Laursen, Reporter for Geomagnetism, at the First CSAGI Session, 10 September 1956 of the Fourth General Assembly held in Barcelona, indicating that the instruments and the methods of observations to be used during the IGY are based on classical principles. 12 recommendations on a co-ordinated program of priorities were adopted at the Final Plenary Session on Saturday, 15 September 1956.



Fig 9 Starting Point of the International Geophysical Year (IGY).

The official starting point of the International Geophysical Year was the Palace of the Académies in Brussels; the occasion was the meeting of the Mixed Commission of the Ionosphere (4-6 September 1950). The President of the Commission, Edward Appleton, is on the left of the photograph with Marcel Nicolet, future Secretary General (1953) of the Special Committee for the IGY. The participants at this meeting were: Appleton, Aono, Berkner, Beynon, Booker, Burrows, Maeda, Hagihara, Hamada, Herbays, Kotani, Lejay, Martyn, Massey, Menzel, Nicolet, Shapley and Waynick. The Commission presented the initial proposal for a Third International Polar Year to the International Council of Scientific Unions, and to the Unions themselves, in 1950.

Fig 10 Solar Activity during the International Geophysical Year (IGY). An outstanding feature of the IGY was the exceptional level of solar activity; the highest ever recorded. For the first time in history, it was possible to observe the Sun continuously, thanks to the distribution in longitude of the chain of cooperating observatories.

On Day 3 of the IGY (3 July 1957) a remarkable solar flare appeared on the disk. The photograph was made at the Meudon Observatory in monochromatic hydrogen light (H-alpha). It shows the bright plages over the regions of strong activity and also the dark filaments representing prominences seen projected on the disk.

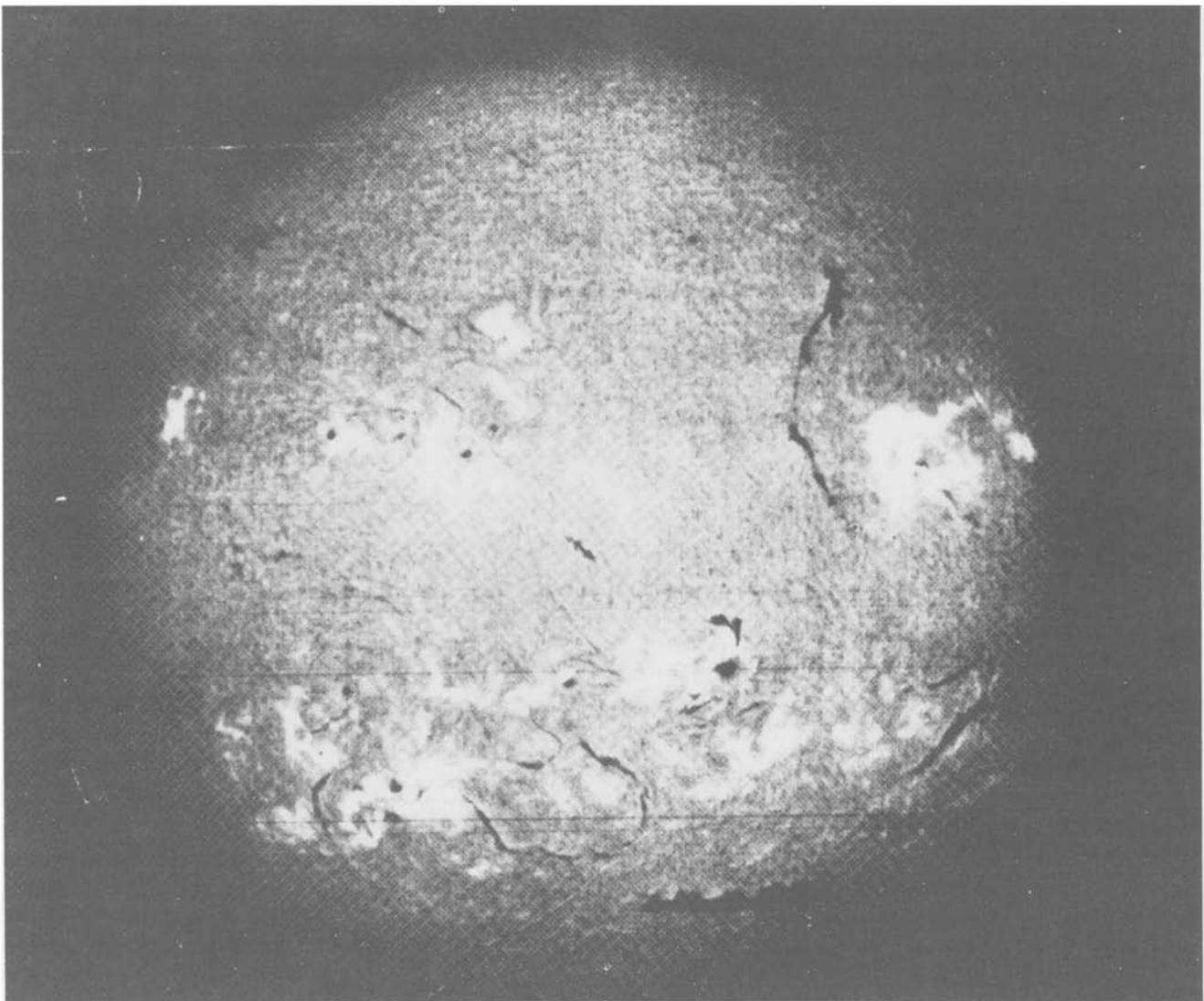


Fig 11 Meeting of the Bureau of the Special Committee for the International Geophysical Year (CASGI) in the office of the Secretary General at Uccle-Brussels, June 1957.

Left to right: V.V. Belousov (USSR); L.V. Berkner (USA), Vice-President; M. Nicolet (Belgium, Secretary General); J. Coulomb (France) and S. Chapman (UK), President.



dent of URSI and who had participated in the Second Polar Year when he had made early ionospheric observations in the Arctic; it was to him that the official proposal was transmitted. After the Brussels meeting, the Commission submitted, to its constituent member Unions, the proposal for a Third International Polar Year to be held in 1957–58 during the expected maximum in the cycle of solar activity. The proposal was unanimously accepted by the Unions and, in particular, by IUGG at its General Assembly in Brussels in 1951. Among the most active supporters in IUGG were Sydney Chapman, then President of the Association of Terrestrial Magnetism and Electricity, and later President of IUGG (1951–1954), and also Jean Coulomb a later President of this Association from 1951 to 1954. In May 1952, the International Council of Scientific Unions formed the Special Committee for the International Geophysical Year, so called because the programme was no longer

restricted to the polar regions alone. In 1953, at the suggestion of Julius Bartels, the Committee became widely known as CSAGI. The members designated to represent the Unions were Berkner and Beynon (URSI), Coulomb and Laursen (IUGG), Norlund and Nicolet (IAU) and Wordie (International Geophysical Union). Later, Van Mieghem was coopted as the representative of the World Meteorological Organisation.

As a result of their collective efforts, scientists had achieved their first success in a politically unstable and divided world. The Korean War had been in progress since June 1950, and there were still many obstacles to be surmounted. However, confidence encourages audacity. On 13 October 1952, three members of CSAGI, Lloyd Berkner, Jean Coulomb and Marcel Nicolet, met in Brussels together with their Secretary, Ernest Herbays, who represented ICSU. The outcome was the dispatch of a first invitation



Fig 12

Fig 12 W.J.G. Beynon, Reporter for Ionosphere, reviewing the state of preparation for the IGY ionospheric program at the First Plenary CSAGI Session of the Fourth General Assembly held in Barcelona. He reported that 150 stations were ready to make regular observations of the ionosphere by vertical incidence soundings. The 19 resolutions adopted by the CSAGI at its final plenary session were based on the IGY ionosphere program considered by the URSI-AGI Committee meeting in Brussels on 29-31 August 1956.



Fig 13

Fig 13 J.M. Wordie, Reporter for Glaciology, at the first plenary session of the Fourth CSAGI General Assembly held in Barcelona, 10-15 September 1956, notes that the principal resolutions pertaining to glaciology have been presented to and adopted by the CSAGI Arctic and Antarctic Conferences, which recommend the standardization of instruments and the mutual exchange of information.



Fig 14



Fig 15

Fig 14 J. Van Mieghem, Reporter for Meteorology, presenting his summary report at the First CSAGI Session, 10 September 1956, of the Fourth General Assembly of CSAGI held in Barcelona. On Saturday, 15 September 1956 at the Final Plenary Session, 27 resolutions were adopted; these related to all aspects of the meteorological observations (synoptic and upper air stations, carbon dioxide measurements, atmospheric chemistry, ozone measurements, actinometric instruments, etc).

Fig 15 S. Chapman, President of CSAGI, and also Reporter for Aurora and Airglow, describing the geographic distribution of the auroral stations and the airglow programme at a Session of the Fourth General Assembly of CSAGI held in Barcelona. 17 recommendations related to the coordination of observations were adopted at the last CSAGI session on Saturday, 15 September 1956. From left to right, Sir Harold Spencer-Jones, CSAGI Editor, L.V. Berkner, S. Chapman, M. Nicolet and J. Coulomb.

to the interested Unions, and to the World Meteorological Organisation, to submit programmes of observations to be made in their respective disciplines. A second invitation was addressed to the Academies and similar national scientific organisations; it proposed the formation of local committees which would keep in close touch with the developing plans for the IGY. Bearing in mind the logistical problems that could be foreseen, it was decided to ask, through ICSU, for some financial support from UNESCO. Finally, the decision was made to convene a plenary meeting of CSAGI in July

1953 in Brussels. The choice of a President for CSAGI was then an important question and there was unanimous agreement that Sydney Chapman should be invited to accept the position. In spite of his continued diffidence over a period of several months, he finally agreed, thanks to friendly persuasion mainly on the part of Coulomb and Nicolet. On 30 June 1953, at the Brussels meeting, Sydney Chapman was duly elected President of CSAGI. Also as a result of the *boomerang effect*, which Jean Coulomb and Georges Laclavère will recall, Marcel Nicolet was elected



Fig 16



Fig 17

Fig 16 G. Laclavère, Reporter for Oceanography, Scientific Secretary for the Antarctic, Chairman of the Publication Committee giving his last report on Saturday, 15 September 1956 at the final plenary session of the Fourth CSAGI General Assembly held in Barcelona. He is translating a text of the Finance Committee, while the General Secretary M. Nicolet is reminding S. Chapman, President, of one or two items for his closing remarks.

Fig 17 Rome, 25 September 1954. An unofficial meeting was held on 25 September 1954 in the Grand Hotel, Rome. The Bureau of CSAGI was represented by S. Chapman (President), L.V. Berkner (Vice-President) and M. Nicolet (Secretary General). The members of a delegation of geophysicists from the USSR were V.V. Belousov, A.G. Kalashnikov, A.S. Monine and M.B. Cornoung. The photo shows (from left to right) A.G. Kalashnikov, S. Chapman (retiring President of the International Union of Geodesy and Geophysics) and V.V. Belousov.



Fig 18



Fig 19

Fig 18 Rome, 25 September 1954. At the end of the meeting on 25 September 1954 (Fig 17), from left to right: L. V. Berkner, A.S. Monine, M.G. Cornoung, S. Chapman and M. Nicolet.

The conclusions of the meeting were that the members of the USSR Geophysical Delegation were acting in personal capacity in relation to CSAGI matters, that they would inform the USSR Academy, and would attend as observers at the final session of the CSAGI Assembly on 4 October at the Palace of Consiglio Nazionale delle Ricerche, Pazzale delle Scienza, Rome. However, a rapid official answer was given. At the opening session, the President made the announcement that notification had been received, through the USSR Embassy in Rome, that the USSR Academy of Sciences would participate in the IGY.

Fig 19 V.V. Belousov, Reporter for Seismology, at the Final plenary session of the Fourth CSAGI General Assembly held in Barcelona, 10-15 September 1956, explaining the collaboration between the Bureau Séismologique International and the CSAGI Working Group for the IGY seismological programme.

Secretary General. At this first CSAGI meeting, the 24 participants were able to draw up a preliminary programme in the knowledge that 30 Academies had already responded favourably to the concept of the International Geophysical Year.

On the political level, the armistice in Korea was signed on 27 July 1953. For the scientists in the CSAGI Bureau, one of the first tasks was to encourage participation in the IGY on a world-wide scale. During the General Assembly of

IUGG in Rome, members of the Bureau met a delegation from the Academy of Sciences of the USSR on 25 September 1954 in the Grand Hotel; as a result, the Academy was represented at the final session of the General Assembly of CSAGI which was held from 30 September to 5 October 1954.

It seems appropriate to recall here the 14 scientific disciplines adopted by CSAGI, which ranged from meteorology and geomagnetism to seismology and gravimetry. Each



Fig 20



Fig 21

Fig 20 A.H. Shapley, Reporter for World Days and Communications, giving a summary report, on 10 September 1956, at the First CSAGI Session of the Fourth General Assembly of CSAGI held in Barcelona. The four facets of the programme were (a) an IGY Calendar of Selected Days; (b) a scheme for Announcing phenomena of unusual interest that could be anticipated a few hours in advance; (c) the general and rapid dissemination of outstanding solar and geophysical events and (d) the organization and use of a world-wide communication network for information of scientific interest.

Fig 21 Y. Ohman, Reporter for Solar Activity at the First Plenary Session of the Fourth CSAGI General Assembly held in Barcelona, 10-15 September 1956, describing the programme of about 50 different observatories engaged in solar work during the International Geophysical Year.



Fig 22 J. Simpson, Reporter for Cosmic Rays, reviewing the programme of cosmic-ray observations already in operation, or coming into operation for the IGY, at the First Plenary Session of the Fourth CSAGI General Assembly held in Barcelona, 10–15 September 1956. New supporting observations on solar physics and ionospheric observations were suggested and later recommended by CSAGI.



Fig 23 A. Danjon, Reporter for Longitudes and Latitudes is explaining at the Final Plenary Session of the Fourth CSAGI General Assembly held in Barcelona 10–15 September 1956, the present state of preparation of the 33 permanent time services and of the 13 new services to be ready for the end of the IGY. Near A. Danjon: on the left J. Bartels, on the right K. Bobrovnikoff and in front of him J. Coulomb and V. Laursen.



Fig 24 P. Lejay, Chairman of the French National Committee for the IGY and CSAGI Reporter for Gravimetry, describing the French Space Program at the CSAGI Inaugural Plenary Session of the Fourth General Assembly in the Gothic Hall of the City of Barcelona on Tuesday 11th September 1956.

was the responsibility of one of the competent Reporters who represented the interests of IAU, IUGG and URSI.

Since the beginning, the membership of CSAGI consisted of the representatives of the Unions and of the WMO, and the need to cover adequately the many different branches of science led eventually to the inclusion of 30 members in the Committee.

The General Secretariat of CSAGI was set up in offices provided by the Radiation Department of the Royal Meteorological Institute in Belgium. The Members of the Bureau, the directing body, were:

† S. Chapman	President (UK)
† L. Berkner	Vice-President (USA)
M. Nicolet	Secretary General (Belgium)
J. Coulomb	Member (France)
V. Belousov	Member (USSR)

The Discipline Reporters are listed below and their names and the titles of their respective disciplines provide an indication of the scope of the programme as a whole.

I.	World Days	A.H. Shapley (USA)
II.	Meteorology	† J. Van Mieghem (Belgium)
III.	Geomagnetism	V. Laursen (Denmark)
IV.	Aurora and Airglow	† S. Chapman (UK) (with F. Roach and † C. Elvey (USA))
V.	Ionosphere	W.J.G. Beynon (UK)
VI.	Solar Activity	Y. Ohman (Sweden)
VII.	Cosmic Rays	J.A. Simpson (USA)
VIII.	Longitudes and Latitudes	† A. Danjon (France)
IX.	Glaciology	† J.M. Wordie (UK)
X.	Oceanography	G. Laclavère (France)
XI.	Rockets and Satellites	† L.V. Berkner (USA)
XII.	Seismology	V.V. Belousov (USSR)
XIII.	Gravimetry	† P. Lejay (France)
XIV.	Nuclear Radiation	M. Nicolet (Belgium)

In addition, the Assistant Scientific Secretaries in CSAGI were responsible for the organisation of international scientific conferences to discuss regional questions relating to the IGY. Several conferences on the Antarctic were arranged by G. Laclavère (Assistant Secretary for the Antarctic, and a former Secretary General of IUGG) and were held in Paris (6–10 July 1955), Brussels (8–14 September 1955), Paris (30 July – 4 August 1955) and Paris (13–15 June 1957). From 22–25 May 1956, Sydney Chapman presided at a regional conference in Stockholm where the problems of the Arctic were discussed. A conference for the American Region was organised in Rio de Janeiro by E.O. Hulburt, Assistant Secretary for the Western Hemisphere, and he himself presided over it from 16–20 July. For the countries in eastern Europe, the Assistant Secretary for the Region was J.D. Boulanger who arranged a conference in Moscow from 20–25 August 1956. From 11–15 February 1957, a conference took place at Bukavu for discussions on the

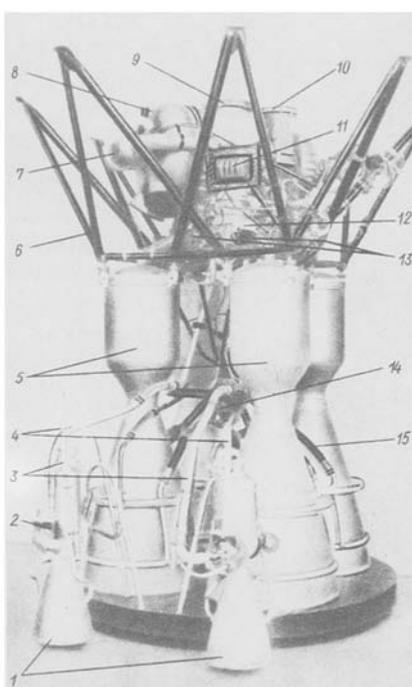
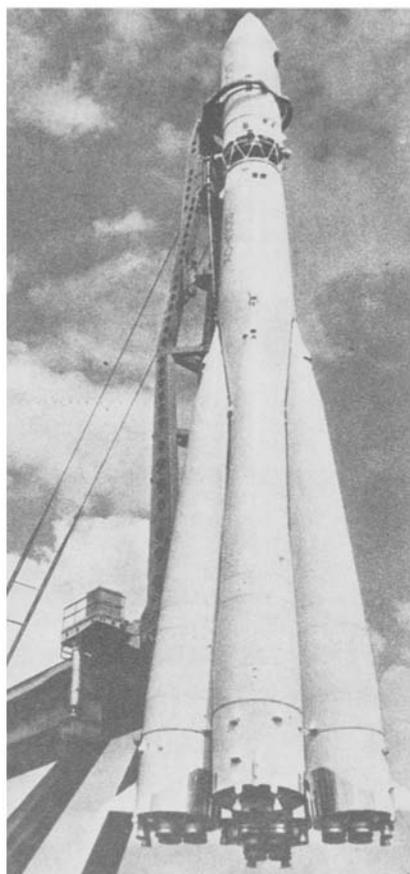


Fig 26

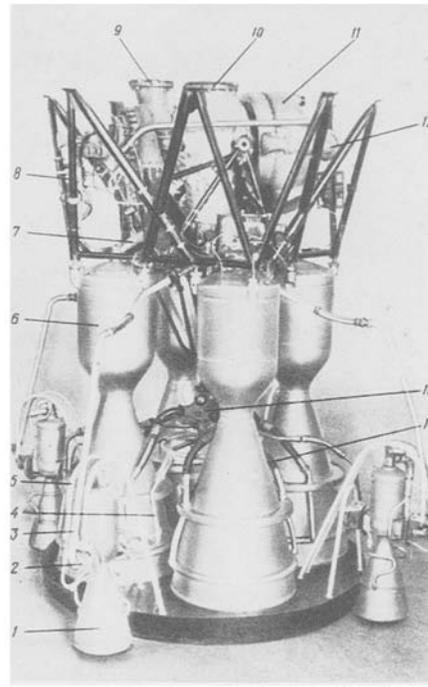


Fig 27

Fig 25

Fig 25 The first artificial earth satellite, SPUTNIK 1, was launched on 4 October 1957, at the beginning of the fourth month of the International Geophysical Year, by the three-stage Vostok vehicle (shown in this figure). The satellite was orbited by a carrier rocket designed by Korolev's ORB (Experimental Design Bureau for Aircraft Liquid-Propellant Rocket Engines) and powered by the RD-107 and RD-108 liquid propellant rocket engines designed by Glushko's laboratory between 1954 and 1957.

Fig 26 RD-107 Engine used in the first stage of the VOSTOK.

The RD-107 is an oxygen-kerosene four-chamber engine. Thrust in vacuum: 102 tons; specific impulse: 314 s; Chamber pressure: 60 atmosphere. 1.- two vernier chambers; 2.- swivel and oxygen-inlet assembly; 3.- vernier-chamber oxidizer pipelines; 4.- mock-up brackets (omitted in the actual engine); 5.- four main combustion chambers; 6.- mount; 7.- gas generator; 8.- turbine heat-exchanger; 9.- oxidizer pump inlet port; 10.- fuel pump inlet port; 11.- chamber pressure transmitter; 12.- oxidizer main valve; 13.- oxidizer pipelines; 14.- fuel main valve; 15.- fuel pipelines.

Fig 27 RD-108 Engine used in the second stage of the VOSTOK.

The RD-108 is an oxygen-kerosene four-chamber engine. Thrust in vacuum: 96 tons; specific impulse: 315 s; chamber pressure: 52 atmospheres. 1.- four vernier chambers; 2.- swivel and oxidizer inlet assembly; 3.- vernier oxidizer pipeline; 4.- vernier fuel pipeline; 5.- mock-up bracket (omitted in the actual engine); 6.- main combustion chamber; 7.- oxidizer pipeline; 8.- mount; 9.- fuel-pump inlet port; 10.- oxidizer-pump inlet port; 11.- turbine heat-exchanger housing; 12.- gas generator; 13.- main fuel valve; 14.- fuel pipeline.

coordination of the work in Africa, South of the Sahara. This event was presided over by M. Nicolet following preparations made by T.E.W. Schuman, Assistant Secretary for the Region. The last regional conference, for the Western Pacific, was held in Tokyo from 25 February to 2 March 1957 with Hasegawa as President.

The programme for each discipline was first drawn up in detail by an IGY Committee created by the appropriate

Union or by some other ICSU body. The IGY programme as a whole was then coordinated, after study by the Bureau and CSAGI, not only during the General Assemblies of CSAGI, but also at the regional conferences already mentioned. In addition, various working groups met to deal with specific subjects: Oceanography at Göteborg (15–17 January 1957), Nuclear Radiation at Utrecht (22–26 January 1957), Rapid geomagnetic and telluric variations at Copenhagen



Fig 28 The emblem for the IGY was designed in 1954 by members of the IGY Secretariat (Paulette Doyen, Maurice Hautfenne and Marcel Nicolet). It showed the trajectory of a satellite across a background of lines of latitude and longitude, as well as the boundary between day and night, and it emphasized the special attention given to the Antarctic.

(April 1957). A special CSAGI Conference on the problems of rockets and satellites took place in Washington from 30 September to 5 October 1957 and coincided with the launch on 4 October of Sputnik I, the first artificial earth satellite.

It would be impossible to summarise here all the work carried out within the 14 Disciplines. Each of the Reporters arranged for the preparation, by experts, of an Instruction Manual and a dozen of these were distributed to all IGY Participating Committees and published in *Annals of the IGY* before the beginning of the observational period. Besides this, the Unions distributed to their members the essential elements of the programmes in which they had particular interests.

At this point we must again recall the audacious proposal that was already in the minds of the CSAGI Bureau in 1953, namely the possibility of launching artificial satellites during the IGY, and which was accepted at the Rome Assembly in 1954. This concept was incorporated in the emblem adopted for the IGY which shows a satellite in orbit round the Earth, and a network of latitudes and longitudes giving prominence to the Antarctic. The boundary between night (the night sky) and day (solar activity) is indicated.

The public announcement that satellites would be launched during the IGY was made almost simultaneously in Washington and in the capitals of the other countries participating in the IGY. The announcement in Brussels was made by the Secretary General of CSAGI who had received a special communication from Joseph Kaplan, President of the IGY Committee in the USA, and later President of IAGA and IUGG. Following the decisions made at the CSAGI Assembly in Rome, special attention was given to the problems, both scientific and logistic, of organising a programme of observations in the Antarctic.

It is fair to say that the Rome Assembly succeeded in putting the finishing touches to the complex arrangements for the execution of the IGY programme. The origins of this success can be attributed to a number of important factors: the great flexibility of the structures adopted for the organisation, with the emphasis on scientific management rather than on administrative rules, and the willing cooperation of the most eminent representatives of the Scientific Unions with their power of actions based on scientific reasoning. Finally, the IGY programme could not have been carried out without the participation of the 67 countries that organised the actual observations and their enthusiasm in supporting international collaboration.

In the early years, the atmosphere in CSAGI circles was characterised by great enthusiasm and almost a sense of euphoria, but other sentiments later began to make themselves felt. Already at the CSAGI Assembly in Brussels in September 1955, tentative attempts had been made to restrict the field of action of CSAGI. Besides this, the Vice-President of CSAGI had been elected President of ICSU, and this sometimes placed him in a delicate situation arising from his responsibilities to both the CSAGI Bureau and ICSU. In the tense atmosphere of the *Fourth CSAGI Assembly* held in Barcelona from 10 to 15 September 1956, the divergent points of view came out into the open. Fortunately the situation was saved thanks to the collective wisdom of the delegates of the participating countries who voted unanimously to support the concept of the IGY and the objectives of carrying out, in an atmosphere of calm, the world-wide cooperative programme that had been envisaged.

It was during the excitement of the Barcelona Assembly that Academician Bardin, President of the IGY Committee in the USSR, announced full participation of his Committee in the IGY programme for Rockets and Satellites. Moreover, a delegation from the Academy of Sciences in the Peoples' Republic of China had made the voyage from Peking to Barcelona with the intention of participating in the work of the IGY. This marked the beginning of a problem with political undertones which has still not been completely resolved and which need not be discussed here. It should be mentioned that, after the Barcelona Assembly, the Bureau was enlarged to include Vladimir Belousov and Jean Coulomb, both later to become Presidents of IUGG; their wise counsels and calming influence did much in helping to



Fig 29

Fig 29 Joseph Kaplan, Chairman of the US National Committee for the IGY, describing the US rocket-satellite programme for the International Geophysical Year at the Inaugural Plenary Session of the Fourth Assembly of CSAGI held in the City Hall of Barcelona on Tuesday, 11 September 1956. The first official announcement that a scientific satellite would be launched as part of the programme of the IGY was received in Brussels by the Secretary General of CSAGI during the early morning of 29 July 1955. This letter, from Joseph Kaplan arrived by special messenger and was released at 6.40 pm at the Palace of the Academies in Brussels a few minutes before the official announcement at 2 pm in Washington DC.



Fig 30

Fig 30 Harrie Massey, Chairman of the UK National Committee for the IGY, describing the United Kingdom programme of upper-atmosphere research using rocket-borne instruments during the International Geophysical Year, at the Inaugural Plenary Session of the Fourth Assembly of CSAGI held in the City Hall of Barcelona on Tuesday, 11 September 1956.

evade obstacles and surmount difficulties until after 1958. In the event, the last CSAGI Assembly, held in Moscow from 29 July to 9 August 1958, was able to confirm that audacity had been rewarded; the IGY was already in progress after having overcome its difficulties, and even the Sun had cooperated by attaining a level of activity never recorded in previous cycles' In addition, artificial satellites had already begun to provide new information about the terrestrial atmosphere. In short, all the Disciplines were making their contributions to the acquisition of new knowledge.

After the Moscow Assembly, the main task was to profit from the enormous quantity of data accumulated during the IGY by collecting, studying and analysing the new information. CSAGI had to make plans for the accomplishment of this work, and both the Bureau and the Reporters decided to make a common effort in this direction. Lloyd Berkner, who had resigned from the Bureau, was replaced by Homer Newell who had been Reporter for the Rockets and Satellites Group in Moscow. The Reporters agreed to carry on after the end of the IGY and to supervise the publication (36 volumes of the *Annals of the IGY*) of



Fig 31

Fig 31 Takeshi Nagata, Secretary of the Japanese National Committee for the IGY, describing the Japanese rocket programme for the International Geophysical Year at the Inaugural Plenary Session of the Fourth Assembly of CSAGI held in the City Hall of Barcelona on Tuesday, 11 September 1956.



Fig 32

Fig 32 At the Inaugural Plenary Session (11 September 1956) of the Fourth General Assembly of the Special Committee for the International Geophysical Year, in the Gothic Hall of the City of Barcelona, Academician Ivan Bardin, President of the USSR National Committee for the IGY, announced in Russian that the USSR intended to launch a satellite to participate in the IGY Rocket-Satellite program.



Fig 33



Fig 34

Fig 33 Dr. Valery Troitskaya is giving the English translation of the communication of Professor Bardin:

“On the request of the General Secretary of the CSAGI, Dr. M. Nicolet, inquiring about the possibility of the Soviet Union’s participation in the Rocket-Satellite program, the Soviet National Committee announced that:

- (1) In addition to the USSR program already presented to the Barcelona meeting, the Rocket-Satellite program will be presented at a later time.
- (2) The USSR intends to launch a satellite by means of which measurements of atmospheric pressure and temperature, as well as observations of cosmic rays, micro-meteorites, the geomagnetic field and solar radiation will be conducted. The preparations for launching the satellite are presently being made.
- (3) Meteorological observations at high altitudes will be conducted by means of rockets.
- (4) Since the question of USSR participation in the IGY Rocket-Satellite observations was decided quite recently, the detailed program of these investigations is not yet elaborated. This program will be presented as soon as possible to the General Secretary of CSAGI.

Fig 34 After the official announcement of the participation of the USSR IGY Committee in the Rocket-Satellite program, Professors Bardin and Belousov discuss the subjects for a press conference.



Fig 35 Press correspondants pose questions to Prof. Bardin and Madame Troitskaya relating to further details of the Soviet rocket and satellite programme.



Fig 36 The four members of the IGY Committee of the Chinese People’s Republic (Coching Chu, Chang Yu-Chen, Lu and interpreter) among the other delegates at the First Plenary Session of the Fourth General Assembly of CSAGI, in Barcelona, 11 September 1956.

the principal results and observations in their respective fields.

The CSAGI, however, still had to encounter some additional difficulties before it could be terminated. Its final Report was based on the Resolutions adopted at the Moscow Assembly and was first presented, by the President and the Secretary General, to the Executive Committee of ICSU, in which all the Unions were represented, and to the General Assembly of ICSU held in Washington from 2 to 6 October 1958. In spite of conflicting opinions and after many arguments, relating even to voting procedures, the Report was finally accepted by the Assembly; the details can be consulted in the official account contained in the *Annals of the IGY*.

In 1956 there were no diplomatic relation between the People’s Republic of China and the countries in Western Europe. Thanks to the good offices of Father Romana, the Spanish Authority agreed that delegations from *all* countries could participate in the Barcelona meetings, provided visas were obtained from a Spanish Embassy. The members of the Chinese delegation first travelled to Moscow where they obtained visas to enter Belgium. On arrival in Brussels, the Spanish Embassy issued visas to attend the meeting in Barcelona, which they reached via Geneva. This was the first and the last occasion on which a delegation from the People’s Republic of China attended a CSAGI meeting.

In the light of these unfortunate circumstances, the CSAGI Bureau decided to meet again, from 1 to 3 November 1958, at the Ionosphere Research Laboratory of the Pennsylvania State University. Homer Newell was detained

in Washington and could not be present, but the other four members discussed preparations for the last meeting of CSAGI, to be held in Paris in May 1959, and for the first meeting of a new committee: the International Geophysical Committee (CIG) which was to encourage international cooperation in geophysics on a long-term basis after the IGY. This Committee first met in The Hague in November 1959 and, in 1960, it took the first steps in planning the International Years of the Quiet Sun (1964-65). It was also responsible for the supervision of the publication of the remaining volumes of the *Annals of the IGY*.

The circumstances in which CSAGI had to work were not always favourable, but its members dared to aim high and to look far into the distance beyond the natural and the artificial obstacles which sometimes barred progress. Perhaps the success of the CSAGI in the completion of the IGY might be summed up in the words of the 18th century English poet, Christopher Smart:

“And now the matchless deed’s achiev’d,
Determined, dared and done”

The IGY 1957-58 had led thousands of men and women from all parts of the world to offer their services freely and spontaneously in the achievement of a common scientific objective. The organisation had benefitted from the support of governments without being itself a governmental body, and it was fortunate in receiving logistical assistance from various armed forces even though the scientific programme was not military in character. In short, the IGY had succeeded in attracting the active collaboration of scientists in 67 countries, but had remained outside of and completely free from the rigid administrative structures that normally control international relations.

The legacy of the IGY has taken on many different forms. This international scientific enterprise led to the establishment of a great number of new observing stations, many of which continue to operate permanently. It is a striking fact that, to date, more than 10,000 meteorological rockets have been launched, and all their results have been stored for future reference. In addition, many of the groups established during the IGY have developed into permanent national bodies.

Besides this, the launchers of the first satellites made an initial contribution to the scientific development of geophysics which has since gone far beyond the hopes of the promoters of the IGY. The well-known ICSU Committee on Space Research (COSPAR) is today, 25 years after 1957-58, very active in the organisation of international



Fig 37 Final remarks before the beginning of the International Geophysical Year. The President Sydney Chapman, expressing the great appreciation of CSAGI to Father Romana (on his right) and Father Cardus, the organisers of the meeting, at the last plenary session of the Fourth General Assembly of CSAGI in Barcelona on Saturday, 15 September 1956. L.V. Berkner, Vice-President, (extreme left) and M. Nicolet, Secretary General, with G. Laclavère, Chairman of the Publications Committee (extreme right).

research in this field. In other fields, the Committees on Oceanographic Research (SCOR) created in 1957, and on Arctic Research (SCAR), dating from 1958, have made their impacts; the latter was associated with the conclusion of the important Treaty on the Antarctic. To these can be added the Committees on the Problems of the Environment (SCOPE) (1969) and on Solar-Terrestrial Physics (SCOSTEP) (1980); but it should be pointed out here that the pursuit of research in the Earth sciences can no longer be restricted to studies of our own planet alone.

To conclude, the present 25th Anniversary of the IGY has led to the recent suggestion that the ultimate legacy of the IGY ought to be the organisation of a new international programme, lasting for about ten years, to be devoted to investigations of all the elements of the Biosphere and the Geosphere.

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