

Aspects of the Soviet IGY

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[1] From original documents in Russian and other archives, and other primary sources, the paper puts together a detailed account of the Soviet decision to join the IGY, the formation of the Soviet IGY committee, and the execution of their IGY programme. Topics covered include the network of stations and its share in the total IGY, the first Soviet Antarctic expeditions, the relationship between the IGY committee and the sputniks project, the part played by women, the work of World Data Center B, and the publication of scientific results. *INDEX TERMS*: 1700 History of Geophysics; 1799 History of Geophysics: General or miscellaneous; 6620 Public Issues: Science policy; *KEYWORDS*: Antarctica, Cold War, International Geophysical Year, Electronic Geophysical Year, Soviet IGY, Sputnik, World Data Centers.

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Decision

[2] The proposal to hold a Third Polar Year in 1957–58 originated in April 1950 at a small private gathering of scientists in Silver Spring, Maryland, USA. In the next few months it was positively received and further discussed at several other meetings in the United States. In September it was put before the Mixed Commission on the Ionosphere (MCI) at Brussels, which also endorsed the proposal. Once the idea of a Third Polar Year had been approved at that level of the international scientific community, it was almost certain to be implemented.¹ So during 1951 and 1952, while the formalities were being completed within the International Council of Scientific Unions (ICSU), scientists linked to those organizations began discussing amongst themselves what the programme should include and who should lead it. In May 1952 the ICSU Bureau asked the secretary of URSI, Belgian radio scientist Colonel Ernest Herbays, to convene a special committee of ICSU to manage the Year; its membership should be decided in consultation with the relevant scientific unions. Herbays organized the first meeting of the committee, usually known by its French acronym as ‘CSAGI’, in October 1952. In November letters were sent to four scientific unions and to all national scientific bodies which adhered to ICSU, inviting them to participate.²

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[3] A key moment in the preliminary phase was the intervention by the Danish meteorologist Johannes Egedal at the Assembly of the International Association of Terrestrial Magnetism and Electricity (IATME) in Brussels on 23 August 1951. At a session chaired by Sydney Chapman, who was later chosen to be president of CSAGI, Egedal argued vigorously that “observations ... should be taken all over the earth”, and especially at the equator as well as at the poles.³ This idea was strongly supported by the inter-governmental World Meteorological Organization (WMO), which was not part of ICSU but was being canvassed as another useful partner in the Third Polar Year. (The two previous Polar Years had been launched by its historical predecessors.) Later, Egedal suggested to Chapman that the global character of the programme could best be shown by changing the name to “International Geophysical Year” (IGY). Chapman agreed, and the change was duly endorsed by ICSU.

[4] Another important point was reached when Chapman sketched a detailed plan for the IGY at meetings of URSI and the MCI which were held in Canberra in September 1952.⁴

[5] There was however a problem, which Egedal referred to at the IATME meeting as the possible “non-cooperation of certain great nations”. In the early 1950s the Soviet Academy of Sciences had almost no presence in the structures of international science that were coordinated by ICSU. Nor was the Soviet Union a member of UNESCO, which had close ties with ICSU. None of the meetings mentioned above, and none of the informal correspondence which surrounded them, included any Soviet scientists.

[6] But those involved were well aware, as Georges Lacombe, general secretary of the IUGG, expressed it, that the participation of the Soviet Academy was essential for the influence of CSAGI to become truly global.⁵ At the time a few Soviet astronomers were members of the IAU, which was structured around individual membership rather than

the adherence of national scientific bodies. The Soviet Union was also a founder member of the WMO. Both organizations were therefore suggested by Chapman and others as bodies which might be able to nominate one or more Soviet scientists onto CSAGI.

[7] Between 1950 and 1952, any Western scientist who wanted to pursue that option would have had to be a senior figure in the ICSU community with a good line of communication to a Soviet scientist working in a suitable field, and one who was in turn sufficiently senior within the Soviet Academy. But despite the wartime alliance, after decades of ideological hostility such contacts between Western and Soviet scientists were few and far between. In the United States, furthermore, those years were the heyday of Senator Joseph McCarthy and the House UnAmerican Activities Committee, which interrogated several scientists suspected of communist sympathies, including prominent members of the IAU. In 1954 Chapman would recall that “the steps taken by these bodies [IAU and WMO] in this direction led to no result”, but his implication – that some such steps had actually been taken – may have been little more than token courtesy.⁶

[8] In the early 1950s there were two further obstacles to cooperation on the Soviet side. The first was the chauvinist cultural policy that had been promoted by Andrei Zhdanov in the late 1940s, and which by no means perished with its author in 1948. Today, the policy is remembered mainly for its influence on the life sciences. But the regime also set considerable store by a materialist cosmogony, and the ideology of physical scientists in relevant fields, such as astronomy and geology, also came under scrutiny. The negative achievement of Zhdanov was to reduce this process to the detection of ‘international’ or ‘cosmopolitan’ influences. In March 1949 Stalin presided over a special meeting of the Politburo which discussed the “unsatisfactory” state of Soviet geology, including fears that information about Soviet uranium reserves was getting out of the country. In the resulting purge several leading geologists were sacked or transferred to minor provincial posts. At least four died under interrogation or later in the gulag. Vladimir Belousov, a future leader of the Soviet IGY and of Soviet geophysics in general, was reprimanded for citing foreign authorities on a par with Soviet ones [*Belousov*, 1948]. He lost his lectureship at Moscow University for a time, but not his research positions.⁷

[9] The second problem arose within the very organization which was providing the only tenuous link between the Soviet Academy and ICSU in time of Cold War – the IAU. In September 1950, after verifying that the meeting would be open to all its members, the Executive Committee of the IAU accepted an invitation from the Soviet Academy to hold its next Assembly in Leningrad in August 1951. In October, however, the Chinese People’s Army entered the Korean War. By early December they had inflicted heavy defeats on United States forces and forced the evacuation of all United Nations troops from the northern half of the country. These ominous events convinced the Swedish president of the IAU, Bertil Lindblad, “that on account of the tense international situation it was doubtful, with a view to actual participation, whether a meeting could be held as planned”.⁸ Over vigor-

ous objections from Soviet astronomers the Assembly was denied to Leningrad and held instead in Rome in September 1952, where the protests were renewed. This was hardly an auspicious context for a Western invitation to the Soviet Academy to join in worldwide scientific investigations on an unprecedented scale.

[10] The first verifiable invitation was sent to the Soviet Academy on 8 September 1952, two years and five months after the IGY had been proposed, by F. J. M. Stratton, the general secretary of ICSU. It was repeated by Herbays in April, Chapman in July, and A. V. Hill (who had succeeded Stratton at ICSU) in August 1953.⁹ The records of the Academy, though sparse, show that Stratton’s letter was handled with reasonable despatch by A. V. Topchiev, the Academy’s chief scientific secretary, a holder of the Stalin Prize and former Deputy Minister for Higher Education. Effectively, Topchiev and Alexander Nesmeyanov, the president of the Academy, were joint political directors of the major part of Soviet science.¹⁰ Topchiev sent a translation of Stratton’s letter to the relevant departments of the Academy for their comments. S. K. Klumov, scientific secretary at the Department of Geophysics and Geography, replied in very positive terms in January 1953. But A. N. Tikhonov, scientific secretary at the Department of Physics and Mathematics, sat on his hands until Topchiev had to send him a reminder in June 1953. At that point Tikhonov explained that the matter had been much delayed by internal consultations, which were being coordinated by V. V. Shuleikin, and that the latter would shortly be making a direct, verbal report to Topchiev.¹¹ Meanwhile further invitations (above) continued to arrive.

[11] With the honourable exception of Klumov, senior figures at the Soviet Academy seem to have been reluctant to take a position for or against the IGY until after the death of Stalin in March 1953 and the first faint breaths of political change which followed it. Their hesitation was understandable in the circumstances. Finally, 18 months after they had been invited, the Academy decided to take part in the IGY and also to join the IUGG. On 4 March 1954 Nesmeyanov sent Chapman the first indication that this was about to happen.¹²

[12] The fact that the Soviet Academy and its imperial predecessor had played a central role in the First and a strong part in the Second Polar Years must have influenced them in favor of the IGY [*Bedritskii et al.*, 1997, pp. 311–325; 1999, pp. 73–80]. The positive outcome may also have been related to the broad political campaign for the reform of Soviet science which the Academy developed in 1954, including proposals for greater autonomy and more contact with foreign scientists. And it is significant that in April 1954 Foreign Minister Vyacheslav Molotov would write to Luther Evans, director general of UNESCO, with the news that the Soviet Union was about to join that organization. The Academy’s decision in favour of the IGY and, after 25 years of self-exclusion, the IUGG was part of a larger process. With Stalin gone, the Soviet Union could begin to replace its pre-war siege mentality with foreign policies more appropriate to its new international situation, namely, that it was no longer alone in a hostile world, hostile though that world remained.

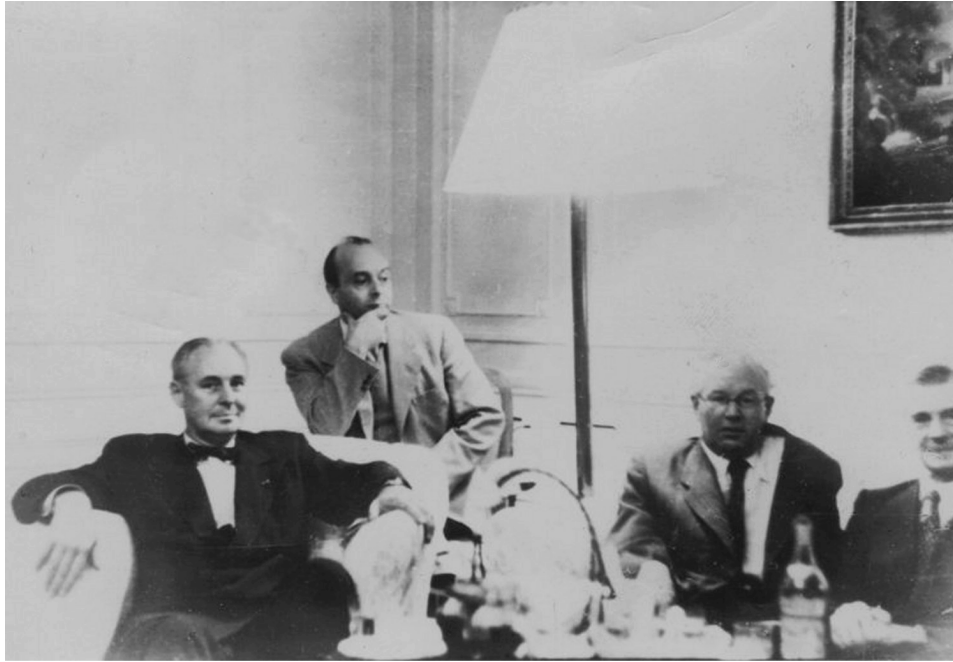


Figure 1. Meeting the CSAGI bureau: L. V. Berkner, M. Nicolet, A. G. Kalashnikov, and S. Chapman

Organization

[13] On 2 August 1954, nearly two years after being invited to do so, the Academy formed an IGY committee under the chairmanship of the seismologist Grigorii Gamburtsev.¹³ In December 1953 Chapman had sent the Academy two more letters, the first inviting them to join the IUGG and attend its Assembly, which would open on 15 September in Rome, the second to join the IGY and attend the separate CSAGI Assembly which would open on 30 September in the same city.¹⁴ There may however have been some confusion in Moscow. An 11-man delegation, led by the seismologist Vladimir Belousov, was organized for the IUGG Assembly. But despite the existence of Gamburtsev's committee, which met for the first time on 2 September,¹⁵ no delegation was nominated for the follow-on CSAGI Assembly. Five days into the IUGG meeting Topchiev was still trying to finalize a CSAGI delegation and its instructions.¹⁶ Meanwhile Belousov and several other Soviet delegates to the IUGG had arranged an 8-day research visit to volcanological and seismological institutes in southern Italy, taking in the Bay of Naples, the Lipari Islands, Sicily and Reggio Calabria. They would only be able to attend the CSAGI meeting on the last of its five days [*Kalashnikov*, 1954].

[14] While their IGY credentials were being sorted out, four Soviet delegates – Belousov, A. G. Kalashnikov, A. S. Monin and M. B. Cornoung – held a private meeting with the CSAGI bureau (Figure 1) in a hotel room on 25 September.¹⁷ They had probably received their instructions by that point, since they raised matters listed in them, notably the representation of large countries, such as India, China and the Soviet Union, within the IGY, and the desirability of in-

cluding disciplines from solid-earth geophysics, such as seismology, gravimetry and earth currents. It was pointed out that CSAGI was not based on geographical representation but on nominations from the international scientific unions, but they were assured that an accommodation over that and over the choice of disciplines could easily be reached. The following day Belousov and his colleagues left for their research trip; the CSAGI Assembly opened on 30 September without them.

[15] On the same day Nesmeyanov sent Belousov a cable accrediting the Soviet delegation to the CSAGI Assembly and repeating their instructions; it was not received until 2 October.¹⁸ Meanwhile documents produced by the CSAGI working groups, none of which the Soviet delegates attended, were being sent by courier to their base in Naples every evening. When they returned to Rome on the evening of 3 October they had another private meeting with Chapman, this time on his own. They raised the same issues. Chapman again reassured them and gave them copies of further documentation from the meeting.¹⁹ The next day they made a dramatic late entry into the closing plenary.²⁰ Addressing the meeting, Belousov went over the same points, but also conveyed the positive message in his instructions, which was that the Academy hoped to participate in all aspects of the IGY and to send scientific expeditions to the Arctic, Antarctic, equatorial regions and oceanic islands. Detailed plans would follow in due course.²¹ Chapman welcomed the Soviet Academy into the IGY.

[16] CSAGI duly invited the Academy to nominate two Soviet representatives to join it, and one of Gamburtsev's last official actions, in November, was to propose Davitaya and A. M. Obukhov for those posts – a nomination that never took effect.²² Instead, at meetings on 21 January and

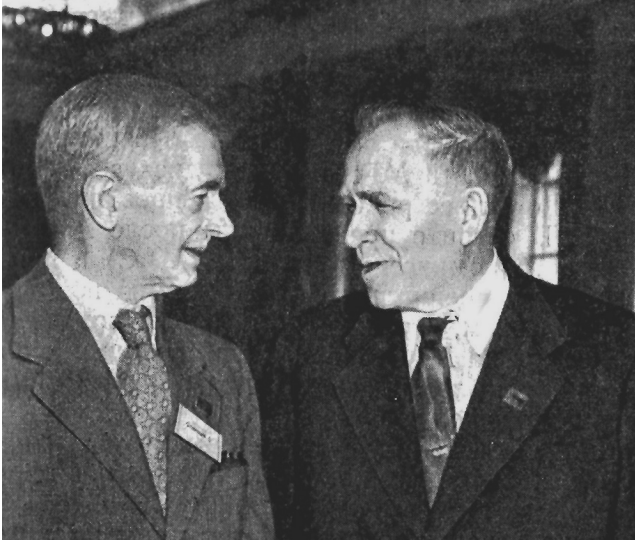


Figure 2. S. Chapman and I. P. Bardin

8 April 1955 the Presidium of the Academy decreed, first, a radical overhaul and strengthening of the IGY committee, and second, the formation of working groups for the IGY disciplines and the Arctic and Antarctic. Some working groups began meeting in March.²³ The new committee had 17 members, and its new president was a vice-president of the Academy, the metallurgist Ivan Bardin (Figure 2).²⁴ Pushkov, Bulanzhe, Obukhov and the veteran Arctic explorer I. D. Papanin joined Davitaya as vice-presidents under Bardin. Gamburtsev and Belousov were made ordinary members.

[17] Besides Gamburtsev's state of health, factional rivalry may also have played a part.²⁵ No members of Gamburtsev's committee took part in the delegation to Rome, and then his nominees for the CSAGI posts were passed over. Some members of that first committee, such as Davitaya, Fyodorov and Pushkov, would remain prominent in the leadership of the Soviet IGY throughout. But others who would later become so, notably Belousov, Yu. D. Bulanzhe and Kalashnikov, entered via the Rome delegation or the 1955 reorganization.

[18] Brushing aside the fiction that Soviet members of CSAGI were supposed to be nominated by the IUGG, Bardin told Marcel Nicolet, the secretary-general of CSAGI, that the two Soviet "representatives" would be Belousov and Pushkov, director of NIZMIR.²⁶ Belousov spoke almost perfect French and some German and English.²⁷ Pushkov was not such a good linguist, but had met Chapman when the latter visited the Pavlovsk Geophysical Institute in 1936. In 1942 Pushkov had made a long and dangerous journey to London, via Iran and Africa, to confer with Chapman about ionospheric forecasting and other urgent wartime problems. He returned on the Murmansk convoy with a gift of three ionosondes.²⁸

[19] Two scientific academies in socialist countries joined the IGY before their Soviet colleagues, those of Czechoslovakia and Yugoslavia. Possibly unaware of this, Bardin wrote to all such academies in March 1955, informing them

that the Soviet Academy had joined and asking whether they were taking part and if so, how.²⁹ Chapman had already expressed the hope, in Rome, that the entry of the Soviet Academy might help to secure the even more problematic entry of the Academia Sinica in Beijing, which he had also wanted all along. In April Belousov led a scientific delegation to China for a visit which lasted till the beginning of July. In September Chapman was delighted to announce that the Academia Sinica was joining the IGY.³⁰ The academies of the remaining socialist countries also joined, except for Albania.

[20] On 23 December 1955 and 10 February 1956 the Soviet committee was further reorganized, with 36 members including conveners of working groups. Belousov now joined the vice-presidents; in another re-shuffle at the end of 1956 he was listed first, after Bardin. The geomagnetist Valeria Troitskaya, one of only two women on the committee, was named as scientific secretary.³¹ (The other woman was the distinguished ionospheric physicist Natalia Ben'kova, a veteran of the Second Polar Year.) A gifted linguist, Troitskaya also coordinated the national programme on earth currents, a sub-discipline of geomagnetism.

[21] Major participating bodies, such as the Arctic Research Institute, also formed their own IGY committees in 1955 or 1956.

Preparation

[22] Troitskaya has recalled the intimacy of a 'kitchen cabinet' comprising Pushkov, Belousov, Yurii Bulanzhe, Artyom Povzner (the committee's administrator) and herself. This group became close enough, for example, to tease Pushkov about his Party membership, which dated from 1925. She remembers working long hours under great pressure as they struggled to prepare an IGY programme second only in scale to that of the United States, but in half the time, with many fewer staff, and in a country which was still far from having recovered from the devastation of World War Two. Fortunately they were able to take any major problems directly to the Science Department of the Central Committee, rather than going through channels at the Academy of Sciences.³² When finalized, the Soviet programme brought together 80 research institutes and departments from inside and outside the Academy, ranging from the modest Kazakh Hydro-Meteorological Institute to such giants as Leningrad University. Those involved saw this level of 'all-Union' cooperation as remarkable, so it probably was.³³

[23] However, the picture of the Soviet IGY committee as a united team of colleagues performing a daunting but eventually successful feat of scientific organization is only partly true. It overlooks how close they came to failure. On 2 November 1956 the Presidium of the Academy took emergency action to ensure that all IGY stations and instruments would be prepared by 1 February 1957, after which various tests and rehearsals were planned for the worldwide network. The key problem was seen as being the diversion to other purposes, by the directors of scientific institutes, of funds allocated to the IGY – a standard Soviet manage-

ment practice [Povzner, 1966, p. 210]. The response was to create a small, senior, trouble-shooting body called the Consultative Committee, with the single task of “ensuring the active participation of establishments of the Academy of Sciences, U.S.S.R., in the implementation of the I.G.Y.” Its members included the Academy’s directors of finance and construction, and it was headed by Kalashnikov, who asked for sweeping powers over the whole Academy structure. It is not clear whether he received them.³⁴

[24] The Consultative Committee came too late to be entirely successful. It was not finally constituted until January 1957, after which it met five times between February and April. The construction deadline was put back to 1 June 1957, which may have seemed the last possible moment. According to the *Annals of the IGY* the Soviet Union ran 223 fixed geographical stations.³⁵ About 40 were newly built between September 1956 and June 1957. For the programme as a whole, 400 types of scientific equipment had to be supplied in various quantities; 30 types were entirely new. But about 50 Soviet stations were not completed on time. At the end of 1957 delays in construction by GlavSevMorPut (the Northern Sea Route Administration) meant that 38 types of data were not yet being recorded at 18 Arctic stations. There were also delays at a few stations run by the Ministry of Communications and the Ministry of Higher Education, as well as with installing equipment imported from Denmark and West Germany at leading Soviet observatories. Lastly, World Data Center B was not yet operational. The report detailing these shortfalls laid the blame on the government for not living up to a financial pledge which it had given at the beginning of 1957, and on Communist Party officials for failing to appreciate the risks to national prestige.³⁶ For its part, the Ministry of Finance could point to massive budget overruns, especially by the Ministry of Communications. The original budget of 13 million roubles had been supplemented by a further 2.4 million in late 1957. By 1958 the total spend looked like being about 25 million and a further supplement was proposed.³⁷ It was decided to cut back the Arctic research programme.³⁸ (No love seems to have been lost between GlavSevMorPut and NIZMIR.)

[25] By the spring of 1958 leading figures in the Soviet IGY had come to feel that, because so much vital data had been lost through late starts, the only way to justify the great expense of the programme would be to extend it for at least another year.³⁹ Delays were also reported from other socialist countries.⁴⁰ The extension proposal was therefore expected to be popular with them, as well as with IGY committees facing similar difficulties in other parts of the world, which many were.

[26] Despite such problems, Soviet scientists carried out a broadly successful IGY programme. They ran the second highest number of geographical stations after the United States. Out of a world total of 2,456, the top three national committees were: USA – 558 (23%); USSR – 223 (9%); Britain – 129 (5%).⁴¹ (The figures also suggest that these three national committees, out of 65 taking part, contributed about one third of the entire programme between them.)

[27] The Soviet committee provided the busiest node in the global communications network which underpinned the



Figure 3. Solar patrol.

IGY, apart from the actual World Warning Center at Fort Belvoir outside Washington. The Soviet hub was established at the NIZMIR geophysical institute, or IZMIRAN as it is today, 40 km south-west of Moscow. It became the IGY coordinating center not only for the extensive networks of the federal, multi-national Soviet Union but also for twelve other countries across ten time zones.

[28] In 1956 Yurii Bulanzhe became CSAGI’s adjoint secretary for Eastern Europe; in practice his coordinating role extended also to Mongolia and China. In that capacity he visited most of the national IGY committees for which he was responsible and convened three CSAGI regional conferences in Moscow. The Soviet committee also took much of the responsibility for managing two of the four global meridians selected for special study during the IGY, at 110°E and 140°E.

Opening

[29] Undaunted by the departure from the IGY, two days earlier, of their political allies in the Beijing Academia Sinica, the Soviet committee celebrated the official opening of the IGY on 1 July 1957. This was mainly done with radio broadcasts in which Bardin and Nesmeyanov took part [Povzner, 1957b, p. 110].

[30] But in fact Soviet scientists had already launched the IGY one week early (Figure 3). Because of their geographic dispersal Soviet observatories could jointly maintain a solar patrol of 22 hours in summer [Silkin *et al.*, 1962, p. 193].

Wherever possible, all IGY stations were supposed to take regular observations during June 1957. The ten days from 20 to 29 June were also to be a World Meteorological Interval, one of four such periods designated annually by the WMO, irrespective of the IGY. And three of those days, 27 to 29 June, would be IGY Regular World Days, flagged up for even more intensive observations. But suddenly the sun became impatient. On 24 June observers at a NIZMIR observatory detected the first signs of a major solar flare.⁴² NIZMIR suggested that the World Warning Center should call an IGY Alert, the second highest level of IGY activity, designed to be sustainable for an indefinite period while unusual solar activity continued. The Alert was called on 25 June and maintained for several days, while the sun produced a second flare on 28 June. Then on 30 June Fort Belvoir raised the stakes by calling a Special World Interval, the most intense level of IGY observation, which could only be maintained for four days, and which ended on 3 July.⁴³ Eventually 30 June 1957 was added to the data sets for certain IGY disciplines.

Antarctica

[31] Amongst the proudest achievements of the Soviet IGY were its Antarctic expeditions, the first of which set sail from Kaliningrad on 30 November 1955 and arrived in the Davis Sea off Antarctica on 4 January 1956.⁴⁴ A coastal site was chosen opposite the Haswell Islands, and unloading and construction began immediately.⁴⁵ On 30 January they were visited by members of the Australian Antarctic Expedition. (For political reasons its leader, Phillip Law, had hoped to “welcome” the Russians to the Australian sector by getting there first.⁴⁶) On 13 February the Soviet flag was hoisted over Mirnyi Station [*Somov*, 1959, pp. 10–12, 19–42]. Soviet, later Russian geophysical stations have been maintained in Antarctica since that date.

[32] The entry of the Soviet IGY committee into the Antarctic part of the IGY preparations was not such plain sailing. Ever since the Soviet Union acquired one of the surviving German whaling flotillas, with the full consent of Britain and the United States, at the end of World War Two, Western governments had monitored its activities in the Southern Ocean with concern. Far from being eased, their anxieties were only increased when in the late 1940s the flotilla began to be regularly accompanied by a strong team of scientists, whose interests seemed to lie at least as much with meteorology and geography as with the biology of cetaceans.⁴⁷ In June 1950 the Soviet government circulated a diplomatic Note to the United States and six other governments asserting their right to be a party to any political discussions about the future of Antarctica.

[33] Formally speaking, the verbal notification by Soviet delegates to the 1954 CSAGI Assembly, that they hoped to send an expedition to Antarctica, should not have caused any difficulty. After all, the meeting had expressly called for “as many nations as possible” to join in the Antarctic part of the IGY, and especially to complete the coverage of the continent by setting up stations at “gap-locations” such as the Knox Coast in the Australian Antarctic Territory. In

practice, however, the news provoked a minor crisis in Washington, where the government felt itself to be “strongly opposed” to the new development.⁴⁸ One of the Eisenhower administration’s main organs of Cold War policy, the Operations Coordinating Board, set up a working group to try to salvage the long-held aim of excluding the Soviet Union from the Antarctic continent. For several months the main focus of its concern was that the Soviet committee might offer to put in a station at Vahsel Bay in the Weddell Sea, which had also been highlighted by the Rome meeting but over which the Royal Society was continuing to hesitate because, unlike the Argentine and any possible Soviet expedition, it would have to face the notorious ice conditions of that region without the help of an icebreaker.⁴⁹

[34] Meanwhile the Arctic Research Institute in Leningrad and other bodies preparing the Soviet IGY programme began planning an Antarctic expedition as part of it. This was reflected in press reports and in announcements of the reorganized IGY committee.⁵⁰

[35] In 1954 Lloyd Berkner, the American vice-president of CSAGI, placed himself in charge of its Antarctic planning.⁵¹ Liaising skilfully between the United States IGY committee and the Operations Coordinating Board, he led a bold last-minute initiative aimed at completing the IGY coverage of Antarctica without Soviet participation, while preserving a semblance of IGY normality. The scheme depended on two things. First, speedy completion, before the Soviet committee could formally announce an expedition; and second, a non-IGY framework, because a meeting organized by CSAGI itself would have to be announced to all national IGY committees, thus alerting the Soviet Academy. In February 1955 Berkner asked Nicolet to ask Laclavère to convene an Antarctic planning meeting under IUGG auspices in Paris on 1 May 1955, to which, Berkner insisted, only the eight committees which had formally announced their Antarctic plans to date should be invited.⁵²

[36] Laclavère, however, was virtually incommunicado while visiting his tea-plantation in Mussoree, Assam. An enigmatic cable from Berkner reached him there in March, but the full proposal did not catch up with him until his return to Paris in April. Distracted by other business, on 16 May he finally posted the formal invitations to a meeting scheduled for 15 June.⁵³ Further delay resulted when the Argentine and Chilean committees protested at the lack of notice; the opening date was finally settled as 6 July. Berkner’s other problem was that he had mistaken his man. Loyal though Laclavère was to Western interests, the recent entry of the Soviet Academy into the IUGG meant that he now had to bear in mind his future dealings with the Eastern bloc. On 7 June the Belgian meteorologist Edmond Hoge happened to discuss the possibility of a Belgian Antarctic expedition with Nicolet, with whom Laclavère was regularly in contact.⁵⁴ This was hardly an official Belgian announcement, but Laclavère seized the opening with both hands. On 10 June he sent Belousov all the details and papers for the proposed meeting, adding that it would probably be postponed to 6 July. He also mentioned – in passing – that Belgium had just announced that it would send an expedition.⁵⁵ Lastly, he would be happy to send the Soviet committee as many copies of the minutes as they might wish.⁵⁶



Figure 4. Tractor train.

[37] Belousov was still in China, but his office must have acted quickly. On 29 June 1955 Nesmeyanov sent a letter to Nicolet, copied to Laclavère, announcing that there would be a Soviet Antarctic expedition for the IGY which would supply one of the stations requested by CSAGI, either on the Knox Coast or else in Princess Astrid Land. No reference was made to Paris. But a follow-up cable to Laclavère, on the same day, stated that Belousov would come to Paris. Laclavère's letter, in short, was taken for the tacit invitation that it was.⁵⁷ With his perfect French and full CSAGI membership Belousov was the obvious choice. He took just two days' rest in Moscow after returning from his efforts in China on behalf of CSAGI (and also, of course, on behalf of Soviet interests in the IGY).⁵⁸ But because of visa difficulties he arrived only in time for the third day of the meeting, Friday 8 July.

[38] When the meeting opened two days earlier the leader of the American delegation, Laurence Gould, announced the three Antarctic stations which they had long been planning for the IGY, including one at the South Pole. "Forewarned of [the Nesmeyanov] letter", he also promised two new US stations, at Vahsel Bay (despite prior conversations with the British, who had finally almost decided to go ahead with that one) and on the Knox Coast.⁵⁹ Only the first of these costly extra commitments had been fully discussed in Washington beforehand. The Soviet Academy's other choice, Princess Astrid Land, was also pre-empted at the meeting by a Norwegian pledge for that area. When at last Belousov arrived he put down a third marker, for the South Pole, a goal which may have been withheld from Nesmeyanov's letter deliberately. In the ensuing discussion he stood by the Knox Coast location, which was ideal for reciprocal scientific measure-

ments with Soviet Arctic stations, but smoothly if reluctantly accepted alternative responsibilities in the interior. From that point the Western policy of excluding the Soviet Union was no longer feasible, though it took several years for it to be formally laid to rest. (Belousov's well-earned reward was a month-long research trip in the French Alps.)

[39] Building Mirnyi at a location where the ships had to be unloaded onto the 20m-high ice-barrier was difficult and dangerous, but it was done. The overland traverses to set up stations, ideally, near the South Geomagnetic Pole and the Pole of Inaccessibility⁶⁰ – the remotest location on the continent – were a far greater challenge, and one for which even the Soviet explorers' extensive experience of the Arctic had not sufficiently prepared them. The two journeys, of about 1450 and 2300 km respectively, were to be attempted with a novel technology – tractor trains (Figure 4), in which heavy freight sledges were coupled to massive snow tractors.⁶¹ Progress was hampered by occasional accidents but more so by the extremely severe conditions, combining altitudes of over 3500 m, temperatures as low as -50°C on the trail and lower than that at overwintering stations, and the fearsome katabatic blizzards of the sixth continent. The supply of tractor fuel was a constant problem. In 1956 and 1957 foreshortened journeys led to unplanned stations where the wintering parties sometimes had to be evacuated, or were maintained, as at Vostok 1 where the temperature fell to -80°C , in conditions of extreme hardship. By dint of strenuous winter preparations the Second Expedition, led by Aleksei Tryoshnikov, managed to set up Vostok Station near the Geomagnetic Pole on 16 December 1957, at an altitude of 3500 m. Using much-improved equipment the Third Expedition, led by Yevgenii Tolstikov, opened Sovyetskaya



Figure 5. “Aerology in the Roaring Forties.”

Station at roughly the same distance from Mirnyi as Vostok in February 1958, at an altitude of about 3700 m and about halfway to the Pole of Inaccessibility. Another tractor train finally reached that elusive goal on 14 December 1958 and set up a temporary station there for 12 days, just before the end of the IGY. When they returned to Mirnyi on 18 January 1959 they had covered a total distance of 4300 km in 88 days [Tryoshnikov, 1959, 1960, pp. 184–198; Ostrekin and Tolstikov, 1962, pp. 312–322].

[40] The heavy demands of Antarctic expeditions for skilled personnel and equipment, especially in 1956 and 1957, may partly explain the failure to complete some of the Soviet IGY Arctic stations on time (above).

[41] Lasting several weeks, the voyages of the Antarctic expeditions also formed part of an extensive network of some 30 Soviet oceanographic cruises for the IGY (Figure 5). Besides the *Ob'*, other vessels taking part included the *Vityaz*, the *Mikhail Lomonosov*, and the non-magnetic schooner *Zarya*. [Sysoev, 1959; Kort, 1960]. Their cruises included numerous goodwill visits to foreign ports, where foreign scientists were generally impressed with their scientific staff and equipment.

Sputniks

[42] Another memorable achievement of the Soviet IGY programme was the launching of the first artificial earth satellite, Sputnik 1, on 4 October 1957. In view of the many scholarly studies of the early sputniks which have appeared in recent years, only their IGY-related aspects will be treated here.

[43] In the early 1950s the Soviet Union and the United States each had their ‘space lobby’, and each grouping brought together scientists keen to probe the upper atmosphere and near-space environment with rocket engineers

from military R&D establishments. But on balance it was the latter who were most effective in the Soviet Union and the former in the United States. It was an important difference.

[44] The idea of including artificial satellites in the IGY, if possible, was successfully proposed by the American delegation, at the instigation of Lloyd Berkner, to the CSAGI meeting at Rome in 1954. The Soviet delegation, as we have seen, could not attend the workshop at which this was endorsed. The final plenary, though formally presented with the workshop resolutions, was no place for a discussion. In any case Belousov had his instructions and satellites were not covered by them.

[45] The US IGY committee then spent several months discussing the technical feasibility of such a project before approaching the Eisenhower Administration for its definitive consent, since rockets developed by military agencies would be needed, in the summer of 1955. The official announcement of a US satellite project for the IGY was made by the White House Press Secretary, Jim Hagerty, on 29 July 1955.

[46] In May 1954 two leading Soviet rocket engineers, Sergei Korolyov and Mikhail Tikhonravov, supported by Korolyov’s immediate boss Mstislav Keldysh, the director of Scientific Research Institute 1, broached the idea of launching small scientific satellites as an increasingly feasible offshoot from missile programmes [Gorin, 2000, pp. 35–36]. At about the same time the Chkalov Central Aeroclub in Moscow formed an Astronautics Section which brought together many enthusiasts. In September 1954 the Presidium of the Academy of Sciences created the Konstantin Tsiolkovskii Gold Medal, in honour of the father of Russian rocketry, to reward outstanding work in the new field of space exploration. It also set up an Inter-departmental Commission for Interplanetary Communications (ICIC) headed by Academician Leonid Sedov with Tikhonravov as his deputy. The purpose of the ICIC, as announced in April 1955, was “to organize work concerning building an automatic laboratory for scientific research in space”.⁶²

[47] A few days after the White House announcement Sedov attended a congress of the International Astronautical Federation in Copenhagen. At a press conference he confirmed that the Soviet Union was thinking about launching a satellite and could be expected to do so “in the comparatively near future”.⁶³ From that point members of the US IGY panels for rockets and satellites tried everything they could to find out whether the Soviet satellite would be an IGY project and when the first attempt might be made. But for more than a year the Soviet IGY committee and the ICIC, two Academy-led bodies with equal status, continued along parallel paths with little sign of converging.

[48] Korolyov kept up his increasingly effective lobbying of government departments, including the Academy, on behalf of scientific satellites. But what he was offering at the end of August 1955 was a chance to beat the Americans by launching just *before*, not during, the IGY. In his capacity as a corresponding-member of the Academy, Keldysh convened a series of elite seminars to brainstorm proposals for the scientific payload. They began by reviewing reports compiled for the ICIC [Skuridin, 1986, pp. 454–456; Golovanov, 1994, pp. 523–524].

[49] With Korolyov in charge of the launch vehicle and Keldysh taking the lead on the on-board experiments, there was little scope for a working group on rockets and satellites under the IGY committee.⁶⁴ One of the many scientists consulted by Korolyov in 1955 was S. N. Vernov, a cosmic ray physicist who had worked with the rocket programme since 1947 and who joined the IGY committee in April. But the committee showed no further sign of wanting to play a part in the satellite programme until it co-opted Anatolii Blagonravov at the end of 1956. An ICIC member and supporter of Korolyov, Blagonravov was chairman of the Academy's commission on upper atmosphere research, yet another interested body with no IGY connections.⁶⁵ At the same time Yevgenii Fyodorov, a founding member of the IGY committee and former director of the meteorological service during World War Two, was named as the IGY committee member responsible for rockets and satellites. He was finally dubbed the convener of an IGY working group on rockets and satellites in dealings with CSAGI's British coordinator Archibald Day, three months *after* the launch of Sputnik 1. But there is no trace of any activity by his putative working group as such.⁶⁶

[50] This chronology shows why the Soviet delegation could only send two silent observers to the CSAGI Assembly's working group on rockets and satellites at Brussels on 10 September 1955, at a point when even Keldysh's non-IGY group had barely got going.⁶⁷ Berkner, by now the CSAGI reporter for rockets and satellites, next arranged a special symposium on satellite programmes for the CSAGI Assembly at Barcelona in September 1956, partly with the aim of drawing out the Russians. His targets seem to have been tempted, only to change their minds, or to have them changed by another part of the Soviet state. In August 1956, with only weeks to go, the Soviet committee included the names of two upper-atmosphere physicists, Boris Mirtov and Sergei Poloskov, in its request for visas. Mirtov had been a member of Korolyov's team since the 1940s; Poloskov joined the IGY committee at the end of 1956 alongside Blagonravov. But neither went to Barcelona.⁶⁸ Instead Poloskov read a paper on Soviet rocket research by himself and the absent Mirtov, which caused a considerable sensation, to an international conference of the French Association for Aeronautical Research at Paris in December [Blagonravov, 1957]. There are several possible explanations for the switch, but the upshot was that at the Barcelona symposium on 11 September Bardin could only announce the existence of a Soviet IGY satellite project, without giving any details.⁶⁹ And his small, linguistically handicapped delegation was in no position even to comment, let alone disagree, when the Americans proposed that all IGY satellites should use the same radio frequency as they had already chosen for their own tracking signals.

[51] Korolyov did not launch a satellite before the opening of the IGY on 1 July 1957. But another significant date was approaching, 17 September, the centenary of the birth of Tsiolkovskii. In June Belousov brought the long-awaited outline of the Soviet IGY rockets and satellites programme to a meeting of the CSAGI committee in Brussels. Western readers found it frustratingly vague. On his copy Richard Porter, the chairman of the US IGY satellites panel,



Figure 6. Tracking Sputnik 1 at the Crimean Astrophysical Observatory. (<http://www.sputnikbook.net/gallery.php>)

tersely listed twelve points which “They have not said—and we have”, including launch sites, tracking systems and instrumentation.⁷⁰ At Brussels Belousov also renewed a Soviet proposal, first made a few months earlier, that a special IGY conference on rockets and satellites should be held. The Americans had earlier refused until they got at least something in writing from the Russians; now they agreed to host the event.⁷¹

[52] The conference opened in Washington on 30 September. Led by Blagonravov, the Soviet delegation was a slimline version of the one to Paris ten months earlier.⁷² Belousov joined them, but took little active part in the sessions. Some Americans asked their Soviet guests what had happened to Tsiolkovskii's anniversary. They were less amused to learn that the two Soviet tracking frequencies bore no relationship to the American one (Figure 6). Bardin had actually sent this information six weeks earlier. His letter reached Washington, but for reasons which have never been discovered its contents were not circulated to the IGY satellite panel which was urgently in need of them.⁷³ The meeting failed to settle all the IGY procedures wanted for the *Manual on Rockets and Satellites*. As it ended, Sputnik 1 was launched and Western scientists scrambled to supplement their tracking equipment.

[53] Negotiations continued. In January 1958 Day visited Moscow to resolve outstanding issues about data exchange for the *Guide to World Data Centers* which he was preparing. The Russians, now two sputniks up on the Americans, presented their own revisions, but then discussed them pos-

itively enough. They followed up with a further version, based on those meetings, saying that it was what “we shall stick to”.⁷⁴ Despite accepting what he called “the two programme principle”, or in other words agreement to differ, Day had to propose that further discussion and amendments were still needed, even as he struggled to put the Guide ‘to bed’ in April.⁷⁵ At the Moscow CSAGI Assembly in July a working group tried yet again, but its chairman Homer Newell was obliged to report that complete agreement continued to elude them. Published only in 1959, the final text reflected that fact.⁷⁶

[54] One of the issues that was never resolved was whether the original, unprocessed recordings of signals from another country’s satellite should be sent to its IGY committee and if so when. Owing to geographical and political circumstances the Soviet committee was more in need of data collected by foreign stations, especially from the southern hemisphere, than the US committee. In Van Allen’s carefully stated opinion, however, his group’s priority in discovering the radiation belts was not a product of this advantage.⁷⁷

[55] Uneasily though the Soviet satellite programme sometimes wore its IGY credentials, it reflected the authentic spirit of the IGY in one respect, the value which it placed on amateur observers. Unlike their Western colleagues the radio amateurs of the Soviet Union operated almost entirely at their clubs, which were provided by the Voluntary Society for Cooperation with the Army, Air Force and Navy, better known from its Russian initials as DOSAAF.⁷⁸ Details of the planned satellite signals and the apparatus and methods needed to observe and report them were published openly, but unnoticed by Western Soviet-watchers, in June, July and August 1957 in the magazine *Radio* and the newspaper *Soviet Patriot*. Amateurs at about 25 locations were trained to listen for and report the signals, samples of which were broadcast in August and September 1957, probably not on the actual frequencies. On the night of the launch amateurs at Khabarovsk and Magadan provided some of the earliest evidence that Sputnik 1 had successfully entered orbit [Bulkeley, 1999; Siddiqi, 2000, pp. 64–65].

People

[56] Although they did not generally have equal power and status with their male colleagues, more women scientists were active in the Soviet part of the IGY than anywhere else. Troitskaya and Ben’kova on the national IGY committee were the most prominent, but at least a dozen other Soviet women directed major IGY projects and 67 appear as the authors of entries in the incomplete bibliography which concludes the *Annals*.⁷⁹ To a degree quite unequalled in the West, women worked alongside men to run stations, build instruments, record and reduce the data, and analyse them in scientific reports. Nowhere were they more in evidence than at the Arctic and Antarctic Research Institute in Leningrad.

[57] Some also ventured ‘in harm’s way’. Between 1955 and 1958 a few women scientists and crew members took part in the first two Soviet Antarctic expeditions. In January



Figure 7. Trekking in to the Fedchenko.

1956, before Mirnyi had even been officially opened, Australian visitors to the *Ob’* were astonished to find “crowded couples dancing in night club settings” [Bunt, 2006, p. 143]. Maria Klyonova, the doyenne of Soviet marine geology and veteran of eleven Arctic cruises in the 1920s and 1930s, sailed on the *Ob’* as a senior member of the oceanographic or “marine” component of that First Antarctic Expedition (1955–1957). She was no tourist; her subsequent report records 160 probes at 85 stations during the cruise, most of them in Antarctic coastal waters or off sub-Antarctic islands such as Heard, Macquarie and Kerguelen.⁸⁰ (There were eight more women in the crew and five in that of the expedition’s second icebreaker, *Lena*.) Nor was Klyonova an isolated case; by the Second Expedition meteorologist Lydia Nikolaeva and zoologist Vera Korotkevich were full-time members of the oceanographic staff, and others followed them in later years. Klyonova or her sisters may perhaps have attended the official opening of Mirnyi on 13 February 1956, or helped with the backbreaking labour of unloading, but women were kept out of the Antarctic front line, namely the overwintering shore party.

[58] In 1957 and 1958 female university lecturers and students joined the summer expeditions to put in IGY stations on the remote and mighty Fedchenko Glacier in the Pamir Mountains. They included Nina Konkina and E. S. Lebedeva, lecturers from the University of Leningrad, and V. N. Kolesnikova from the University of Moscow. Some were the wives of fellow expeditioners, a Soviet tradition, but they published independently (for example, [Kolesnikova, 1961; Konkina, 1967]). The teams brought in over 100 tonnes of equipment, using packhorses for the last 50 miles and fording mountain torrents where necessary (Figure 7). The three Fedchenko stations, the middle one of which had been built for the Second Polar Year, were at 3000 m, 4169 m and 4880 m. The latter was the second highest IGY station in the world, after the cosmic ray station at Chacaltaya, Bolivia (5220 m).

[59] The remote location of many IGY stations, the extreme conditions in polar and mountainous regions, and the

tens of thousands of scientific and support staff involved, all combined to make loss of life statistically inevitable. Over the five years in which the IGY and its one-year extension, the International Geophysical Cooperation, were prepared and carried out, 100 people worldwide, all men, are known to have died in accidents or from sudden, possibly work-related illnesses. Twelve of them were Soviet citizens, a higher proportion than the estimated Soviet share of the programme given above. Nearly all perished in the Arctic or the Antarctic. In chronological order they were: I. F. Khmara, N. I. Buromskii, Ye. K. Zykov, A. K. Tokarev, A. A. Fogel', N. A. Chugunov, A. A. Yablonskii, A. I. Gaudis, V. S. Suvorov, V. I. Sudakov, N. N. Ivanov and A. P. Zhilenko.⁸¹

Results

[60] On 10 March 1958 eighteen men, representing powerful organizations, sat around a table in Moscow discussing the ins and outs of IGY data exchange. It was the fourth meeting of the IGY committee's working group on oceanography. Would all data really have to be made available to foreign scientists via World Data Center B, or only that from IGY projects? The group was conscious of the value of collecting all Soviet oceanographic data at WDC-B. But they were concerned that only data officially designated for the IGY should be sent abroad, not the "internal observations" that were also being collected under the current Five-Year Plan. The solution – strict differentiation and separate handling of IGY and non-IGY data, but all at WDC-B.⁸²

[61] Within those limits, the Soviet IGY committee took their responsibility for the creation and management of WDC-B seriously, starting with an intervention by Belousov at the 1955 CSAGI Assembly which had ensured that IGY data would be made available to all scientists.⁸³ The Data Center was originally formed in two sections, with eight IGY disciplines handled at the Academy's Institute for Aeroclimatology (WDC B1) and five at NIZMIRAN (formerly NIZMIR - WDC B2). They became operational in 1958. In May 1959 a survey compiled for the US IGY committee found the flow of Soviet data "considerable", "very good", and above the world average for several disciplines. But the provision of data for auroras and for glaciology was felt to be "weak", and the position over rockets and satellites was still unsatisfactory.⁸⁴ The last point seems to be confirmed by an astonishing report issued by WDC-B in 1960, which presented a tally of everything it had sent out and received to date. Data from rockets and satellites were specifically included in its responsibilities, but nothing whatsoever was listed for them – on either side of the balance-sheet.⁸⁵

[62] During the IGY there was Soviet disappointment at the limited number of committees, outside the Eastern bloc, which took the optional decision to send their data to Moscow as well as to Western WDCs. There was no obligation on scientists, either, to send copies of their subsequent IGY-related publications to any WDCs at all. The amount of such material reaching WDC-B also fell below expectations. A later report bears out those early concerns.



Figure 8. Fifth CSAGI Assembly.

In many categories the data for 1957–1959 had come from fewer than half the committees in the IGY.⁸⁶

[63] Strictly speaking, the IGY was limited to the collection and exchange of a vast pre-arranged set of measurements of worldwide physical processes, in short geophysical data. The extraction of new knowledge from that data, or science, was never part of the IGY but was left to individual scientists working as usual in their local or national organizations. But the distinction was widely ignored at the time and will be so again, briefly, here.

[64] In July 1958 the Soviet committee welcomed about 220 foreign and 185 Soviet delegates, plus 800 guests and over 200 journalists, to the 5th and last CSAGI Assembly.⁸⁷ Despite a bitter row behind the scenes about who was to blame for the absence of a delegation from Taiwan, the scale and splendor of plenary sessions in the Great Hall of Moscow University (Figure 8), and the number and quality of scientific papers presented, were a fitting conclusion to the largest international research programme ever undertaken.⁸⁸ (So many scientific and organizational documents needed to be circulated that bureaucratic obstacles had to be bypassed by shipping in extra supplies of duplicating paper from Brussels.⁸⁹) On 4 August a Soviet proposal that the IGY should be continued for a further year was accepted in a modified form, establishing the International Geophysical Cooperation of 1959.

[65] Like their colleagues elsewhere, Soviet scientists held many subject-specific conferences based on IGY materials in later years. In January 1963 they held another general conference on the IGY in Moscow, which was also the occasion for one of the first IGY philatelic exhibitions.

[66] Turning to publications, Soviet scientists edited only one of the 35 volumes of scientific reports in the *Annals of the IGY*, which perhaps reflects their weak position at the center of the programme. But they were also responsible for one of the Year's key data sets, the Catalogue of Sunspot Magnetic Fields, which was compiled at the Crimean Astro-

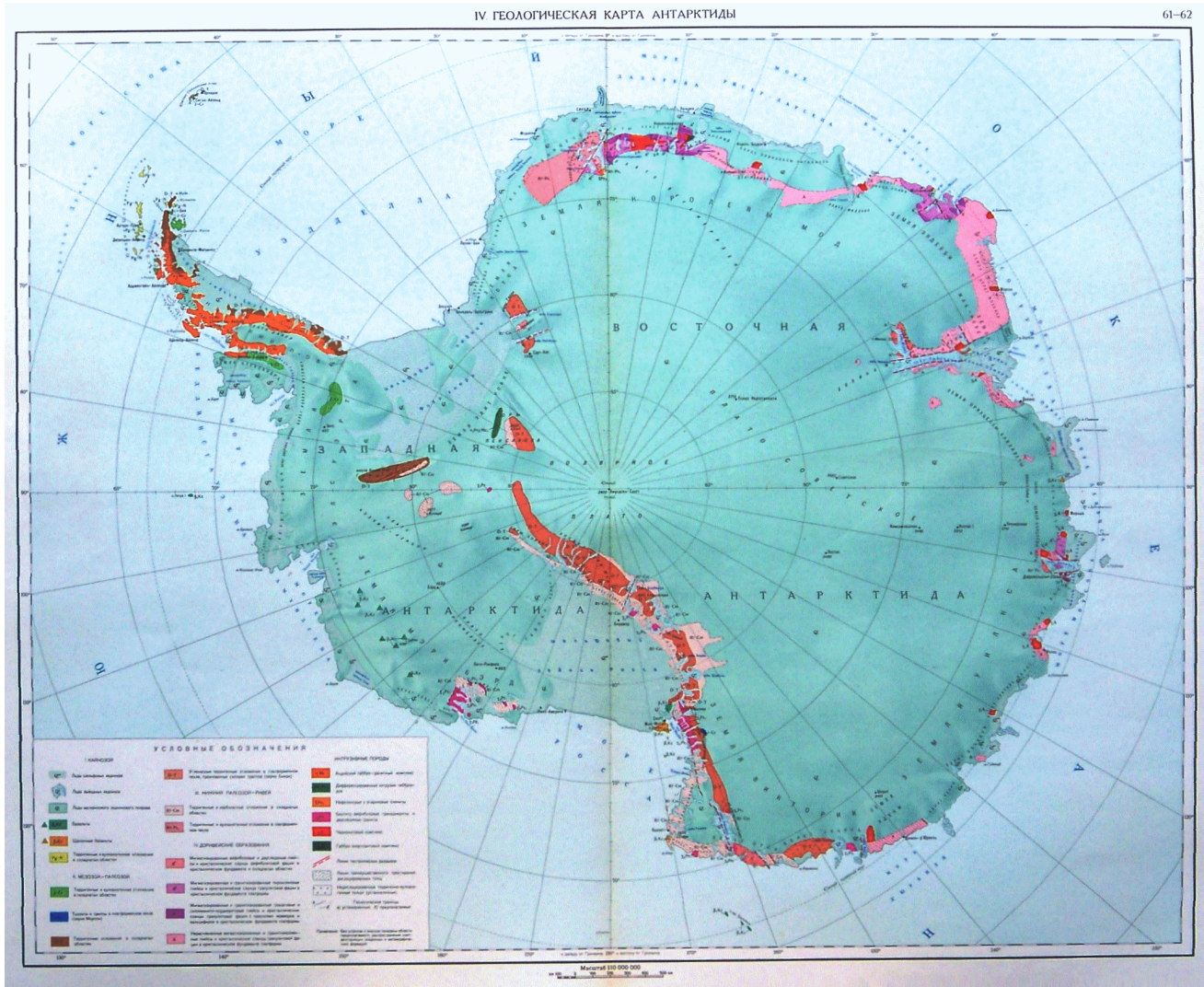


Figure 9. “The Geology of Antarctica.”

physical Laboratory.⁹⁰ And out of some 6,400 entries in the bibliography of the IGY, over 1,000, or 16%, were written by Soviet authors.⁹¹

[67] Within the Soviet Union every IGY discipline except Nuclear Radiation, in which the Soviet committee did not take part, received its own series of reports. There were additional series for the Antarctic Expeditions and for the Arctic ‘North Pole’ drift-stations. Work at other Arctic stations was covered in the regular series of the Arctic and Antarctic Research Institute. The results of expeditions to the Pamirs were presented in separate volumes, and the Academies of Science of some of the national republics also published IGY reports (for example, [Belinskii and Khromov, 1960; Dubinskii and Kovalyev, 1964]). Another impressive publication was the *Antarctic Atlas*, which presented several hundred maps, plans and tables on 75 loose, double-sided elephant sheets (Figure 9) [Bagaev et al., 1966; Tolstikov et al., 1969]. The value of some of this work can be inferred from its early translation into English.

[68] Soviet IGY scientists also wrote for the general public, mainly about their polar expeditions. Books of this sort by Tryoshnikov and Vvedenskii, for example, were well-written and entertaining. In 1962 Troitskaya and two of her colleagues published a drily factual, but also strikingly even-handed and internationalist account of the IGY as a whole [Tryoshnikov, 1959; Vvedenskii, 1970; Silkin et al., 1962]. Books about the first sputniks were naturally popular, but were usually written by science writers rather than by scientists or engineers. An exception was the rocket engineer Yurii Pobedonostsev, whose book was finished three weeks after the launch of Sputnik 1 [Pobedonostsev, 1957; Shternfel’d, 1957; Petrov, 1958].

[69] After the event, one of the best-informed Soviet commentators on the IGY reflected that its great achievements for both international and Soviet science had only been possible because the interests of the two coincided. At the time it had seemed like the natural thing to do in order to transform Soviet geophysics, and not in the least like a one-off

event [Povzner, 1966, pp. 214–215]. Taking part in the IGY did indeed change Soviet geophysics for ever, not only in itself, but also in its relationships with the rest of Soviet science and with the international scientific community. That is why so much institutional reverence is still directed towards it today at the Geophysical Center of the Russian Academy of Sciences, a sentiment which was voiced repeatedly at the Suzdal conference in 2007. But this article is already too long, and the broader significance of the IGY for Soviet science will be discussed elsewhere [Bulkeley, 2007].

[70] **Acknowledgments.** The Endnotes reveal my debt to archivists and others. I thank the many people at the Geophysical Center and at the Archives of the Russian Academy of Sciences who went out of their way to help me with the research on which this paper is largely based. Of the many individuals in Russia and elsewhere to whom more general thanks is owed, I would particularly like to mention Valeria Troitskaya and Vitaly Nechitailenko.

[71] The conference paper on which this article is based was originally given to an IGY history session in the IAGA section of the 24th IUGG Assembly at Perugia in July 2007. It was revised and given again to the Conference on the 50th Anniversary of the International Geophysical Year and the Electronic Geophysical Year, convened by the Geophysical Committee of the Russian Academy of Sciences at Suzdal in September 2007. I thank the organizers of those meetings for their permission to publish it in both proceedings.

[72] **Picture credits.** (1) Photographer unknown; sent to Nicolet by Kalashnikov; (2) IGY Information Bulletin, Moscow; (3) Stamp designed by Ye. Gundobina, issued in July 1957; (4) Artist unknown, from [Tryoshnikov, 1959]; (5) Artist – Igor Ruban, from [Ruban and Morozov, 1967]; (6) Photographer unknown, from the collection of Paul Dickson; (7) IGY Information Bulletin, Moscow; (8) From the documentary *Alert!* Mosnauchfilm, 1959; (9) Sheets 61–62, *Antarctic Atlas*, Vol. 1.

Endnotes

Key to symbols in notes: § series; ‡ sub-series; [] box or drawer; \ folder; f. numbered folio. (Documents in Russian archives that were not originated abroad, and items cited from Soviet journals and other series, can be assumed to be in Russian.) Web pages have been saved in my name at Furl (<http://www.furl.net>) under keyword “Aspects” (<http://www.furl.net/member/quijote?topic=Aspects&page=1>), but Cyrillic text may need to be processed with a code converter.

- 1) The MCI was made up of representatives from the International Union of Geodesy and Geophysics (IUGG), the International Scientific Radio Union (URSI) and the International Astronomical Union (IAU). Originally formed by the IUGG at its Edinburgh Assembly in 1936, it was revived by the International Council of Scientific Unions (ICSU) in 1948.
- 2) The fourth union approached was the International Geographical Union.
- 3) Minutes of the Morning Session, IATME Assembly, 23 August 1951: Archives of the Royal Danish Meteorological Institute (hereafter ARDMI) § IATME [II] \16 “Dr Joyce”/
- 4) S. Chapman “The International Geophysical Year, 1957/8” MS: Archives of the Australian Academy of Science § MS53 [1] Item 1. Geography and geology were included in his list of possible IGY disciplines.
- 5) Laclavère-Laursen, 20 December 1951: ARDMI § IATME [II] \17 “Prof. Coulomb”/
- 6) “The Second Meeting of the CSAGI: General Report” Annals of the IGY (hereafter Annals) (see [CSAGI, 1958, p. 85]).
- 7) [Goryachev, 1999, pp. 59–63]; A. G. Grek, *Cruel Uranium*, 2004, <http://www.memorial.krsk.ru/Articles/200402.htm>.
- 8) [Strömberg, 1952, pp. iv–xi]. Lindblad was no stranger to the conduct of sensitive international scientific affairs, having mediated between American and British astronomers and their German colleagues during World War Two. In 1952 he became president of ICSU.
- 9) Stratton-President, Soviet Academy of Sciences, 8 September 1952; Herbays-same, 27 April 1953; Chapman-same, 29 July 1953: Archives of the Russian Academy of Sciences (hereafter ARAS) § 579 [3] \481/.
- 10) In 1947, before the Cold War had fully set in and four years before becoming president of the Academy, Nesmeyanov accepted the honorary post of vice-president of the International Union of Chemistry, as it then was. On the strength of this the Union claimed the Soviet Academy as a member.
- 11) Klumov-Topchiev, 21 January 1953; Topchiev-Tikhonov, 4 June 1953; Tikhonov-Topchiev, 10 June 1953: ARAS § 579 [3] \481/.
- 12) Nesmeyanov-Chapman, 4 March 1953 (exact date is from ARAS): Papers of Sydney Chapman, University of Alaska (hereafter SC) § IGY [62] \254/. Nesmeyanov wrote to Hill in the same terms on the same date. The letter to Chapman was sent to the CSAGI office in Belgium and received the following day, so perhaps by diplomatic bag.
- 13) The other nine members were: Th. Th. Davitaya, B. A. Vvedenskii, Z. V. Topuriya, A. A. Kopytin, P. A. Gordienko, Ye. K. Fyodorov, N. V. Pushkov, G. I. Golyshev and M. E. Ostrekin: ARAS § 579 [3] \481/ f. 2.
- 14) Chapman-President and Council of the Soviet Academy, x 2, 13 December 1953: ARAS § 579 [3] \481/; Nesmeyanov’s letter to Chapman in March 1954 was probably a response to these letters rather than to the earlier correspondence handled by Topchiev.
- 15) [Povzner, 1966, p. 208]. This unique account of the organization of the Soviet IGY programme, by an insider, mirrors its subject by saying little about rockets and satellites.
- 16) A. V. Topchiev, draft instructions and memo, n.d. but on or by 20 September 1954: ARAS § 579 [3] \481/ f. 26-28.
- 17) “Draft Report of the Meeting of the CSAGI Bureau with the Soviet Delegation at the I.U.G.G. Assembly”, n.d.: SC § IGY [62] \254/; see also [Nicolet, 1984]. Monin, though trained as a meteorologist, was probably present in a political capacity, since he was working in the Science Department of the Central Committee of the CPSU at the time. Chapman also met diplomats from the Soviet Embassy in Rome.
- 18) ARAS § 579 [3] \481/ f. 29.
- 19) “Notes of a meeting between S. Chapman and four of the USSR representatives appointed by the USSR Academy of Sciences to attend CSAGI” n.d.: SC § IGY [62] \254/.
- 20) Belousov’s late arrival may have resulted from last-minute changes to his prepared address to the meeting, perhaps by Soviet officials: author’s interview with John Simpson, 1 March 1991.
- 21) Draft instructions, c 20 September 1954: ARAS § 579 [3] \481/ ff. 27-8; see also [Povzner, 1966, p. 208]. There was no verbatim record, and the Soviet delegation did not circulate a written summary of their plans; this may have been a tactical mistake, at least in respect of Antarctica (below). The eleven Soviet delegates to the preceding, fortnight-long IUGG Assembly probably also outlined their plans for the IGY, language and other things permitting.
- 22) Gamburtsev-Presidium, 9 November 1954: ARAS § 579 [3] \481/ f. 105.
- 23) [Editorial, 1955]; Draft IGY Cosmic Rays Programme: ARAS § 683[1] \1/.
- 24) According to Povzner [1966, p. 201], Bardin only took over from Gamburtsev in February, because of the latter’s failing health. (He died in June.) Bardin is said to have been chosen for his managerial skills and for his experience in dealing with industry during and after the war, since Soviet IGY stations and expeditions would need quantities of new equipment and construction. How the Soviet IGY programme related to the Academy’s share in the Fifth (1951–1955) and Sixth (1956–1960) Five-Year Plans is unclear.

- 25) Two broad sets of affiliations could be suggested. The first may have included the Hydro-Meteorological Service, its parent body GlavSevMorPut (the Northern Sea Route Administration), and Leningrad. The second may have included NIZMIR – the Academy’s Institute for Geomagnetic, Ionospheric and Radio Research – and planetary geophysics in general, the Ministry of Communications, and Moscow. Belousov’s rise to leadership in Soviet geophysics might reflect his ability to bridge this divide. But all this remains conjectural.
- 26) Bardin-Nicolet, 7 April 1955, cited in Nicolet-Bardin 14 April 1955: SC § IGY [52] \50/.
- 27) The official story on Belousov’s French is that he learned it from a Belgian neighbour in the 1920s. But Laclavère believed, perhaps on the best authority, that Belousov had had a French governess in his affluent, pre-revolutionary childhood.
- 28) “In the Central Region” in [Afinogenov, 1961]; “Reminiscences of Galina Nikolaevna Pushkova” n.d. (http://www.izmiran.ru/info/personalia/npushkov/o_pushkove/pushkov4.html).
- 29) Bardin-Academia Sinica et al., 5 March 1955: ARAS § 579 [3] \481/ f. 110 et seq.
- 30) “Belousov, Vladimir Vladimirovich (Prof., Dr.)” n.d. but mid-1957: Australian National Archives, Canberra (hereafter ANAC) § A1838 \1495/13/1 Pt 2 /. The most likely occasion for this well-informed but unattributed intelligence report (with American spellings) was Belousov’s visit to North America for IUGG and IGY meetings, and a tour of seismological research institutes, in 1957. For Chapman’s announcement see *Annals* vol. 2A, p. 222.
- 31) [Editorial, 1956; Povzner, 1957a, pp. 91–93]. The latter shows the committee roughly as it appears in volume 9 of the *Annals*.
- 32) Author’s interview with V. A. Troitskaya, 8 April 1991; see also [Povzner, 1966, p. 203].
- 33) Coordinated planning only started “at the beginning of 1956”: [Povzner, 1966, p. 213].
- 34) V. S. Zaletaev “The Tasks and Activities of the Consultative Committee” *Izvestiya of the Soviet Academy of Sciences, Geographical Series*, 1957 (AGU translation); Kalashnikov-Nesmeyanov, 4 December 1956: ARAS § 683 [1] \2/; Bardin-Scherbakov, n.d. but December 1956: *ibid.*
- 35) “General List of Stations” *Annals* vol. 8, pp. 1-76. The list does not include stations temporarily occupied by oceanographic vessels, polar traverses etc. On 2 November 1956, however, Bardin reported to the Presidium that there would be 350 Soviet geographical stations, not including the standing meteorological network. (The committee listed 293 WMO-registered stations for IGY meteorology, but many locations would have overlapped.) [Povzner, 1957a, pp. 61–66, 87–88] Even allowing for some cancellations the different totals are hard to reconcile. Soviet sources often cite Bardin’s other figure of 500 instrumental or discipline stations, i.e. counting the instruments and observers for each discipline at each location as a single station. For a multi-disciplinary programme like the IGY there are always more instrumental than geographical stations. In the end there is little difference between the round figure of 9%, which I give below for the Soviet contribution to the IGY, and the 8% reached by the instrumental stations method [Dolgin, 1983, p. 26].
- 36) “Report on the fulfilment of the Soviet Union’s obligations within the IGY” n.d. but late 1957: ARAS § 683 [1] \7/.
- 37) A. Poskonov (Minister of Finance)-Council of Ministers, n.d. but early 1958: ARAS § 683 [1] \7/.
- 38) Minutes of the Soviet IGY Committee, 16 January 1958, Item IV.2: ARAS § 683 [1] \9/.
- 39) Minutes of the Soviet IGY Committee, 13 March 1958, remarks by N. V. Pushkov: ARAS § 683 [1] \9/; see also Minutes of the Working Group on Oceanography, 5 April & 27 May 1958: ARAS § 683 [1] \10/.
- 40) Reports by Yu. D. Bulanzhe on discussions with the Polish, Czechoslovak and Hungarian IGY Committees, February 1958: ARAS § 683 [1] \12/.
- 41) “General List of Stations” loc. cit. n. 35 above.
- 42) The sources (below) do not specify whether the observation was made at NIZMIR’s High Altitude Station near Kislovodsk, or at NIZMIR’s main complex of observatories and laboratories outside Moscow, which also had optical instruments for solar observation.
- 43) *New York Times*, 27 June and 5 July 1957; [Sullivan, 1961, pp. 45-48; Silkin et al., 1962, pp. 38–39].
- 44) The flagship of the First Expedition, the *Ob’*, was converted, refitted and loaded in 100 days.
- 45) This was about 10° further west than the location originally proposed in June 1955 (below).
- 46) Memo, Law-Waller “IGY Bases on Knox Coast” late 1955, unsent: Papers of Phillip Garth Law, Museum of Victoria (since moved to Australian National Library, Canberra) [21] \7/15/
- 47) Cable, Australian Dept of External Affairs (DEA), London - DEA Canberra, 23 December 1949: ANAC § A1838 \1495/13/1 pt 1/; “Russian Interest in the Antarctic” March 1955, Foreign Office Research Department: ANAC § A1838 \1495/13/1 pt 2/; see also [Wolk, 1958, pp. 44–45].
- 48) US officials first warned their Australian colleagues about Soviet intentions for the Knox Coast in November 1954: Cable 1620, DEA Canberra - DEA London & Washington, 11 July 1955: ANAC § A1838 \1495/1/9/2/
- 49) Minutes, USNC-IGY Antarctic Committee, 13 October 1954: Archives of the National Academies of Science, Washington (hereafter ANAS) § IGY ‡ 9 Regional Programs: Antarctic \Antarctic Committee: Meetings & Minutes: 1954-1955/.
- 50) “On the shores of Antarctica” *Komsomolskaya Pravda*, 28 January 1955; *Vodnyi Transport*, 29 January 1955; “Chronicle: the International Geophysical Year” 1955, loc. cit. n. 23; announcement of Soviet IGY committee, *Pravda*, 12 April 1955.
- 51) In May 1954 Berkner prompted the re-establishment of the US National Academy’s Committee on the International Scientific Unions and soon became its chairman. This gave him extensive influence over the affairs of ICSU and its member unions, including their dealings with UNESCO.
- 52) Kaplan-Chairman, OCB Working Group on Antarctica, 7 February 1955: ANAS § IGY ‡ 16 USNC Member Files, Kaplan J \Letter from Kaplan J to Operations Coordination Board: 7 Feb 1955/; Berkner-Nicolet, 15 February 1955: SC § IGY [60] \205/.
- 53) Prompted by Nicolet, Berkner added Chile to his list but continued to stress that “only the nine nations ... [should] be invited” - Berkner-Nicolet, 26 April 1955: SC § IGY [52] \50/; see also Berkner-Martin, 1 April 1955; Laclavère-Nicolet, 12 May 1955; Laclavère-Berkner, 13 May 1955: all *ibid.*; also Laclavère circular, 14 May 1955 but posted two days later: SC § IGY [57] \144/. For the cable to Assam: author’s interview with Georges Laclavère, 12 June 1990.
- 54) E. Hoge-President of the Belgian Academy, n.d. but mid-June 1955 at latest; the meeting with Nicolet referred to may perhaps have been 7 May but 7 June is more likely: Archives of the Royal Belgian Academy of Sciences (hereafter ARBAS) \009061/.
- 55) The exaggeration may have arisen with Hoge rather than Laclavère. At its meeting in October the Belgian IGY committee rebuked Hoge for taking too much on himself, both before and during the Paris meeting, for which he had had only a fact-finding mandate: ARBAS \009058/.
- 56) Laclavère-Belousov, 10 June 1955: ARAS § 579 [3] \481/ ff. 136-38.
- 57) Nesmeyanov-Nicolet, 29 June 1955; Nesmeyanov-Laclavère, 29 June 1955: *ibid.* ff. 134-5, 157. The letter was mistranslated for the US IGY committee, inserting a Soviet intention to install both bases and thus losing the accommodating tone of the original. Whether it was similarly misunderstood in Brussels and Paris, before Belousov arrived, is not known. In view of what transpired in Paris, it should also be noted that the Soviet committee’s choice of possible bases, made on 25 June, was taken with conference papers in front of them which had specified a strong Norwegian interest in Princess Astrid Land and a slight US interest in the Knox Coast. However only Laclavère’s letter, and not the accompanying papers, had been translated into Russian. A letter from Bulanzhe to Nicolet in June 1955, asking for the report on geographical distribution of IGY sta-

- tions from the Rome CSAGI meeting and for the statutes of CSAGI itself, may also have related to Soviet Antarctic plans and Belousov's mission to Paris. Unfortunately like many file copies of Soviet documents its date is incomplete: ARAS § 579 [3] \481/ f. 139.
- 58) "Belousov, Vladimir Vladimirovich (Prof., Dr.):" loc. cit. n. 30.
- 59) Dillon-Secretary of State, 6 July 1955: US National Archives, Washington, Record Group 59 [2773] \702.022/; a follow-up cable two days later reported station changes from the meeting but none by the United States.
- 60) This phrase was first applied to a point in the Arctic Ocean in 1920 by the Canadian explorer Vilhjalmur Stefansson.
- 61) Soviet IGY expeditions were restricted to aircraft brought in by sea, because a request for air transit facilities in Australia, though never finally refused, was not granted during the IGY. The Antonov-2 planes which supported the Soviet tractor trains could carry about 2 tonnes of freight near sea level; the corresponding figure for the Douglas C-124 "Globemaster" was 27 tonnes. The latter's average load when airlifting components to an altitude of 2800m for the US South Pole station in February 1957 was 11.7 tonnes: [Sullivan, 1961, p. 303]. Several Soviet aircraft were lost in Antarctic accidents between 1956 and 1959, some during ground handling, but luckily with no loss of life.
- 62) [Buchheim, 1959, pp. 220-221; Siddiqi, 2000]. Within the structures of the Academy, the ICIC was subordinate to the Astronomical Council of the Soviet Union.
- 63) Pravda, 5 August 1955.
- 64) Vertical sounding rockets for the IGY seem also to have been planned and prepared by existing bodies, rather than the IGY committee, but the subject needs further clarification. The programme of such launches drawn up by Korolyov in April 1957, for instance, did not include all those planned for the IGY [Rauschenbach, 1998, pp. 215-220].
- 65) Despite its name, Blagonravov's commission focused on biomedical rocket experiments.
- 66) [Povzner, 1957a, pp. 91-93]. Unlike Fyodorov, the heads of ten other working groups were all identified as such in this listing. Also: Day circular "Coordinator's Moscow Visit", 20 January 1958: ANAS § IGY † 10 \CSAGI: Correspondence: General: 1958/; Day-Berkner, 28 January 1958: SC § IGY [62] \252/. As late as January 1958 Bardin signed a version of the Soviet IGY programme that made no reference to rockets and satellites: ARAS § 683 [1] \4/. A recent comprehensive account of the organizational arrangements which resulted in the first sputniks makes no reference whatsoever to the Soviet IGY committee or to (this) Yevgenii Fyodorov, let alone to any conception by protagonists in the Soviet satellite programme that they were under some obligation to negotiate and then to follow international IGY procedures: [Siddiqi, 2002]. It would be impossible to ignore the US IGY committee in any comparable study of US IGY satellites.
- 67) Wyckoff-Odishaw "Report of Activity at CSAGI Meeting in Brussels" 26 September 1955: ANAS § IGY † 6: Earth Satellite Program \Correspondence: Jan-Sept 1955/.
- 68) Berkner-Chapman & Nicolet, 29 February 1956: *ibid.* \Correspondence: Feb 1956/; Nicolet-Cardus, 15 August 1956: SC § IGY [54] \79/. The list in Nicolet's transcription included a certain "Tschubukov" who also failed to appear; a possible but unlikely candidate is meteorologist and climatologist Leonid A. Chubukov.
- 69) Povzner [1966, p. 266] claims that Bardin did enlarge slightly on Soviet satellite payloads at Barcelona, but eye-witness accounts do not support this.
- 70) Berkner-Nicolet, 16 June 1957; Reid, memo, 24 June 1957, enclosing Bardin-Nicolet 10 June 1957, the report, and Porter's MS comments: ANAS § IGY † 6: Earth Satellite Program \Correspondence: 16-30 Jun 1957/.
- 71) Reid, memo, "Manual on Rockets and Satellites", 4 June 1957: *ibid.* \Correspondence: 1-15 Jun 1957/; Odishaw, circular, 23 July 1957: *ibid.* \Correspondence: 1-15 Jul 1957/.
- 72) According to Blagonravov the number of Soviet delegates to Washington was cut at the last moment – Bobrovnikoff-Kaplan, "IGY Rocket and Satellite Conference", n.d.: ANAS § IGY † 10 CSAGI: Disciplinary Conferences \Rockets & Satellites: Washington: US Delegation: 1957/. With Boris Petrov instead of Blagonravov, the same small delegation had already visited Britain in July. They gave lectures on Soviet upper atmosphere research with rockets at the University of London and the Royal Air Force Aeronautical College. The Soviet satellite programme was touched on only briefly.
- 73) Bardin-Berkner, 16 August 1957: SC § IGY [62] \257/. A copy also went to the Royal Society where, bizarrely, by August British scientists were registering their concern at the difference in frequencies but also their interest in the experimental possibilities of the Russian choice. They even tried to alert their sleep-walking colleagues on the other side of the Atlantic, but all to no avail – Moore-Odshaw, 27 August 1957: ANAS § IGY etc. as n. 72 above. The strangest aspect of the frequencies affair, however, is that all Soviet IGY satellite information distributed before Sputnik 1 was carefully collected and included in the Manual on Rockets and Satellites, which then became Annals vol. 6 – except for this perhaps embarrassing letter.
- 74) Fyodorov-Day, 20 January 1958, enc. with Day-Berkner, 28 January 1958: SC § IGY [62] \252/.
- 75) Day-Shapley, 4 February 1958: ANAS § IGY † 6: Earth Satellite Program \CSAGI on Rockets & Satellites: Chapter XI: Folder 2: 1957-1959/; "Amendments to the CSAGI Guide to IGY World Data Centers", 4th Issue, Section XI, 2 April 1958.
- 76) Annals vol. 10, pp. 182-84, and vol. 7, p. 315; see also [Newell and Townsend, 1959].
- 77) Richter-Reid, 10 September 1958: ANAS § IGY † 6: Earth Satellite Program \Correspondence: 1-18 Sept 1958/; Odishaw-Elvey, 30 April 1959: ANAS § IGY old filing system [49] \646 etc/; Van Allen-Leonard, 4 May 1959: *ibid.* † 6: Earth Satellite Program \Correspondence: May 1959/; Belousov-Newell "Fulfillment of the V CSAGI Meeting Resolutions", May 1959: *ibid.* † 16: USNC Member Files \Newell H. E.: CSAGI: Correspondence: 1958-1959/.
- 78) DOSAAF was controlled by the Central Committee of the CPSU and led by military officers. Its activities included driving schools, gun clubs and aviation clubs, including the Chkalov. Its publications included a booklet by V. P. Petrov on Guided Missiles and Rockets in 1957, a semi-weekly newspaper Soviet Patriot, and, jointly with the Ministry of Communications, the monthly magazine Radio: [Gouré, 1962, 1973].
- 79) Annals vol. 48, 1970. A rough estimate would be that this group forms between 2 and 3% of named authors. The bibliography was poorly compiled and any consultation of Soviet IGY literature soon reveals more items, many of them by yet more women.
- 80) [Bardin, 1958], ch. 8. Klyonova continued her IGY work in November-December 1957 during the stormy first cruise of the Mikhail Lomonosov in the North Atlantic.
- 81) R. Bulkeley (manuscript in preparation, 2008). The deaths of Grigorii A. Gamburtsev, Ivan P. Bardin, A. V. Kopteva and O. A. Kamenskaya during or soon after the specified period are presumed to have been natural.
- 82) Minutes of the Working Group on Oceanography, 10 March 1958: ARAS § 683 [1] \10/. One source of confusion, evident from the minutes, was that the entire national oceanographic programme was being referred to internally as "IGY", although much of it was not officially assigned to the international programme.
- 83) "Belousov, Vladimir Vladimirovich (Prof., Dr.):" loc. cit. n. 30.
- 84) P. Hart "Status of Data Flow from USSR to WDC's A", 28 May 1959: ANAS § IGY † 6 Earth Satellite Program \Correspondence: May 1959/.
- 85) "Report on work done by WDC B from July 1957 to 1 March 1960", n.d.: ANAS § IGY † 8 World Data Centers \WDC-A General Correspondence: Jan-Mar 1960/. One intriguing but sadly unreliable source draws a vivid picture of the censorship of satellite information by a nameless official based at the offices of the IGY committee: [Vladimirov, 1973], ch. 2.
- 86) "Report on functioning of WDC-B 1957-1975": ARAS § 683 [1] \194/.

- 87) Figures for delegates are based on [Editorial, 1958, pp. 48–51]. The report in the Annals states that “514 persons took part in the meetings” – vol. 10, 1960, p. 1.
- 88) The scene was vividly captured in the documentary film Alert! (Mosnauchfilm, 1959). The US IGY committee had been prevented from hosting the event by the Eisenhower Administration’s policy of non-recognition towards four countries with IGY committees.
- 89) Author’s interviews with Marcel Nicolet, 26-28 September 1989.
- 90) V. V. Belousov and N. V. Shebalin (eds) Annals vol. 30, 1965; M. A. Ellison (ed.) Annals vol. 23, 1962.
- 91) Annals vol. 48, 1970. The proportion would be even higher if the anonymous items, most from Western sources and generally of lesser scientific value, were removed from the calculation.

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