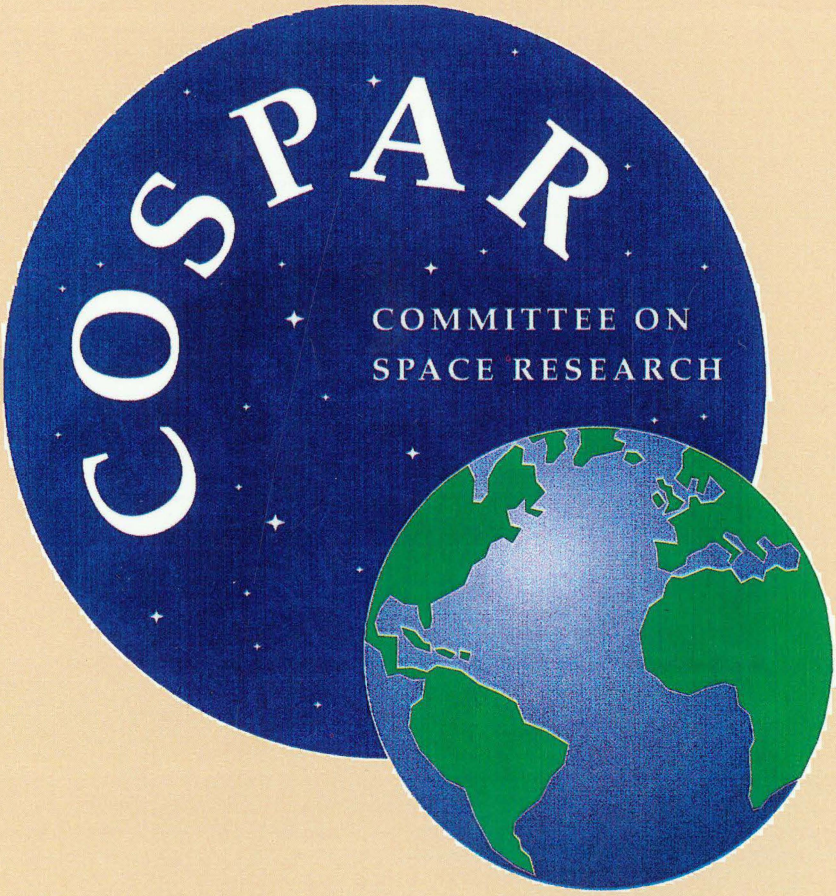
40 YEARS OF COSPAR



BR-135

40 YEARS OF COSPAR

Published by: ESA Publications Division

Editors : G. Haerendel, S. Grzedzielski, G. Cavallo & B. Battrick

Design/Layout: C. Haakman

Price: 15 Dfl

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Preface

This booklet commemorating forty years of COSPAR's existence is not meant to be an historical account, but a collection of personal reminiscences, rather divergent in style and content, enriched with some photographs and statistical material. The authors include some of the early actors in COSPAR. Several of them shed light on the importance of COSPAR as a meeting place for East and West in space research, but also on the political and diplomatic problems with which this forum was burdened and how they were overcome. Others describe their role in serving the organization, their observations, and sometimes amusing personal experiences. The evolution and reformation of COSPAR, in particular the way in which its officers are elected, is also covered. In summary, although it is far from being a complete and systematic account, it conveys some of the flavour of the role and operation of COSPAR. On behalf of the COSPAR Associates and friends, I would like to express my most sincere thanks to all contributors.

Not covered in this booklet are the ongoing efforts to serve COSPAR's community ever better and to become even more attractive to a growing clientele. Just three such developments are: the improvement in quality and speed of publication of Advances in Space Research, COSPAR's main journal; the first steps towards getting industry more actively involved by introducing the concept of 'Associated Supporters'; and, thirdly, the preparatory steps in holding regional workshops for developing nations with the aim of establishing closer ties between scientists in those areas and experienced space researchers willing to share their data and advanced techniques with them. More generally, after having lost its earlier importance as a meeting place for East and West, COSPAR now sees one of its major objectives as promoting space research in developing and new space-faring nations.

I would like to add a few remarks concerning my own involvement in COSPAR. For many years, starting with the meeting in Florence in 1964, I was just an attendee, enjoying the particular aspects that COSPAR was offering. When Karl Rawer, the German national representative for many years, retired in 1984, I was appointed to this post by the Deutsche Forschungsgemeinschaft. One of my national committee's goals was to attract the COSPAR Assembly to Germany again (after the Constance meeting in 1973). We succeeded for 1994, and thus I found myself in the role of Chairman of the Local Organizing Committee. This was quite an experience! In addition, it so happened that at this meeting I was elected COSPAR President. As all of this took place in my birth place, namely the City of Hamburg, the local edition of the popular Bild-Zeitung, in a complete misunderstanding of the role of COSPAR, printed the news item: 'Ein Hamburger ist jetzt der Chef vom Weltraum' (13.7.1994). Although attempts to convey COSPAR's achievements to the public are often subject to distortions of this kind, we must continue to seek, by every possible means, to inform the public correctly and to gain their support. COSPAR Assemblies offer excellent opportunities for that, but also for the widening of our own horizons. To enrich the possibilities for doing so is another goal of COSPAR.

Although the primary role of COSPAR is to promote the exchange of scientific information and ideas related to space research, the attendees of the Scientific Assemblies are also able to savour the local environments of the venues and cultural events organised by the hosts. As an expression of gratitude to all those who have enriched our Assemblies in this way, I have included here a picture from one of the wonderful concerts that I had the opportunity to attend during a COSPAR Scientific Assembly.

COSPAR is indebted to the European Space Agency and to ESA Publications Division for the production of this booklet.

Gerhard Haerendel
President

PART 1
SOME PERSONAL RECOLLECTIONS

COSPAR's First Years: A Personal View

H.C. van de Hulst
Leiden Observatory, Leiden, The Netherlands

How often can one reminisce? In 1990 I wrote an article on 'COSPAR's First Years' for the COSPAR Bulletin[1]. With the consent of the COSPAR President, I freely borrow from this article for the present review, adding a few more personal observations here and there.

After 40 years I am still surprised how, in November 1958, I suddenly entered the world of space politics and space science. From being a quiet astronomy professor, I became, far beyond my intentions or expectations, the first President of COSPAR. This simply came about because a week earlier, at coffee time, Oort had said to me: 'The International Astronomical Union (IAU) has asked me to represent them at a meeting in London, but I have little time. Would you like to go?'

That London meeting, just before my 40th birthday, was convened on behalf of ICSU by Homer Newell and was attended by an elite of mostly senior scientists, among whom - in my observations - Massey stood out as the most knowledgeable in space matters. Of course, all of us knew about the Cold War. The prime reason for ICSU establishing COSPAR (in a hurry, the month before) was to discourage the United Nations from taking rapid steps toward establishing a specialised agency for outer space. Such a move would undoubtedly have drawn space experiments into the Cold War and would have led to an emphasis on political dispute, rather than on scientific cooperation.

I do not know if the outcome of this prime effort of COSPAR has ever been formally evaluated. The fact is that the mere existence of COSPAR delayed action in this area by the UN for several years. When, finally, in 1966 the first 'UN Conference on the Peaceful Uses of Outer Space' was held in Vienna, I noticed with deep satisfaction that many of the participants greeted each other as old friends from earlier COSPAR meetings. The Chairman of this Conference was Vikram Sarabhai, who had already been of great service to COSPAR. If my memory serves me well, he acted as Chairman of the ad-hoc group dealing with potentially harmful experiments. Several years later I had an occasion to visit Sarabhai at his home and laboratory in Ahmedabad. He was a tremendously hard worker, involved in among other things a variety of projects in education, and starting his day at 4 or 5 o'clock in a cabin near the river. When I asked him why his office in the physics laboratory was not air-conditioned he replied, typically: 'We air-conditioned the library and the computer room for technical reasons, but we don't have the money to do all the offices'.

Let me step back to 1958. We established the COSPAR Secretariat in The Hague, which then was also the seat of ICSU. There were two full-time employees: a senior secretary, Mr Bik, who by his former activity as dean of the military attachés in London during the war was competent in both technical and diplomatic matters, and a junior typist, Annabel, who was also no stranger to the diplomatic world, because her father held a high office in the British Embassy. I wished to keep up my essential university duties and reserved roughly half of my time for COSPAR. Unfortunately, Mr Bik had heart trouble and died soon after. The day after the funeral, Annabel received phone calls from several persons who had heard of this vacancy, and she duly made appointments for interviews. So the next week I had the curious experience of interviewing five applicants, among whom were three retired generals. I modestly chose the Rear-Admiral, Van Straelen. One episode that stuck in my memory occurred one or two years later. When I came into the office, Van Straelen was walking around the long table sorting mimeographed sheets that had to go out. Meanwhile, Annabel was on the phone,

successfully finding out via a friend the hotel address in London (which the Moscow office did not wish to disclose) of a functionary of the Soviet Academy, with whom I had to speak urgently. The spontaneous reversal of tasks of the pair manning the office gave me the happy feeling that, to quote Browning, 'All is right with the World'.

COSPAR's aims in those first years can be best seen in perspective if we distinguish four levels of international cooperation:

- Level 0: The parties are not on talking terms.
- Level 1: Exchange of information on accomplishments, but not on plans or failures.
- Level 2: Exchange of plans with a view to coordination.
- Level 3: Joint projects, doing things together.

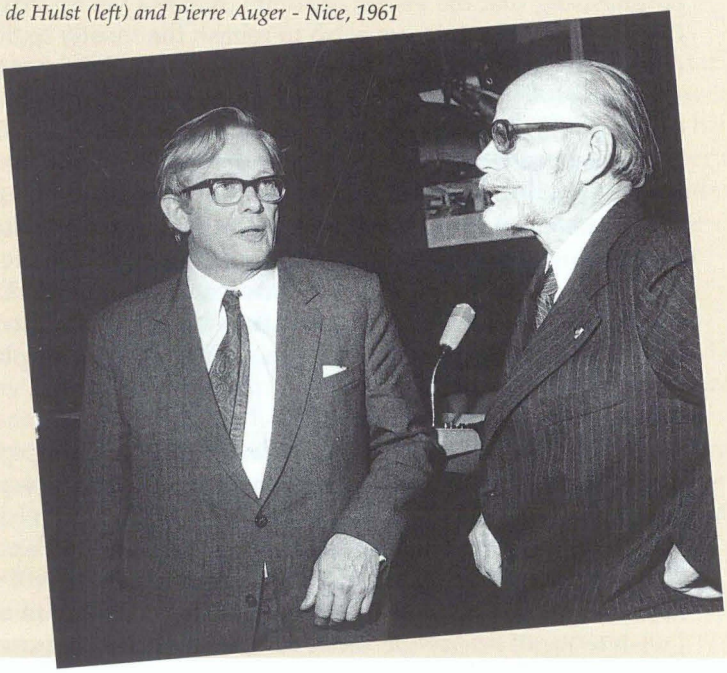
The step from Level 0 to Level 1 took place in the first year and was symbolised in my memory by the Russian words 'project ustav' (draft charter), which rang in my ears at every meeting, emphasising that the Soviet Academy had not yet approved the COSPAR Charter. I do not wish to rehash the mostly tedious and only sometimes amusing details. A personal highlight at that time was a three-week visit to UN Headquarters in New York. COSPAR was not yet recognised by the UN, even as an observer, but Kovda, the President of UNESCO, took the initiative to invite me along as his personal adviser. I wrote a report on the achievements of the international scientific unions in fostering international cooperation of a non-governmental kind, i.e. between academies, rather than between governments. During that time, I had one quiet conversation with Dag Hammarskjöld. He impressed me greatly, but I remember only one simple piece of advice: 'Never shut the door'.

The structure of COSPAR's Bureau and Working Groups had been designed in the 1958 London meeting. It was carried over with several amendments into the final Charter. The Bureau had seven members: the President, a Russian Vice-President and an American Vice-President, and four more members. I will skip the first year of negotiation, when different persons were in office, but I wish to recall briefly the Vice-Presidents who served during the

remaining years of my Presidency. The American, Dick Porter, was an excellent diplomat and an inspired engineer. He once told me about his intense study of the option of recoverable rockets. In the much later Shuttle programme, I recognised several of his ideas. The Russian Vice-President, Anatoli Blagonravov, was a tall white-haired gentleman. He always spoke a soft Russian, translated by his interpreter, but did not hesitate to correct the English translation when his interpreter had missed a detail. During the intermissions, he preferred to speak French. One day, at tea-time, I asked him where he had learned his perfect French. His reply 'From my gouvernante', was for me a lesson in history. He had grown up in a well-to-do family before the Soviet Revolution, where it was quite common to have private teachers.

Several mutations occurred among the further Bureau members, and I feel no urge to review them all. Massey clearly stands out;

Henk van de Hulst (left) and Pierre Auger - Nice, 1961



unfortunately my impressions of him during my COSPAR years have been overtaken by the more intensive interactions we later had in European space research. The Canadian, Rose, had spent many long daylight summers with research missions in the Arctic. I could well imagine that sitting in a meeting room was not his first preference. The most colourful Bureau member was Zonn from Poland, who often, in a philosophical manner, managed to weave some implicit criticism of his country's formal policy into the messages he had to deliver.

When COSPAR organised its first Space Science Symposium in Nice in January 1960, we had definitely reached Level 1 of my list. This meeting was quite successful, with a highly varied menu of lectures, as can be seen from the monumental volume edited by Mrs Kallmann-Bijl[2]. This meeting, and the ones that followed at approximately yearly intervals, did a lot to put COSPAR solidly on the scientific map. But we also noticed with some regret that they contained hardly any trace of coordinating plans (Level 2) or of aiming at joint projects (Level 3).

What finally helped to get some form of coordination going were the ad-hoc groups in which a very small number of scientists (some 5 to 10) were given the task of studying a limited subject. The upper-air influence on satellite drag, about which abundant data were available, varying with time of day, season, and solar activity, was one of these. It was for me a personal pleasure and a real satisfaction to see experts from at least four countries not just looking from a distance at the well-prepared slides of someone else, but jointly bent over a set of graphs spread out on the table. This soon led to the publication of the COSPAR International Reference Atmosphere[3].

The aim of joint projects was really beyond COSPAR's ambitions, but the Nice meeting provided the proper setting for at least one regional initiative to that end. One day, during the lunch intermission, Pierre Auger gathered some ten representatives from western European countries together around a marble table in the lobby. He handed out a paper by Amaldi, who could not attend himself, urging that Europe should make a deliberate effort to

'catch up in space science and technology' with the USA and the USSR. While this aim seemed too far-fetched, the fact is this brief gathering formed the start of what became COPERS, then ESRO, then ESA. Other regional and local initiatives budded at around the same time, but this is not the place to expand on those.

When COSPAR started, the possibility of (future!) manned space flight already had a wide popular appeal. We discussed what COSPAR should do in this area. On the advice of Massey and others, we decided *not* to include this topic among our initial points of interest. But history took a different path. It can hardly have been an accident that Gagarin's successful flight was announced by Blagonravov, then Vice-President of COSPAR, during our meeting in Florence in April 1961. The permission for COSPAR to meet in the Palazzo Pitti had not been easily forthcoming, because two city departments, of Musea and of Monuments, were involved. But that afternoon, when the news of

American Astronaut John Glenn (left) and Russian Cosmonaut Gherman Titov (right) with Henk van de Hulst - Washington, 1962

the first manned space flight broke, there was no way of stopping the press photographers from climbing on the monumental tables.

Things happened very fast. Less than a year later, when we were preparing the next COSPAR symposium (Washington, May 1962), I received the suggestion that we stage the first eye-to-eye meeting between a Russian and an American astronaut there. I hesitated strongly to say yes, for the decision of COSPAR not to get involved with manned space flight was still in effect. After several consultations, however, I agreed. My main consideration was that any accident in the truly hazardous manned space flight programme - on either side - would have made such a friendly meeting politically impossible for a long time. The feeling of competition was still too strong. Therefore, it seemed better to discharge this condensor now, while there was an opportunity. Thus, in May 1962 I had the pleasure of being present at the breakfast where Glenn and Titov first shook hands, and in the late afternoon I presided over the scientific COSPAR session which culminated with their talks. There were news cameras in every niche of the large meeting room. At a loss for how to end this session, I had bought a pair of 'klompen' (wooden shoes) in my home town. At the end of the session, I presented both of them with one klomp of the pair, with the key line: 'They were cut from the same tree and are meant to be used together'.

After more than three years in the COSPAR world of science mixed with diplomacy, I felt a strong urge to return to my personal research. So at the same May 1962 meeting, I resigned as President and Maurice Roy was elected to be my successor. At Porter's suggestion, I was given the Bureau seat vacated by Roy. I celebrated this new freedom by moving 3 months later with my family to New York for a sabbatical half year at the Goddard Institute for Space Science and Columbia University. I started writing a book on Multiple Light Scattering, having firmly decided that this time I would stick to my own style and my own speed. The book was published 18 years later!

Funnily enough, in retrospect, 1962 does not feel at all like a break in my relations with COSPAR. I attended three more annual

symposia with the same vigour and the same pleasure as before. Let me end this contribution with a few personal recollections from those meetings.

The Warsaw meeting, in June 1963, was held in a most congenial atmosphere. COSPAR was now fully accepted by East and West and it was a distinct satisfaction that we could meet for the first time in a Socialist-bloc country. It also felt good to be back in a smaller country for a change. The welcoming speech by Zonn on 'Contrasts in the Polish Character' was a beauty. I would love to hear it again. I also enjoyed a private visit to the astronomical observatory, where I gave an informal talk to some ten students and staff members.

Just why we met again in Florence in May 1964 is beyond my recollection. But we were more than welcome; Mayor La Pira even invited us to meet there every five years. The new, spacious congress building was less colourful, but far more efficient than the Palazzo Pitti where we had met the first time. During the bus ride on an afternoon excursion to Siena, a game developed which was to think up what the acronym COSPAR might stand for. I remember the two winners reflecting both the political and the scientific side of COSPAR's work: 'Crowd Of Silly People Amending Resolutions', and 'Collection Of Slides Projected At Random'. Clearly, COSPAR was growing up!

From the very beginning in 1958, I had argued that satellites circled the northern and southern hemispheres equally, and that COSPAR should meet as soon as possible in some southern country. Argentina, which I had never visited, seemed a good choice. Finally, in May 1965 it happened, largely through the push of Carlos Varsavski, who had set up the local organisation. The start took an unexpected political turn. The day before we were to meet in Buenos Aires, the government decided that, owing to the recent intervention of the USA in the Dominican Republic, the risk of violent student protests was too great. So each COSPAR participant arriving at Buenos Aires airport received a note, essentially saying: 'Sorry, the meeting is one day later and 400 km further south in Mar del Plata'. It was amusing to see the

spontaneous separation into two groups: a small number of participants were annoyed, or worried about the validity of their insurance in the military planes taking us on this extra hop. A larger group of them greeted the change as an added adventure. The local organising committee showed an excellent example of the Latin American power of improvisation. Dust covers were soon removed in the wintry beach resort, and meeting rooms and offices assigned. If a slide projector occasionally turned up in the wrong place, the necessary corrective action was rapidly taken.

Just a few personal recollections from this meeting. The paper that impressed me most was delivered by Hayakawa in the Dag Hammarskjöld Auditorium. It not only had a superb scientific quality, but was also pronounced in a very articulate English. One day, feeling tired, I took an afternoon off for a lonely walk along the beach. I loved the rough landscape and was wondering whether I should venture in for a swim. Then a penguin which had strayed too far north appeared in the surf. I immediately decided that I should not compete! In the course of the meeting I had talked the two leading ladies from the American and Russian delegations, Mrs Kallmann-Bijl and Mrs Massevitch, into jointly hosting a dance party which COSPAR should offer to the local organisers and their staff as thanks for the marvellous improvisation. This party was a great success, and at the same time the end of my regular participation in the COSPAR meetings. But for many years I retained a keen interest in contemporary Latin American literature.

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A Few Souvenirs from COSPAR's Early History

Jacques Blamont
CNES, Paris

I would like to try to convey, in just a few words, some of my fondest memories from the first years of COSPAR, and from a world which exists no more, without any pretence as to the historical value of these remembrances.

The first COSPAR meeting was held in January 1960 in Nice, on the French Riviera. I attended that gathering of a few tens of scientists without really knowing what it was about. There was in the background some Resolution of the United Nations to create a kind of forum for discussing space-related matters. At that time, space was an activity strictly confined to two countries, the USSR and the USA. There was a need for people really engaged in satellite development to be able to meet and talk outside the prevailing mediatory arena. A distinguished Dutch scientist Henk van de Hulst was nominated President, and the two Vice-Presidencies were attributed to the Soviet Union and the USA.

Nobody at that time believed that any new player would enter into the field, except me. At that time, the French space effort was limited to the development and launch of a successful, but primitive, sounding rocket, the Véronique, which could launch 200 kg to 200 km altitude. Around this modest asset, the French Government, headed by General de Gaulle, had created not an Institution but a committee, the Comité des Recherches spatiales, headed by Prof. Pierre Auger, a famous physicist hungry for a job of major importance. As a young professor at the University of Paris, I was in charge of running the Véronique programme. Spurred on by the launch of Sputnik, I had organized my thinking

by publishing an anonymous paper in the influential French monthly review Courrier de la République in November 1957, in which I proposed that the Europeans should join forces to develop some kind of space programme devoted to science, modelled on the organization of the International Geophysical Year (IGY). I therefore viewed the COSPAR meeting, at which Pierre Auger and myself represented France (that meant nothing), as an opportunity to meet scientists who could possibly be talked into some action. I explained my hopes to Auger who, with a sceptical smile, authorized me to explore the situation.

My first achievement was in getting my British friends Robert Boyd and Peter Willmore, both of whom were engaged in research into the Earth's upper atmosphere using sounding rockets, to Auger's hotel room. I consider this meeting of the four of us as the conception of space in Europe. We decided among ourselves that we would try to find other interested colleagues during the Nice meeting and propose to them the creation of some permanent committee which would develop a plan. It was not easy to interest on the spot these European scientists, who could not see the point of our philosophy, starting from scratch with nothing in the face of the two superpowers who already had a prestigious records, unlimited resources and the full support of their military establishments! I do not remember how many colleagues we were able to coerce into a small room, nor their names; I think Reimar Lüst from the Federal Republic of Germany and Dr. Bromberg from Sweden both attended. The most important result of all this was perhaps that Pierre Auger became convinced that something was indeed possible.

Back in Paris, he worked feverishly to set up a serious committee, which met repeatedly under his chairmanship during 1960 and ended up creating ESRO and ELDO, but that is another story which I think is well-documented. The British, and especially Sir Harrie Massey, played a major role in the lobbying, which succeeded really when the Prime Minister decided to get rid of the hot potato called Blue Streak, by dumping it in the lap of the not yet born European space programme.

I have another anecdote from that Nice COSPAR meeting. Taking my courage in both hands, I approached the chief Soviet Delegate and newly elected Vice-President of COSPAR, the five-star artillery general Anatoly A. Blagonravov, to ask him if there might not be a possibility for France to benefit from some kind of cooperation with the Soviet space programme. He was noncommittal, but to my extreme surprise two days later I read on the front page of the extremely widely circulated daily paper Le Monde, an interview with General Blagonravov in which he was proposing to give France access to Soviet rockets, satellites and deep space probes! Without an existing space agency, France was at that time certainly not able to respond properly to this sweeping offer. However, during 1961 the French Government decided to create such a space agency, which became CNES (Centre National d'Etudes Spatiales), to develop a satellite launcher, the Diamant, and to support a space industry. I became the Scientific and Technical Director of the new Institution. In 1964, the Soviet Government reopened the issue of cooperation with France, and in June 1966 General de Gaulle signed an agreement which made CNES the only agency in the western world to be a strong partner of the Soviet space agency.

Meanwhile our links with other partners, European and American, had been strengthened, on the one hand by the creation of the two European space organisations, stemming from our early discussions in Nice, and on the other by the generous help offered by NASA to a fledgling CNES. With our successful launch of Diamant in 1965, France had become the third space power. Because of our privileged relationship with both the USA and the USSR, we believed that it was our duty to serve as a bridge between the two space systems. COSPAR was at the time the only place where we could meet at the same time with our two partners, who were to remain on non-speaking terms for many years as the race for intellectual, scientific, economic and political supremacy dominated space activities. For many years, our attempts at rapprochement were futile. It was during the 1980 COSPAR meeting held in Budapest, Hungary, that a breakthrough first became possible. At that time Roald Z. Sagdeev was the Head of the Space Research Institute of the USSR Academy of Sciences.

We had worked together for many years on various planetary missions, and in particular on the project for launching balloons into the atmosphere of Venus, which I had proposed to the USSR Academy in 1967. For budgetary reasons, Roald had decided to internationalize that mission which, with the addition of a flyby of Comet Halley, became the Vega project. He asked me during this fateful COSPAR meeting to help by introducing new partners. He had already succeeded in enrolling Karoly Szegö, Head of the Space Department of the Institute for Nuclear Physics of the Hungarian Academy of Sciences. I was able to convince Prof. Hugo Fechtig, from the Max Planck Institute for Nuclear Research in Heidelberg and others, like Prof. Willy Riedler from Austria, to join in also. Very soon we were able to build up a truly international participation in the mission with, for first time in the Soviet programme, an international scientific and technical council. It is well known that the Vega mission was a complete success, both at Venus and at Comet Halley, but what is less well known is that we tried (and succeeded) in enrolling NASA/JPL in organizing the largest VLBI network in the World, including all the major radio-astronomy antennas, the 70 m dishes of the DSN, the 70 m dishes of the Soviet deep-space programme, Jodrell Bank, Arecibo, Eiffelsberg, etc.

At that time in 1981/82, the American scientists still considered the Soviet Union to be an exotic evil empire. When, after long discussions, we finally drafted an agreement, I was the only one to sign it; both the IKI and JPL representatives were too shy to put their names to such an insignificant piece of paper. However, the way was open for a more extensive cooperation for the next Soviet Mars mission, Phobos. Then history took over and collaboration in space has since become the normal mode of working.

Even if these days COSPAR is no longer useful for negotiations between the two major space powers, which have worked out direct channels for bilateral cooperation, it still remains the best forum for initiating programmes and discussions with other partners in space missions.

The First Ten Years of COSPAR Activities

Alla G. Massevitch
Institute of Astronomy, Russian Academy of Sciences, Moscow

I have been associated with COSPAR almost since its birth. At the first meeting in Nice in 1960, I was nominated for the chairmanship of Working Group 1, 'Tracking and Telemetry of Satellites', and took over that role at the next meeting in 1961 in Florence. This was a very memorable meeting because it coincided with the famous flight of the 'First Man in Space', Yuri Gagarin, in his Vostok spacecraft on 12 April 1961. It was on the morning of that day, when all of the Working Groups were holding their meetings, that the great news arrived. Immediately, the Marble Hall of the ancient Pitti Palace, where the COSPAR meeting was being held, was crowded with the participants and press representatives from many countries. Accompanied by much applause, the USSR delegation was led to the podium. The COSPAR President, Henk van de Hulst, congratulated us on a magnificent achievement for science and technology in our country. Academician Blagonravov (head of our delegation and Vice-President of COSPAR) made a short presentation on the key features of the orbit, the spacecraft and the cosmonaut on board. His presentation was transmitted live in several languages.

People in Italy received the news with great enthusiasm. Crowds surrounded our hotel in Florence, shouting 'Viva Gagarin' (even at night!). The small restaurant where we ate our meals became famous and the grateful proprietor tried always to add delicate little extras to our orders. The head of the city council, Signore La Pira, organized a meeting of the local inhabitants with the COSPAR participants in honour of the First Man in Space. This meeting was held in a very big hall in the Veccio Palace, the City

Cornelis de Jager and Alla Massevitch - Tel Aviv, 1977

The President of Israel receiving COSPAR Officers at his residence in Jerusalem. Left to right: President E. Katzir-Katchalski, A.G. Massevitch (USSR) and Z. Niemirowicz (COSPAR Executive Secretary)

Hall, with all the congress members present. The room was overcrowded, with people standing around the walls. The solemn ceremony resembled a 'triumphal manifestation', with every mention of the name Gagarin evoking a real uproar.

Members of my Working Group 1 were mostly astronomers engaged in the optical tracking of satellites, including a number of well-known scientists like Cornelis de Jager, Fred Whipple, Jan Kovalevsky and others. Our first aim was to promote joint efforts in the exchange of available satellite tracking data, so that they could be used not only for ephemeris purposes, but also for addressing scientific problems in the fields of geodesy, atmospheric density changes due to solar activity, etc. It was not easy at that time to establish a truly efficient collaboration in these fields, due to the Cold War atmosphere prevailing in the World, with various branches of space research remaining classified.

However, the efforts of the national scientific groups united in the COSPAR community made it possible to overcome many of the difficulties. One of the earliest examples that I recall was the following. In January 1964, the balloon-satellite Echo-2 was to be launched in the USA - a 41m-diameter sphere to be put into a 1200 km-high circular orbit with an 81.5 deg inclination and a 108.7 min period. The inflation of the balloon was to start one hour after launch. The problem was how to observe the increase in the balloon's brightness during the time of its inflation, e.g. the first 10-20 minutes. One hour after launch the satellite would be moving north over Madagascar island and afterwards over the Ural mountains and the far northern parts of the USSR. As its orbit was to be near-polar, the satellite would then turn south and move towards Alaska. Thus, observations had to be performed by the Russian tracking stations in these areas. An agreement concerning these observations was reached between NASA and the Astronomical Council of our Academy of Sciences (our part in it only became possible thanks to the patronage of COSPAR, as a well-recognised international organization). We organized three special expeditions to the most northerly areas and notified our permanent tracking stations in Middle Asia, the Caucasus, and in the Ural region. They were provided with preliminary ephemeris

data received from NASA and were able to start their observations once the exact time of the launch was transmitted to them. This turned out to be the main problem, as no fax or e-mail links were available at that time and telegrams arriving from abroad usually incurred delays. Our American colleagues promised to notify us by phone immediately after the launch, and also to send us a telegram. We also asked the USA Embassy to call us as soon as they got any information.

Originally, the launch was fixed for 23 January, but due to several setbacks - about which I was duly notified - it eventually took place only on the 25th. I was waiting in my office and one of my colleagues was waiting at the central telegraph to immediately communicate the launch time to the stations. The phone call from the USA came just 4 minutes after launch, the telegram arrived 25 minutes later, and the call from the US Embassy only after a further two hours! Later, at a reception, the US Ambassador told me that he would never have believed that anyone in the USSR could receive information about an event taking place in the USA before he did !

So, all of the observers were notified in time, and shortly after inflation of the balloon had started the Echo-2 satellite was observed by seven stations for the subsequent 20 minutes. 41 photographic plates showing the brightness variations of the satellite, and 91 position determinations, were transmitted to the USA. These brightness-variation results, together with US radar data, showed that the balloon was inflated so fast that the rocket-carrier passed through it, distorting only slightly the spherical shape of the balloon. This distortion manifested itself as small regular oscillations in Echo-2's brightness, revealed by later observations.

This story may seem quite trivial today, but at that time it was considered a heroic action by both partners, as this was the first East - West collaboration in the field of space research with real results and not only complacent intentions. It also served as a precedent, making further collaboration much easier.

The new generation of space scientists is, of course, not so familiar with the situation that existed in the early sixties and probably is therefore probably not able to appreciate fully the important role that COSPAR has played in the development of international cooperation in space science, especially during the first decade after it was founded. Several international observing campaigns were carried out by COSPAR's Working Group 1: ISAGEX and Arctic-Antarctic in 1971, Doppler-Africa in 1983, Merit, and other more and more sophisticated efforts as observational methods improved. In addition to photographic tracking cameras, Doppler-measurement and laser-ranging instrumentation appeared. The new discipline of geodynamics is developing rapidly with the increase in measurement accuracy, and contamination of the Earth's surroundings by space debris has become a very real problem. The solution of these and many other important problems in space science urgently demands international cooperation, and this is probably also the most important consequence of space activity.

I participated in almost all of the scientific meetings of COSPAR until 1988, and naturally I have an enormous reservoir of personal impressions and recollections - especially of the meetings in Argentina, Brazil, Israel and Japan - but that is another story!

A Cold War in Space Research*

Cornelis de Jager
Laboratory for Space Research and Astronomical Institute, Utrecht, The Netherlands

Rockets over the North Sea

The start of space flight and space research for me is intimately related to war activities, either 'hot' or 'cold'. During the last war, my country was occupied by Nazi forces. In early September 1944, the Allies tried to break through towards the north, over three bridges to Arnhem, but they failed at the last bridge. During the battle of Arnhem, the Dutch railways went on general strike to prevent the Nazi's from using the railway system. Since Montgomery's attack failed, that strike continued until the liberation in May 1995. The consequence was hunger and mass starvation in the western part of the country. Food was with the farmers, but it could not be transported. I had been in hiding until that time, in order to escape being transported to Germany for forced labour, but from then onwards there was a stronger need to look for food. I returned from my hiding place to my parents' home in order to be able to go out into the countryside south of Utrecht, on a shaky bicycle, to buy potatoes at prices that were going up and up by the day. That period lasted for about two weeks, after which food could no longer be obtained.

During these trips we occasionally saw in the west whitish vapour trails running steeply upwards. We wondered what they were, until someone told us that he had heard of a mysterious

* This article is based on a paper entitled 'A White and a Red Star', published in *Solar Physics*, 169, 443 - 464, 1996.

weapon that was launched at the shore and then flew out over the North Sea to bombard England. We tended to laugh at that fantastic story. We were completely ignorant of political or military developments. At that time there was no radio, since there was no electricity; the telephones were not working either, and there were no newspapers. Letters arrived only occasionally, taking several weeks and longer to travel just a few tens of kilometres.

We continued wondering, until a few weeks later, when I met my present wife, Doetie, who lived at that time in The Hague. She confirmed the seemingly unbelievable story. She had actually witnessed the first operational military V2 launch ever. As a student in The Hague, the schoolgirls (all male students were working in factories in Germany or in hiding) were summoned one day to assist in evacuating, within 12 hours, the town of Wassenaar, north of The Hague, because the area was apparently needed for urgent military operations. At the end of that day, when virtually the whole population of Wassenaar had left for a destination that was unknown, even to themselves, she was still around and suddenly they heard a terrible noise and then saw a huge cigar-shaped structure first rising slowly, then accelerating. When she approached that area a few minutes later, she saw the launch pad and some excited military personnel.

It was 8 September 1944 and the first V2 had been fired towards London.

Little did I realise at that time that some 25 years later I would be the first Dutch professor with a Chair in space physics, and then President of COSPAR, the World organization for scientific space research!

My First Involvement in Space Research

When in 1957 the first Sputniks were launched, soon to be followed by the first Explorers, the wish was expressed in Europe to follow the USA and USSR in embarking on space research. The United Kingdom and France had already started their national

rocket programmes, and in 1962 NASA launched the first UK satellite. In Europe preparations were started to establish a cooperative European space research organization, which was successively called COPERS, ESRO and ESA. I was involved in it from the start, in various capacities. I was the chairman or a member of an uncountable number of commissions and committees, of which I most liked the membership of the first Launching Programme Advisory Committee, a four-man group headed by Reimar Lüst, and with Jaques Blamont and Robert Boyd, three eminent scientists with whom it was a pleasure to cooperate.

At the same time our Government made money available for establishing the Utrecht Laboratory for Space Research. I started on 1 October 1961, and ten years later the laboratory had 100 employees. We embarked on three main topics of research: monitoring solar flares in X-rays, UV stellar spectroscopy, and non-solar X-ray astronomy.

During that period there were a lot of organizational and committee meetings and only little time for research. Several of the research papers that I still managed to write during that period were written partly in the noisy environments of waiting rooms at airports or in the planes themselves.

Do I regret it? Certainly not. The outcome justified the efforts.

The Birth of Space Science Reviews

The first staff members of the Utrecht Laboratory for Space Research were engineers and physicists with greatly different origins and training: industry, university, etc. None of us was hindered by too much experience in the new discipline, but we were enthusiastic about the new tools given to us. The prospect of observing the Sun in many other wavelengths than just the visual spectral region looked fascinating to me, and I had great expectations that continuously monitoring the Sun would reveal the secrets of the origin and initial development of flares.

To improve our knowledge, I visited Blamont in France and Boyd in London and I sent younger co-workers to the USA, England and France to gain some experience. I myself found it a drawback that my general knowledge of space physics was too limited: I had grown up in solar spectroscopy; I also had a good training in developing and constructing optical instrumentation, but now we found ourselves confronted with things like proportional and scintillation counters, with such problems as how to develop spectrographs for X-ray spectroscopy, instruments for X-ray imaging, etc. I wished there was a kind of book or journal introducing scientists like me to the complicated and vast field of space physics, and keeping them abreast of new developments, but such a source did not yet exist.

In the course of 1961 I was visited by Mr Anton Reidel, director of the Dutch publishing house carrying his name (it is now part of Kluwer). Thus far, he had been publishing books and journals in fields far removed from astronomy, but he saw this new opportunity and asked my advice. I suggested that he start a journal containing invited reviews on the various aspects of space research, for which I suggested the title '*Space Science Reviews*'.

The question in return was whether I would be willing to become Editor-in-Chief of that journal. That was other matter, but given my deep interest and fresh involvement in that field I realised that such a position would make it easier for me to ask just those questions to which I sought answers, and so why not? I decided to accept and I started selecting an Editorial Advisory Board of some 20 persons. With help of Robert Boyd, we wrote a policy statement, which still appears in the journal.

The coming of the new journal was generally welcomed by scientists who felt a similar need to me, but in circles around COSPAR, the newly created (1959) World organization for space research, there were some initial objections. Some COSPAR officials were of the opinion that the new journal should rather be a COSPAR undertaking. I agreed with them and to remedy that situation we selected a number of prominent COSPAR Council members for the Editorial Board, thus linking the new journal,

de facto, to COSPAR. In an efficacious meeting of nearly the full Editorial Board in Washington during the COSPAR congress of 1962, the policy of the journal was further defined.

Global Organization of Space Research: COSPAR

The COSPAR Council contains representatives from all of the scientific unions that have ties with, or that are involved in one way or the other in, space research. In the period 1967 - 1976, I was a member, in various capacities, of the Board of the International Astronomical Union. Since space research was my specialty among the IAU Board members, I was appointed in 1968 as IAU representative to COSPAR. That was how I entered into this very dynamic organization - a highly interesting environment, but one with some funny aspects.

COSPAR was a product of the Cold War and that was reflected in its structure: its Charter prescribed that the two Vice-Presidents should be proposed by the USA and USSR Academies of Sciences, respectively; that thereupon each of these would propose two other Board members, and that the Board should then elect a President. The latter's position was comparable to that of someone balancing on a rope over Niagara Falls. That aspect was indeed reflected in the way in which I became COSPAR President.

In 1971 the US Academy of Sciences put my name forward as their candidate for the COSPAR Presidency, but as a reaction the USSR Academy became suspicious of me and did not want to support that proposal. No new President was therefore elected in 1971.

During the year thereafter, the USSR Academy apparently found out that I was not as bad as they had initially thought and so I was nominated in1972 by the USSR Academy. In the meantime, however, the US Academy had already selected another candidate, Sir Harrie Massey. When the latter heard of my nomination, he withdrew. That was how I became President of COSPAR in 1972, as the successor of Prof. Roy from France. I held that position for two terms, until 1978, and was later elected again for the period 1982 -1986.

The COSPAR Congress in Florence in April 1961, a few minutes after A. Massevitch had announced the successful orbital flight of cosmonaut Yuri Gagarin. From left to right: C. de Jager, L.D. de Feiter, A. Massevitch, an interpreter (?), and A. Blagonravov

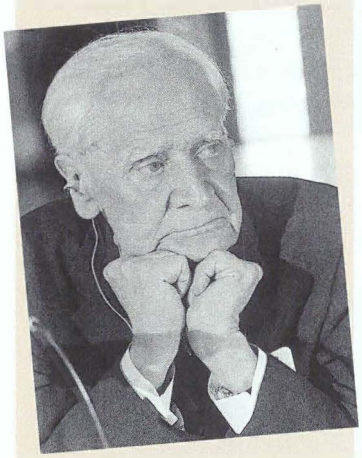
The COSPAR Congress in Constance, Germany. From left to right: an English interpreter, C. de Jager, Oberbürgemeister Speer giving his speech, A.A. Blagonravov, and a Russian interpreter

During the first year of my Presidency, the Vice-Presidents were Herbert Friedman from Washington, an eminent pioneer of space research, and Academician Blagonravov from Moscow. The latter had had a remarkable career in the Soviet army. Before the 1917 October Revolution, he served as a young lieutenant in the Royal Czarist army. Once, during the COSPAR congress of 1970 in Leningrad, I met him in one of that city's many theatres. With some apparent signs of amusement, he then pointed at the main box opposite the stage. At one time, he said, he had been standing in the back of that box as a honorary guard for the Czar and his family. He had had an interesting life during the Revolution and the second World War and ended his military career as a well-known Soviet general. I liked him. He combined wisdom with a sharp political intuition and it was pleasant to deal with him, in sharp debate as well as in cooperation.

From the many remarkable, often delicate, matters that we were confronted with, I will mention only one here, because it sheds light on an interesting and at the same time human episode from the Cold War period.

The first annual COSPAR meeting that I had to preside over was that in 1973 in Constance, Germany. There, we had to decide on the location for the 1975 meeting. It so happened that there were two candidate countries proposed: Bulgaria and Israel. Selecting Israel would, of course, cause great difficulties for the Eastern European countries who had no political ties with Israel. Probably, no East European scientist would be allowed by his Government to go there. We realized that, and although many Council members (Council was composed of the representatives of the 35 Adhering Countries and the 12 Scientific Unions) felt sympathetic towards meeting once in Israel, they felt it was politically wiser not to do so. I rapidly discovered that feeling while consulting a number of Council members before the meeting. Hence, in its wisdom the Council would vote for Bulgaria. That 'tendency' was not well recognised by General Blagonravov, who was very concerned indeed that the Council would still select Israel.

When the meeting was at the point of voting, Blagonravov, whom I normally respected greatly for his temperate judgment, asked for the floor and then launched a fierce and somewhat unjustified attack on Israel. During his unbalanced address I could see from the faces in the room how some Council members were changing their opinions in a direction contrary to Blagonravov's intentions. Because of the sensitive nature of the matter under discussion, I therefore decided that the voting would be secret, and hence in writing, and not just by a show of hands as was usually the case for items like this one. The result was a slight majority for Israel.



General A.A. Blagonravov

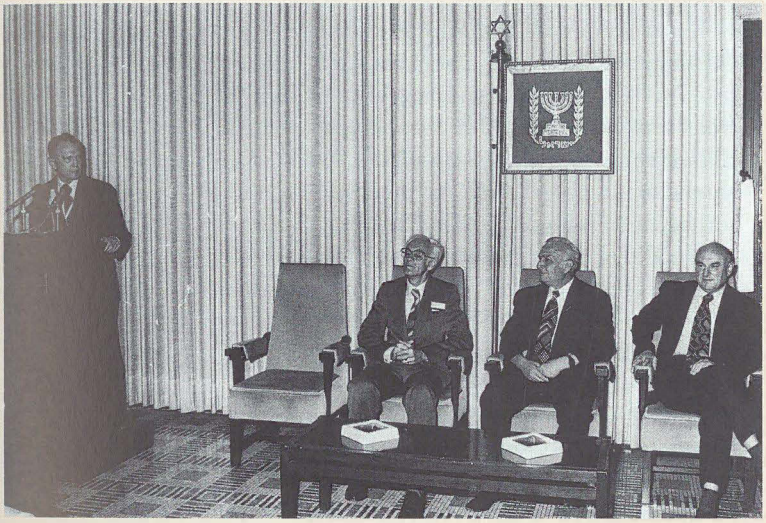
Blagonravov was furious and commented immediately that this decision was impossible and could not be maintained. He contacted me directly after the meeting, urging me to reverse the decision. My point was that the decision was not mine, but the Council's, that it was taken in a democratic manner, and that it could not be reversed, unless by another decision of Council, for which I saw no room.

Although in my heart I liked the outcome - it was a first expression of some democracy in COSPAR, and I had voted for Israel too - I was worried at the same time, because we might end up with no Eastern European scientists at the Israel meeting in 1975. That would be contrary to one of the main aims of COSPAR, namely to bring eastern and western space scientists together. But I had hope that a satisfactory compromise could be found. The following year, after that meeting, I therefore had several talks with Blagonravov and his adviser Geinrich Balayan. Things then stagnated somewhat because Blagonravov died early in 1974.

During these discussions I developed an idea that might satisfy all parties: let us somewhat give in to the USSR and agree not to meet in Israel in 1975, but instead in Bulgaria, but let us agree at

the same time to have the COSPAR meeting in Israel two years after that, in 1977. This latter date seemed sufficiently far away to make that decision acceptable to the parties involved.

I met initially with heavy opposition from Israel: Why change a decision taken in a democratic fashion? I had to make a few trips to Israel, trying to convince them that in the longer run my proposed solution might turn out to be the best one. Of course, the USSR Academy did not agree either. But the ground was prepared and at the 1974 meeting of COSPAR, in Sao Paulo, there were several meetings between David Abir (Israel), Kyril Serafimov (Bulgaria), Mrs Alla Massevitch, the well-known Soviet astronomer who temporarily replaced Blagonravov, and me. After a full week of almost daily evening talks, we indeed came to the suggested decision. It was signed by all parties, including Alla Massevitch 'from the USSR Academy of Sciences' (note the subtle formulation: not 'for the ...').



Reception for COSPAR Officers at the residence of the President of Israel in Jerusalem, in June 1997. Left to right: D. Abir, Chairman, National Committee for Space Research; C. de Jager, President of COSPAR; President of Israel, E. Katzir; A. Dvoretzky, President Israeli Academy of Sciences and Humanities

We raised our glasses on the outcome. Thereafter, Alla and I walked back to the hotel. She suddenly stopped: 'You do understand, Kees, that I did more than I was allowed to?' I had realised that and added that I had deep respect for her wisdom. Alla Massevitch is one of the women I admire most.

The COSPAR meeting in Tel-Aviv turned out to be a great success, with the participation of a delegation of some 20 Soviet scientists and delegates from all other Eastern European countries also. It was the first visit by a delegation of Soviet scientists to Israel for many years. One of my ideals has always been to bring peoples and cultures together; I am still very pleased with the outcome of the debate that had started in 1973 and ended so successfully in 1977.

Solar-Flare Research

Let me return to science now, because that is what it is all about. Since the IGY, I had been fascinated by the problem of the origin of flares. Where is the seat of all this energy and why this nearly explosive behaviour? Theory says that the best scenario is to look for conversion of magnetic energy into heat and motion, but how does that happen? I therefore proposed to ESRO that they equip one of their satellites with a soft X-ray monitor. The ESRO-2 satellite, launched 1968, carried such a monitor, but we soon found out that soft X-rays from flares just display what we would now call the 'gradual component', i.e. the radiation of the hot plasma created during the impulsive phase, which occurs, as we now know, after flare ignition. It shows the impulsive phase's aftermath and gives no information on the ignition process.

We began to suspect that, even before ESRO-2 was actually launched. Science can sometimes progress quicker than spacecraft can be built. In 1964, we had obtained some balloon observations of a remarkable flare observed in hard X-rays by Jean-Pierre Legrand from France. The observations showed two highly impulsive very hard X-ray bursts slightly prior to the origin of the flare as seen in H_{alpha}. There should exist an as yet invisible source for these very short-lived bursts. Leen de Feiter coined the name

'superthermal plasma nodules' for these sources and these were the objects we decided to look for. Since we did not yet know how to image the Sun in hard X-rays, we proposed a hard X-ray monitor for the ESRO TD-1A spacecraft.

That spacecraft was launched in 1972 and it immediately gave us a useful lead. During what we now call the 'impulsive phase', the Sun appeared to emit fierce short-lived bursts of hard X-rays, the 'impulsive phase bursts', apparently, as we thought, linked to our 'nodules'. But we were lacking images. Imaging in X-rays is a difficult job.

In the meantime three excellent co-workers, Frank van Beek and Bill Lafleur, with astrophysical help from Peter Hoyng, in cooperation with George Simnett from Birmingham, had conceived a way of imaging the Sun in hard X-rays. Their Hard X-ray Imaging Spectrometer (HXIS), launched in 1980 on NASA's Solar Maximum Mission, did provide us with images and showed the 'footpoints' originating in the chromosphere after its bombardment from 'above' (from where?) by beams of charged particles or by plasma, apparently streaming along magnetized loops having their feet at these locations. In 1977, Zdenek Svestka had joined forces with us and, working together, the members of our group could advance some aspects of the scenario for flare ignition

But the true source of the flare's origin, our 'nodules' of 1974, had not yet been seen.

I retired from the Directorship of the Utrecht Space Research Laboratory in 1983 (and from University in 1986) and my successor at the Laboratory, Johan Bleeker, decided to quit solar physics and to embark fully on non-solar X-ray, infrared and gamma-ray astrophysics, an excellent choice that I understand and fully support. But in 1990 the Yohkoh spacecraft was launched by Japan and although I was initially not involved, Jun-Ichi Sakai pulled me in, by visits to Utrecht and by inviting me to Japan. Thanks to Yohkoh's fantastic imaging achievements in soft and hard X-rays I am now convinced that flares originate

by the interaction (reconnection or coalescence) of current-carrying loops, which leads to a fierce explosion at the point of interaction, followed by the rest of the observed phenomena. In 1996 Sakai and I published a long review on the relation between flares and current-carrying loops, which summarises our views.

COSPAR's Early History - A Personal Souvenir

Karl Rawer
March, Germany

An Extraordinary World Situation

In the first years after the Second World War, political tensions between the former allies reached an intensity that had never before existed in peace time. Fundamentally distinct in terms of their ideologies, the two blocks had burned almost all bridges. Even in the field of science formerly existing contacts were broken. Observational data were no longer exchanged, and publications in scientific journals appeared only after careful screening for potential military aspects. Thus, in this rearranged political constellation, scientific interchange and cooperation had no better chance than in a period of war.

I was involved with the French ionospheric prediction service SPIM from 1946 to 1955. We did not receive actual ionospheric data from any territory in the socialist countries. In order to derive the urgently needed basic data, we had to rely on earlier published data, applying statistical methods (based on solar-cycle dependencies) that had formerly been developed in Germany.

After a decade of extreme tension, at least in the field of the geosciences a modest opening was achieved via an American initiative. Remembering that the 'International Polar Year', 1937, had provided one of the rare occasions for multilateral international scientific cooperation, colleagues from the high latitudes felt that one might be able to repeat this successful exercise 50 years later. Exploiting and generalizing this argument, Lloyd V. Berkner - well known for his fundamental work in the early years of ionospheric research - put forward a proposal to

organize such cooperation in a world-wide framework under the banner of the 'International Geophysical Year'. The activity should cover the whole globe, because a separation into zones as made during the 'Polar Year' was felt to be inadequate. To the astonishment of many colleagues, Berkner's initiative achieved a breakthrough, at least in the field of the geo-sciences. He finally secured the participation of the great majority of the national scientific organizations all over the World, the only exceptions being the 'People's Republic of China' and her allies. As Secretary General of the new organization, Marcel Nicolet also received the support of almost all International Scientific Unions.

In terms of coverage and intensity, no other world-wide scientific exercise could be compared with the IGY. Soon after its beginning, in 1957, the USSR launched the first Earth satellite 'Sputnik-1',

COSPAR's Very Particular Beginnings

Distinct from almost all other international scientific organizations, COSPAR identifies its field not as a particular branch of science, but rather by a technique: namely the use of space vehicles. It had originally been used during World War II for military applications, and after the war had ended remained a field of military competition. Given the extreme political tension prevailing at the time, it was unavoidable that ICSU's intention to create a 'Committee on Space Research' attracted World political attention.

When Sputnik had opened the space age, the technological competition between the two superpowers was seriously affected by the frozen political World climate. In this situation, both sides wished to avoid a deadly confrontation and were looking for some 'platform' where contacts might be achieved in an informal way, without officially engaging the state administrations.

Though for the time being they were developing a powerful military tool, many of the pioneers of rocket techniques had a dream of future peaceful space flight that they were preparing for by their engineering work. The early space research efforts had in

fact been organized by military organizations and quite a few rocket specialists had become engaged in this brand-new field. Politicians on both sides therefore felt that space research might be a suitable forum for the desired informal contacts.

At that time, distinct from all other nations, the two superpowers were the most advanced in space technology and research. Taking this fact in account, the terms of reference of the new 'Committee on Space Research' were drawn up in close agreement with the common wishes of both superpowers. This led to a 'constitution' quite different from those of other ICSU bodies. The most important posts were the two Vice-Presidents, who were not elected but nominated: one by the US National Academy of Sciences, the other by the USSR's Academiya Nauk. The President had to be 'elected' by the Plenary based on a common (and unique) proposal by the two Vice-Presidents. The four other members of the Board (called the 'Bureau') were elected based on proposals made by the Vice-Presidents, each having the responsibility for two seats. In the first two decades it was usual to have one candidate only per seat, so that the elections were made by acclamation.

Thus, but for the President, each of the superpowers in fact had the right to fill half of all seats. The scheme was, of course, based on the pre-supposition that the superpowers could mutually agree on the person to be President. It could have been foreseen that this might eventually lead to problems.

During an international meeting at London in 1958, ICSU established its 'Committee on Space Research'. Richard W. Porter and Anatoli A. Blagonravov were nominated as Vice-Presidents by the USA and USSR Academies, respectively. They remained in office until 1972 and 1975, respectively. Hendrik C. van de Hulst (NL), a radio astronomer of the highest order, was proposed and elected as the first President. In 1963, at the end of his term, both Academies agreed on Maurice Roy, head of the French organisation ONERA as his successor. Roy would have to bear this responsibility for three terms, until 1972. He was not at all keen on serving a third term, but no other candidate could be

CONSEIL INTERNATIONAL DES UNIONS SCIENTIFIQUES

INTERNATIONAL COUNCIL OF SCIENTIFIC UNIONS

TENTH MEETING EXECUTIVE BOARD

SUMMARY RECORD

The meeting was held in the rooms of the National Academy of Sciences, Washington D. C., September 29 to October 2, 1958.

Present : Dr. L. V. BERKNER, President, in the Chair
Prof. B. LINDBLAD, Retiring President
Révérend Père LEJAY, Vice-President
Sir K. S. KRISHNAN, Vice-President
Col. E. HERBAYS, Treasurer
Sir Harold SPENCER JONES, Secretary General
Prof. W. A. ENGELHARDT, Member of the Bureau
Prof. A. STOLL, Member of the Bureau

Prof. J. A. OORT, IAU
Dr. D. H. SADLER, IAU
Prof. J. T. WILSON, IUGG
Ing. Gén. G. LACLAVERE, IUGG
Sir Ch. E. DODDS, IUPAC
Dr. Rudolf MORF, IUPAC
Dr. Balth. van der POL, URSI
Prof. Robert B. BRODE, IUPAP
Prof. P. FLEURY, IUPAP
Prof. G. MONTALENTI, IUBS
Dr. Anton F. BRUUN, IUBS
Prof. Hans BOESCH, IGU
Dr. D. W. SMITS, IUCr
Prof. F. K. G. ODQVIST, IUTAM
Prof. R. TATON, IUHPS
Prof. R. NEVANLINNA, IMU
Prof. B. ECKMANN, IMU
Prof. B. A. HOUSSAY, IUPS
Prof. Elmer H. STOTZ, IUB

In attendance: Dr. Ronald FRASER
Mr. A. S. MACLENNAN (Accountant)

Observers and Alternates :

Mr. J. MUSSARD, representing Unesco
Prof. L. A. GUINIER, IUCr
Prof. Maurice B. VISSCHER, IUPS

The following were present for the discussion of certain specific items :

Prof. Sydney CHAPMAN, President CSAGI
Dr. Marcel NICOLET, Secretary General CSAGI
Dr. G. E. R. DEACON, Vice-Chairman SCOR
Dr. Peter ALEXANDER, Rapporteur CETEX
Prof. Paul BOURGEOIS, President IAB
Prof. H. S. W. MASSEY, Convenor IAF/ICSU Committee
Mr. Andrew G. HALEY, President IAF by invitation of the President
Rear Admiral VIGLIERI, IHB by invitation of the President

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Item 18 a. Proposed Special Committee on Space Research

The President urged that the Executive Board accept the recommendation of the Bureau for the immediate formation of a Special Committee on Space Research, in view of the enormous scientific potential of this activity. In particular, he stressed the need for ICSU to take the scientific initiative, whereby the United Nations would fulfil its proper role in governing the international regulation which was clearly necessary in the new field of space research.

Opinion amongst the members of the Board was sharply divided on this question. After hearing Professor Massey speak, on the President's invitation, of the need for Special Committee : Oort, Wilson, Brode, Lindblad and van der Pol spoke in favour of its formation ; on the other hand, Engelhardt, Fleury, Laclavère and Morf warned against too hasty a decision.

On the suggestion of Boesch, it was finally agreed to propose a Committee to function for one year only, by which time it might be more clearly seen what the next step ought to be.

Note : The proposal of the Board was accepted by the Assembly in the following terms :

The General Assembly

recognizing the need of an International Committee on Space Research and

considering that ICSU should continue its work of coordination in this field

establishes and ICSU Committee on Space Research (COSPAR) to function until the end of the year 1959 as follows ;

a) A representative from each of the countries which are actually launching earth satellites, as also of those having major programs in rocketry.

b) Three representatives, designated on an agreed system of rotation, from among countries actively participating in tracking and other aspects of space research.

c) One representative each from the following Unions : IAU, IUGG, IUPAC, URSI, IUPAP, IUBS, IUTAM, IUPS and IUB.

found on whom both parties were willing to agree. Finally - to give Roy a chance to bow out - it was decided in 1972 to ask van de Hulst again. Three years later, in 1975, the search for a successor lead to a clash. The US Academy first proposed the Dutch astronomer Cornelis de Jager who, however, was not accepted by the other side. The US Academy therefore approached Sir Harrie Massey (UK) who accepted to be a candidate. Meanwhile, however, the USSR Academy had decided that de Jager was acceptable to them. A serious confrontation could was avoided only because Sir Harrie was noble enough to withdraw his candidature - without signs of grief.

Over many years, COSPAR had to live with this special constitution, i.e. with 'elections' that were fully pre-determined. This led to a kind of a 'feudal' system in which each Vice-President took care of his own 'allies' - a very disadvantageous system, of course, for colleagues in the 'non-aligned' countries.

Left to right: Carl Sagan, Cornelis de Jager, Karl Rawer, Mrs de Jager - Constance, 1973

Efforts to achieve a fundamental reform of this constitution were undertaken rather late, mainly promoted, of course, by the 'non-aligned' (developing) countries under the skillful leadership of R.R. Daniel (India), supported by a small number of Union representatives, myself for URSI for example. It took many years for at least the most discriminatory rules to be eliminated from the 'constitution'.

A Problem Circumvented

Traditionally, the international Unions had considered countries for membership in spite of the fact that the basically apolitical scientific aims of a Union do not require that 'national' sub-organisations be affiliated with a country. Before and after the First World War, however, the political world was so well ordered that no problems had been encountered with such affiliations. The situation became quite different after World War II because serious disagreement was reigning, particularly in certain 'frontier regions' between the existing blocks. Some countries, including Germany, were in fact divided into a 'western' and an 'eastern' part, both claiming independence, whatever that meant. Most Unions encountered serious difficulties with this situation. Fortunately, such problems could not arise in COSPAR because, from its very beginning, it had declared academies as its members. In the meantime, most Unions have adopted definitions comparable to those of COSPAR.

As for my own country, the West-German scientists were represented by the 'Deutsche Forschungsgemeinschaft', those in Eastern Germany by the old and venerable 'Akademie der Wissenschaften zu Berlin' (formerly the 'Preussische Akademie'). As its representative to COSPAR, the West-German academy nominated the well-known geomagnetics specialist Julius Bartels. I succeeded him after his death, and held this office from 1964 to 1984. My counterpart on the East-German side was Ernst-August Lauter. Speaking for independent academies, we had no problems in applying a kind of gentlemen's agreement by which we tried to avoid a clash whenever one was looming. In fact, our relations always remained smooth.

Beginning of World-wide Cooperation

The first general scientific meeting of COSPAR was held in 1960 in Nice (F). The contributions published in the first volume of a new series titled '*Space Research*' covered a large spectrum of subjects more or less related to space research. Apart from the superpowers and two rocket-launching countries, there were no other noticeable national space programmes. A large gap opened up between these few rich countries and the large number of poor 'underdogs'.

The satellite launching activities of the superpowers, however, opened one door to true space research for all others, namely orbit determinations of satellites that could easily be undertaken on the ground, either by optical or by radio observations. As for the first, in the USSR and the socialist countries Alla Massevitch organized an extended network of lay observers (later called 'moon watch'). Radio observations were started in many places; the laboratories involved organized themselves into three cooperative groups that were more or less 'politically coloured'.

The first satellites had low-altitude orbits such that the day-by-day decay was appreciable and could easily be measured. The accuracy of individual measurements was rather poor and most stations were unable to determine all orbital parameters at once. Nevertheless, a large number of such data were sufficient to determine the orbital decay accurately enough for air-density values near the perigee to be reliably determined. It soon appeared that the upper atmosphere was much more dense than had been expected from theoretical considerations. This finding was one of the most important early achievements of space research.

COSPAR founded a Working Group (chaired by Hilde Kallmann-Bijl) which had the task of establishing a new model atmosphere in which the conclusions from the new orbit data should be duly taken into account. This model is called CIRA (COSPAR International Reference Atmosphere). With a considerably increased data set, and using his finding that solar activity plays a key role in the game, Wolfgang Priester was able to produce the next version of CIRA just four years after the first one.

Problems of and with the 'Underdogs'

When wanting to determine orbital parameters, it is advantageous to have provisional orbit data available. For many satellites these were indicated by the satellite launching organizations; otherwise some well-equipped laboratories soon determined them. More difficult was the situation for radio observers, since they needed some information about the radio frequencies emitted by the different satellites. These were not notified by all agencies or for all satellites.

Furthermore, a serious legal problem arose due to the fact that reception by 'non-authorised persons' is forbidden by the International Radio Regulations. Emissions are considered the property of the sender, who alone has the right to declare them accessible to users other than the intended receiver.

The resolution of these and related problems was given to a Working Group on 'Real Time Transmission' (later 'Frequency Allocation and Radio Transmission'). It was chaired first by Vikram Sarabhai (India), and later by myself (1966 to 1974). I needed two years to resolve the legal problem after convincing Academician Blagonravov that such authorisation should not violate the security of information flux from satellites to ground. Only when I received the assistance of Alla Massevitch could we together convince all satellite launching countries that such authorisation does not damage essential national rights - provided it is limited to selected satellites and admits carrier reception only.

My next problem was to unify the three groups of radio observers, replacing them by only one affiliated to COSPAR. This goal was achieved in 1971 with a 'Steering Committee on Satellite Beacon Satellites' under a 'neutral' Chairman, namely the Austrian Reinhart Leitinger, who still holds this function. The group was transferred from COSPAR to URSI in 1981. It is part of URSI Commission G on 'Ionospheric Radio'. Its goals have meanwhile been extended considerably, the techniques being much more accurate now than in the early years.

Environmental Problems

With the increase in space activities, quite a few problems of mutual interference were noted. In order to assess such risks, COSPAR decided in 1976 to set up a small panel on 'Potentially Environmentally Detrimental Activities in Space' (PEDAS). Its first Chairman was the Indian Dr. Vikram Sarabhai, who resigned after a short time because he had been appointed to an important post in his country's research administration. Again I was the second choice. The panel started not with an environmental, but with a linguistic problem: the name, proposed by American colleagues, contains two adverbs one after the other, which drew the criticism of the British participants. After some discussion, a majority voted for the 'potentially incorrect' American expression.

This done, we established a list of 15 subjects that we felt needed some discussion. Five of them were raised by astronomers; in fact most space activities may cause them some apprehension. We made efforts in lengthy debates to find rules by which interference might at least be minimized. We could not find fully satisfactory solutions (the problem still exists and is even increasing in importance). As for radio astronomy, we found the kind assistance of Fred Horner, Secretary of the 'Panel on Frequency Allocation for Scientific Uses' (IUCAF) in ICSU. Following a request by the IAU, the 'World Administrative Radio Conference' of 1979 decided to afford protection to some of the most important spectral lines and bands. Very annoying are the spurious emissions, harmonics in particular, of broadcasting satellite services and space radar systems; spacecraft debris is another area of increasing concern.

'Releases' from spacecraft should be so limited that the natural conditions are not seriously disturbed for a longer period. The execution of a military project aimed at creating a reflecting belt of small dipoles could not be prevented; fortunately, these dipoles were 'clever enough' to stick together (due to electrostatic forces) and so the intended belt was never formed. After that failure the project was buried.

Concerning exobiology, three biological contamination risks were discussed:

(a) of other planets by terrestrial micro-organisms
(b) of Earth by extraterrestrial micro-organisms in returned samples, and
(c) of Earth by mutated terrestrial micro-organisms exposed in space.

Mars was seen as the only potential candidate for risk (a); even then, the solar ultraviolet radiation should exterminate material imported from Earth. Parasitism might be the most dangerous means for risk (b). It was, however, felt that contamination with an independently developed bio-system should easily trigger the terrestrial immune response. Also, the threat of alien genetic information being introduced from a planet was seen as extremely small. As for risk (c), the question was whether hazards in space produce mutations other than those that are known to occur on Earth. The main conclusion was that the terrestrial biological system was felt to be extremely stable.

A report containing the answers to all 15 problems was written by specialists and published in 1982 under the title 'Detrimental Activities in Space', as No.5 Vol.2 of *'Advances in Space Research'*.

The International Reference Ionosphere

As a counterpart to the CIRA, Sid Bowhill proposed that COSPAR might establish an 'International Reference Ionosphere' (IRI) which should give an average description of the main parameters of the ionized layers in the terrestrial atmosphere. This proposal was accepted in 1968 and I was appointed Chairman of a new 'Task Group on the IRI'. This was to become a time-consuming and long-lasting job - I had it until 1984.

The starting conditions were distinct in several respects from those that CIRA had encountered. Most importantly, the subject could not be one for COSPAR alone because one Union was actively interested in the matter - namely URSI. This Union was

contacted and agreed that the IRI should be a common project of both. This decision was also supported by the fact that many colleagues were engaged simultaneously in both organizations. Except for one short period, it can be said that the cooperation was generally quite good.

There was still a governmental organization interested in the subject, namely the 'Comité Consultatif International des Radiocommunications' (CCIR) in Geneva. Having the task of specifying the basic data needed for frequency allocation, the CCIR had established so-called 'numerical maps', namely a computer code giving monthly average worldwide values for two of the most important characteristics of the ionospheric F2-layer. This code had been developed as a result of a long and intensive international study, and so it could not just be set aside by the IRI group. As for the matter itself, it was well known that the ionospheric variability in space and time was much greater than that of the neutral atmosphere. From the very beginning of our work, this fact and the existence of the CCIR code induced us to start straightforwardly in the modern way, i.e. by establishing the IRI model not like the CIRA as a set of tables, but as a computer code.

Starting with a small group of interested colleagues, the task group grew in the following years in both size and importance. It appeared that in many respects the basic empirical data needed for the job just did not exist. The IRI project has provoked many special investigations; for example, in view of the chemical composition of the ions special rocket campaigns were undertaken by Aleksei Danilov in the USSR; the observational schedule of the two German-US satellites AEROS was oriented towards missing worldwide information on ion composition and electron and ion temperatures; later Larry Brace made important contributions to the composition problem with NASA's Explorer satellites. In fact, the IRI project has considerably 'fertilized' the science of the ionosphere.

An important aspect was and still is the publication of the papers contributed to the IRI special symposia and of successive IRI

codes as they were established, as a consequence of the resolutions accepted at these meetings. Short meeting reports were regularly published in the URSI and COSPAR Information Bulletins.

After a period of discussion by correspondence, in addition to the CCIR code a provisional set of equations was established describing the other most important parameters of the ionospheric electron density profile. In 1971, it was accepted at a Workshop during the Seattle General Assembly of COSPAR. 'Tentative Tables' of electron densities derived from this base were circulated as a working report in 1972. As for plasma temperature, the empirical base was poor at that time: the techniques of in-situ measurements were questionable, and ground-based mid-latitude incoherent scatter measurements were used to produce tables of the excess temperature of electrons to ions (T_e-T_i).

Contradictory experimental evidence was reported about the lower ionosphere at a well-attended symposium on this subject arranged during the 1973 General Assembly. The Proceedings were published by COSPAR as a book on 'Lower Ionosphere Structure' (Berlin, 1974). Also published were those of the Workshops held in 1974 (in the volume *'Space Research XV'*) and 1980 (as WDC-A Report UAG-90). The first full computer code 'IRI 1978' was published by URSI as a Special Report. The contributions to the yearly IRI Symposia have been published since 1982 in the COSPAR Journal *'Advances in Space Research'*.

The 1973 General Assembly at Constance

It was as a result of a concession on the eastern side that a General Assembly could be held at Constance in West-Germany in 1973 - the only one held in a divided country! We had considered the choice of our meeting place carefully. Evidently, Germany is mainly known for its industrial power. We felt that we should not paint a too one-sided picture, and a meeting place like Constance could serve to demonstrate the historical role of Germany in Europe.

Constance is a small town, much smaller than the other places where COSPAR had been convened. This made the local organization a bit more involved, e.g. accommodation had to be provided in many smaller hotels, which meant that a complex transport schedule had to be arranged. Our guests, on the other hand, could enjoy the small-town environment and would not be so dispersed after the sessions; they could be found together on the lakeside promenades and sitting under the beautiful old trees, experiencing the charms of a German 'Biergarten'. Fortunately, we had fine weather during the whole period, with the exception of one thunderstorm that happened to appear just when the participants were being brought by boat across the lake in order to take part at a reception in a rococo palace at Meersburg. In fact, even then it stopped raining just as the boat landed - it looked as if it had been carefully ordered.

There was not enough office space available in the town. As the main meeting place, the 'Konzil', was quite near the harbour, we had been advised to hire a ship that would remain at its landing-stage. Unusual as it was, this solution was well-accepted and treated as a nice local peculiarity. Moreover, the same ship could transport us that evening to Meersburg, as mentioned above.

At the XVIth Meeting in Constance in May/June 1973, the boat "München" served as the COSPAR Secretariat's base

People also noted with enthusiasm that we had hired a famous historical building called the 'Konzil' as the main meeting place, a spacious wooden building that had been constructed in the 15th century to house the General Council of the Church, held there from 1414 to 1418.

Constance and the region around its lake have a remarkable medieval history. After the Migration of Nations, Christianity had its origins here in Germany, the message being borne by Irish and British monks who founded monasteries all around the lake, in particular on the island of Reichenau and at St. Gallen in Switzerland. Some of these places could be visited during the meeting. In the Middle Ages, Constance remained a very important place. In 1183, Emperor Friedrich Barbarossa made his peace here with the Lombardian towns. As already mentioned, it was here that the final and most important in a series of occidental church reform council meetings was held. I felt that in a place with so rich a past, we should not start the meeting without a presentation on the town's history. I therefore asked a competent medieval historian, my good friend and colleague Prof. Oskar Koehler, to deliver that talk - something he completed to much applause from the floor.

I remember a few other events more or less characteristic of the period. First of all, we had to organize the meeting with rather limited financial means. We received official support for office charges and translations and, from the German car industry, for transport. A few of the evening receptions were hosted by the German electrical and space industry. It was, however, not possible to hire a commercial conference organizer to run the logistics, as is quite usual nowadays. I could only call upon my own collaborators working in my laboratory in Freiburg - and then for no extra pay of course. These young people dealt with the meeting in the same way they had learned to deal with problems arising during rocket campaigns. This meant clearly defined individual tasks so that each one knew his or her own responsibilities, and limits too. Most importantly, there was a small crew of 'troubleshooters' who had to intervene when unexpected difficulties occurred

In summer time, the region around the lake draws many tourists. This had been considered when the dates had been fixed, as the meeting needed a large part of the available accommodation. Whenever possible specific wishes were fulfilled. From the USSR, we received an announcement that a group of students wished to be modestly accommodated. When the group arrived, it transpired that they were mainly University Professors. They were the poorest participants, receiving half pension and 10 DM per day, and they took part in the excursions without fee. Another group of the same origin expressed a preference for the highest-ranking hotel. This is an historical building called the Insel Hotel, a medieval cloister nicely situated on an island beside the harbour. The USSR's Embassy in Bonn had informed us of the times of arrival of this group at Frankfurt Airport and at Constance's railway station. We organised a reception committee, including an interpreter, at the station. When the train arrived, the interpreter spoke a few words of greeting over the station's loudspeaker system, in Russian of course. But no Delegation appeared. The people arriving on this train were of course very surprised, and drew mixed conclusions. Just as we returned to our office, we were told that the group had indeed arrived, but by bus. So we went to the Insel Hotel and saw in its courtyard the cream of the USSR Academy sitting in the sunshine on their luggage, and apparently waiting for something. After twenty minutes, Mr Balayan, the Secretary of the USSR Delegation appeared and announced triumphantly that he had negotiated a price reduction of 50 percent!

As Constance is situated at the borders of Switzerland and Austria, excursions undertaken from there always risk crossing one frontier or another. Regulations were quite liberal for European citizens, but not so for foreigners from abroad. At that time visitors, particularly those from Eastern Europe, had to present a visa. So we encountered a major problem when arranging a Sunday excursion aboard a Swiss ship down the Rhine river from Constance to the Rhine Falls. In order to allow our colleagues from the Soviet Union to enjoy this fascinating trip, I had arranged with the Swiss Consul in Freiburg that an extraordinary one-day entrance visa would be issued without

applying the lengthy checking procedure normally requested, together with a quite exceptional global authorization from the Swiss Government in Berne. When I informed Mr Balayan, he was enthusiastic, hoping to obtain easily the agreement of the main USSR Consulate in Bonn. This, however, was refused and so to their and our regret our colleagues from the USSR could not take part in the excursion. We therefore arranged a free bus trip for them, staying strictly within the borders of Federal Germany. Two Polish colleagues to whom I had made the same offer declined with a wink of the eye, assuring me that they could resolve the problem 'in their own Polish manner'. On the Sunday morning, both appeared at the boarding stage and moved so smoothly around the passport check that they were overlooked as intended.

There is an unwritten rule that after a General Assembly the President and Vice-Presidents are accompanied by the hosts to the airport, from where they leave the country. In our case President de Jager intended to spend several more days on the lake. I therefore decided that I would drive with Dr. and Mrs Friedman to Zurich, whilst my wife would accompany Academician and Mrs Blagonravov to Munich. This eventually turned out to be a fortuitous arrangement, because of a clash that occurred during the last Plenary held immediately before leaving. The critical point was the choice of the country where the 1975 General Assembly should take place. A kind of exercise in democracy was intended: for the first time in COSPAR's history there was not a unique proposal presented; for the US Academy, Dr. Friedman proposed Israel, whilst Academician Blagonravov proposed Bulgaria. Also for the first time, the Plenary allowed a vote on so important a problem. This vote went in favour of Israel. Academician Blagonravov declared this decision a serious affront and left the Plenary under protest. After this upset, I was relieved that my wife and not I had to make the trip to Munich, during which Blagonravov was very polite to my wife. They talked together in French, which was the preferred language of both, and parted on good terms.

In the months following the Constance assembly, the sensitive question of the 1975 venue was negotiated again 'at higher levels'. In fact, the 1975 Assembly was held in Bulgaria, while Israel hosted the 1977 Assembly. So worked COSPAR in its early years.

The First Magnetometer in Space

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Participation by the USSR in the first international project after the Second World War - the Global Geomagnetic Field Survey - through its Institute of Terrestrial Magnetism and Ionosphere (NIIZM) of the Hydro-meteological Survey helped it to prepare for the first space projects. S. Chapman, relating the history of the project, dated its actual beginnings to 1950. In that year, following the suggestion of the NIIZM's Director, N. Pushkov, construction of the non-magnetic schooner 'Zarya' was begun in Finland. Although the schooner was built in a foreign shipyard, it was fitted out with Soviet equipment. Of the instruments available at the time, only a binary compass could be used for measuring the horizontal component of the geomagnetic field. The development of a device able to measure the geomagnetic field on a moving platform became a matter of urgency for the project.

In 1946, the NIIZM had started to move from the Urals, to which it had been evacuated from besieged Leningrad, to Troitskoe in the neighbourhood of Moscow. There we settled into a partially destroyed building belonging to the former Meteorological Observatory. I began to restore what equipment remained from the Observatory and to create apparatus for research into the magnetisation of materials by both constant and varying magnetic fields.

The descriptions of the various types of magnetometers did not include all the 'little secrets'. With no clues as to these 'secrets', however, it was not possible to proceed. To design stable fluxgate

magnetometers, second-harmonic type sensors with axial drives were used. But little by little, a group of enthusiasts acquired the necessary experience and, overcoming great difficulties, began to produce devices for equipping the 'Zarya', namely fluxgate magnetometers to measure elements of the geomagnetic field Z,H,T, and proton precession magnetometers.

The experience gained in the use of these devices on the 'Zarya' was exploited when similar magnetometers were designed at the 'Etalon' plant of the Institute of Metrology run by D.I. Mendeleev (Leningrad). These magnetometers were large devices using electronic valves. It was at about this time that semiconductors were appearing. In 1954, Lev Zhuzgov graduated from Gorky State University (Dept. of Physics) and joined our team. We began replacing blocks of the fluxgate magnetometers: the electronic valves were replaced with transistor elements. We took pleasure in our newly created miniature magnetometers. We thought that our devices would find application in our physics laboratories. However, these magnetometers were to have a very different future.

In the spring of 1956 I had occasion to listen to and later to meet Sergej Korolev in the conference hall of the Institute of Earth Physics (IFZ). He was talking about high-altitude rockets for geophysical research. I was mindful of the many defects in our geophysical devices. He was also of the opinion that the speed of development of geophysical instrumentation and methods was lagging behind the development of the rocket technology itself.

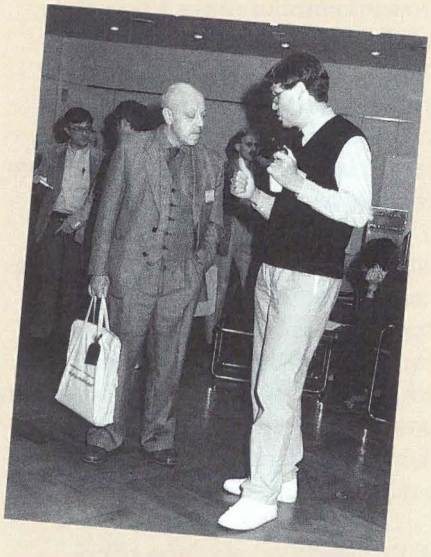
In the summer of 1956 N.V. Pushkov rang me and suggested that we meet representatives of two organisations to inform them about our instruments for geomagnetic measurements. We met at the building of the Presidium of the USSR Academy of Sciences. The first representative was from the Council of Academicians, under M.V. Keldish, and the second from the Special Design Bureau (OKB), under S.P. Korolev. From these conversations I learned that NIIZM was involved in a project to produce the first artificial Earth satellite Sputnik (ISZ). I was telling them about the metrological capabilities and technical properties of the proton

precession magnetometers, flux-gate devices, etc. Specifically, I mentioned the possibility of determining the satellite's rotation and its attitude. I remember just how much this caught their attention. They listened attentively too my detailed report on the excellent metrological qualities of the proton precession magnetometers. In a book titled 'Creative Inheritance of Academician S.P. Korolev (Selected Works and Documents)', from 1981, various details about this project to build the first artificial Earth satellite were published for the first time. In this report, besides the purely scientific problems, work that was necessary for the creation of future Sputniks with better attitude control was also described. It included the important problem of the nature of satellite's movement relative to the centre of mass. These data could be gathered with help of the flux-gate magnetometer. Largely for this reason alone, the flux-gate magnetometer was chosen for the first space experiment.

This resulted in a period of intense work for our Magnetic Space Research Laboratory. It was possible to create an automatic magnetometer in such a short time only if one exploited some complete units made by industry. For example, reversal switches from telephone exchanges were used to extend the range of measurements (our Institute had links to the Ministry of Communications). In the attitude unit of the magnetometer, magnetic amplifiers developed by industry were used. Everything else was made in our own laboratory. We mounted separate functional systems onto standard plates, and then assembled the overall package.

The Special Design Bureau (SKB) 'Geophysics' of the USSR Ministry of Geodesy was engaged to produce the flight-model of the magnetometer. The principal circuits, the list of bought-in products, the general plans and the breadboard model of the electronics unit were brought there urgently. At SKB, a good designer, Viktor Seljunin, quickly worked out the engineering documentation needed for making the plates, electronic blocks and attitude unit. In February 1956, L. Zhuzgov and I arrived at SKB to participate in the wiring of the electronic blocks and flux-gate sensors. At last, the first magnetometer was ready. The

device was vibration-tested. Despite the fact that there were no visible breakages, the magnetometer did not work. It was subsequently found that all inductances in a particular part had failed because the filling material used did not prevent torsion/twisting. Epoxy resin was simply not known at SKB at that time. Eventually, the final flight-model magnetometers were received at our laboratory for final tuning and alignment. A talented wireless engineer, Alexander Klimovsky, usually completed this work. The flight-model magnetometers were tested at the vibration and magnetic calibration facilities again and again.



K. Gringauz, a leading experimenter on early Russian missions, and A. Richter - Graz, 1984

To determine any magnetic deviations, a special piece of rotating equipment was produced by the Construction Bureau (KB) of Nikolaj Barmin. The engineering model of the satellite was placed on it and rotated to determine the nature of the deviation. The deviation measured was actually several hundred nT, but it was caused in the main by the influence of the iron masses present.

At last, the final stage of experiment preparation began - the flight-model magnetometer was installed on a nonmagnetic plate, together with a proton precession magnetometer designed and made by a collaborator of our laboratory, V.I. Nalivajko. With the help of this magnetometer, the readings of the on-board magnetometer were linked to absolute values of the magnetic field. So the ground-based metrological testing of the flux-gate magnetometer was complete. The device was delivered with great emotion for final mounting on the satellite.

Sputnik-3 was launched on 15 May 1958. Today, of course, observing a space launch on TV is almost an everyday event. But then, to see a launch for the first time carrying that Sputnik and the magnetometer on which I had worked with my own hands, was a truly exciting event. L.N. Zhuzgov, A.V. Klimovsky, V.I. Nalivajko and I shared this great emotion. The fact that scientific equipment weighing almost 750 kg had been successfully jnjected into orbit was an outstanding achievement for Soviet rocket technology and, with hindsight, the first step towards future manned spacecraft.

As far as our instrument was concerned, the attitude unit of the magnetometer was engaged at an active point on the trajectory. Here the first data recordings of measured magnetometer and attitude-sensor channels were transmitted. First of all, we noticed the familiar records of magnetic deviation, which for us was a sign that the instrument was operating normally. Soon afterwards it was decided that information would be transmitted in real-time mode only over our own territory.

The same day, a Marshal with the rocket forces, M.I Nedelin, gave a reception in his residence in Baikonur in honour of the participants in this historic project. The Principal Investigators of the geophysical experiments were also invited. S.P. Korolev invited us to share his car. On the way there, a discussion started and I still remember something he said: 'Soon rockets using a chemical power supply will be able to put spacecraft into orbits that embrace the whole Solar System'. At the reception, there was a very nice atmosphere and the general enthusiasm was felt by all participants.

M.I. Keldish called me and asked: 'Do you really hope to get something useful?'. I answered:

'There is a certain hope. The magnetometer in fact measures a sum of vectors of the geomagnetic and Sputnik's fields. In so far as the vector of the Sputnik field rotates together with Sputnik, measurements are modulated by this rotation. Because the gradients in the field caused by the magnetic deviation are strongly distinguished from the gradients of

the normal geomagnetic field at the height of the orbit, it is possible to exclude the deviation and consequently to determine an accurate value for the modulus of the vector of the geomagnetic field'.

Later, at the Institute of Applied Mathematics of the USSR Academy of Sciences (Institute of M.V Keldish), 'cleaning' of the magnetograms of the influence of the magnetic deviation was carried out by Y.V. Fryazinov. V. Beletsky and Y. Zonov from the same Institute determined Sputnik's attitude in space (using the attitude sensor data and the analytical model of the geomagnetic field), and consequently the attitudes of the other geophysical devices which were not fully adapted for operation on Sputnik.

Epilogue

The Global Geomagnetic Field Survey project was officially completed in 1969. The schooner 'Zarya', the airborne magnetometer 'Magnit', and a Sputnik flying above the Earth were its emblem. The question of nearly simultaneous launching of the special satellites for the investigations in the programme of the Global Geomagnetic Field Survey in the USSR and USA was decided in 1962 during the meeting of US President Robert Kennedy and the Chairman of USSR's Council of Ministers, Nikita Sergeevich Krushchev.

In March and October 1964, Cosmos-26 and Cosmos-49 were launched into orbits with a 49 degree inclination to the equatorial plane, and an altitude range of 270-470 km. They were small spacecraft with chemical power supplies developed in the Special Design Bureau by designer Vyacheslav Kovtunenko. They were equipped with PM-4 proton precession magnetometers built to the technical designs of IZMIRAN by talented designer Marat Chinchevoy of Kiev Radiofactory. The programmed timing and memory systems permitted a uniform set of measurements to be received over 75% of the Earth's surface. The 18 000 measured and calculated values of the magnetic field along the orbit of Cosmos-49 were presented in a fundamental catalogue. These data were given to science data centres in the USSR, USA, Japan and Denmark. Cosmos-26 and -49 data provided the first

information on the magnetic-field anomalies connected with the structure and tectonics of the Earth's crust, projected to the altitude of low-orbiting satellites. The Cosmos-49 magnetic-field data were compared with various analytical models of the geomagnetic field and were an important source for the creation of the international geomagnetic reference field 1965 epoch. Proposed by Joseph Cain and his co-authors, the iteration method for the determination of geomagnetic Gauss coefficients on magnetic-field magnitude permitted the Geomagnetic Field Model with multiple indices n=m=12 to be created on the basis of Cosmos-49 data. This work was conducted at IZMIRAN under the guidance of Natalya Benkova. In the USA, the magnetic-field measurements on OGO-2 and 4 equipped with a caesium scalar magnetometer were carried over a longer period, but at higher altitudes.

On 20 January 1970, Cosmos-321 was launched into a 71 deg. inclination orbit. It was equipped with a solar battery and a caesium scalar magnetometer. The satellite operated for about two months and permitted measurements to be made over 94% of the Earth's surface in the altitude range 237-507 km. These measurements were carried out at a frequency of 0.5 Hz. The results were presented in the form of a catalogue on magnetic tape. The USA's OGO-6 was operating in the same period. These measurements permitted the creation of the analytical model of the geomagnetic field for epoch 1970, and derivation of geomagnetic field variations for the period 1966 - 1970.

The results from Cosmos-321 measurements during a magnetic storm on 8-10 March 1970 were found by geophysicists to be particularly interesting. Besides the traditionally known current systems of magnetic storms observed by ground-based magnetic observatories, the magnetic effects of field-aligned currents which are not observed by the nearest ground magnetic observatories were revealed. When a component of the interplanetary magnetic field B_z = -20 nT (which determines the reconnection of IMF lines with geomagnetic field lines) in the midnight sector, a sharp change in geomagnetic field of about 700 nT was measured. The magnetic field of equatorial electrojets was observed for the first

time at orbits over these electrojets. These data were used to estimate the conductivity of the Earth's crust in the electrojet model proposed by S. Chapman.

A global survey of the magnetic fields of the planets and moons of the Solar System and the study of unsolved geo-dynamo problems within the framework of comparative planetology was begun with the flight of an onboard magnetometer on the Luna-2 station. We are witnesses to this grandiose project.

The IZMIRAN magnetologist group has been privileged to share in the difficulties and joys of the first space experiments, in a spirit of creative enthusiasm. The participation of IZMIRAN and other institutes in the data processing and analysis efforts have been described in 'Successes of the USSR in Space Researches: The First Space Ten-Year Period, 1957-1967' (M. Nauka, 1968), 'Successes of the Soviet Union in Space Researches: The Second Space Ten-Year Period, 1967-1977' (M. Nauka, 1978), in papers devoted to the 50th Anniversary of IZMIRAN, 'Electromagnetic and Plasma Processes from the Sun to the Earth's Core' (M. Nauka,1989), and in other publications. The results of space magnetic studies have been described also in many publications by COSPAR, whose 40th Anniversary we now celebrate.

Continuity of science is necessary to progress. That is why I am very grateful to Prof. Gerhard Haerendel, COSPAR's President, for his kind invitation to share my recollections of the first magnetic-field studies in space with you. I was helped in compiling these remembrances by my colleagues at the IZMIRAN Magnetic Space Research Laboratory, particularly Dr. L.N. Zhuzgov, Dr. T.V. Kuznetsova and Dr. V.A. Styazhkin.

When Is Lunch a Lunch or Really a Launch? - George Abell Remembered

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It was 8 October 1958 in the launch control room in Inglewood, California. 'Lunch will be at 12 noon', or was it 'launch' that Prof. George Abell had to yell into the telephone connection to Mt. Palomar, the connection being very poor at the time? Thus was established the eating arrangement at the 'monastery' at the observatory for Prof. Abell's visit to photograph the Pioneer-1 spacecraft against the near Moon background several days later as the lunar probe was expected to arrive in the lunar neighbourhood. This was to provide angular position information to aid in fixing the spacecraft orbit.

George Abell, then a young astronomer in the Astronomy Department at UCLA and soon to become famous as the 'father' of the Palomar Sky Survey, and a World expert on the clustering of galaxies (STL), was consultant to my space-physics group at Space Technology Laboratory (no, we were not planning a mission to a cluster of galaxies!), the technical advisors to the Air Force Ballistic Missile programme and parent organization of this series of space missions.

To measure the position on the plane of the sky as a guidance aid in the determination of when to fire the de-boost rocket to put the spacecraft into a lunar (capture) orbit, the 48-inch Schmidt provided the high-resolution telescope. At Abell's suggestion, he undertook an examination of the expected brightness of the

spacecraft by reflected sunlight when seen in close proximity to the full Moon. The answer to this was a stellar magnitude of m~ +15, which was a quite detectable value for the Palomar 48-inch Schmidt camera, and arrangements were made for use of the telescope at the time about three days subsequent to launch when the spacecraft was in approximate position for firing its retrorocket and placement into a lunar capture orbit. The use of the telescope was easily arranged as Abell was a principal user of that instrument, having just completed the Palomar Sky Survey. At the time of launch, the control room was set up in Inglewood, California, the location of STL. It was from there that control of the post-launch operations was to take place.

It was in conjunction with this that the telephone conversation took place between Abell and the 'monastery' on Mt. Palomar to inform the personnel of when to expect him to arrive. At the same time, the mission control room was heavily populated by various operational personnel as well as a group of Air Force officers associated with the mission. The telephone connection to Mt. Palomar was very poor and a loud voice was needed in the control room. According to a Lt. Colonel Latham, Abell had just supposedly informed the 'monastery' on Mt. Palomar of the expected time of launch. For reasons best known to the military, the time of launch was to be maintained secret, and this officer was incensed to hear what he thought was a breach of security over the telephone. The relief was palpable when the misunderstanding was cleared up with Abell's explanation that he was to arrive at 'lunch' time on Mt. Palomar, not launch time!

The envelope of the early American space missions was the first response of the US to the USSR's Sputnik, other than the failed Vanguards and for a time, other than the presidentially edicted Atlas-Score, a stripped down Atlas launched during Xmas with a payload consisting of a small transmitter and a tape recorder playing Xmas carols, the total of American space flight other than the purely ICBM programmes. Of the 10 missions, four were successful, culminating in a significant library of publications.

These spacecraft, mostly intended as lunar orbiters, contained what was the first Doppler space navigation system designed to give a highly accurate measurement of the outward velocity of a spacecraft as measured from the Earth. The position of the spacecraft on the plane of the sky was to aid in determining the exact time for firing of the retrorocket intended to place the vehicle into its designated lunar orbit. This was to be a considerable aid, as Doppler would give only the component of velocity along the radius vector from the Earth.

Space flight and launches (and life !) were simpler than today and each operation was a new and novel experiment, including the first radio transmissions away from the Earth into deep space. My involvement as project scientist shortly out of graduate school, for the impossible want of an experienced scientist, was an equally unique introduction to the development and launches of the early Pioneer lunar probes.

It is an honour to be invited by way of this volume back to this distant time, though it is a shock to be forced to recall events so long ago as to be dimmed by four decades of eternity.

COSPAR and the Young Scientists of a Developing Country

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As an old scientist from an advanced country, I want to share some treasured experiences concerning COSPAR that I had as a young scientist in Argentina.

The first COSPAR meeting took place at the beginning of 1960 when Argentina had just elected its first constitutional government after 15 years of military rule and the Peron dictatorship. The new civilian authorities were in the middle of a frustrating battle to wrestle from the military some of the major scientific research operations such as atomic energy and space research, and they tried to regain the national representation in international non-governmental organizations such as ICSU. A newly established Research Council was the logical national body to take care of the latter, mainly because the Academy of Sciences of Argentina was left weak and small after years of despotism, and could not adequately represent the scientific community. Space research, however, was still firmly anchored in the framework of the Air Force. Yet the Council, acting quickly, managed to sneak in a civilian, the Dean of the School of Engineering of the University of Buenos Aires, as the national representative to the inaugural meeting of COSPAR; no other Argentine scientists were able to attend, however.

At the 1961 second COSPAR meeting and Space Science Symposium in magnificent Florence (where during a memorable reception at the Palazzo Vecchio Dr. Alla Massevitch from the

Soviet Union dramatically revealed the first photographs of the back side of the Moon), in addition to a national representative designated by the Argentine Space Commission, a group of young scientists, including myself, were sent as delegates by the Research Council and the University. This indeed gave us the first opportunity to interact personally with renowned pioneers of space research, something very important for us because we had just started to fly home-built energetic-particle and X-ray detectors on high-altitude balloons - the first 'space' experiments to be conducted in Latin America by Latin American scientists. The encouragement received during the meeting was pivotal to our later success in establishing an important space research centre in Argentina.

Things started getting a bit more complicated at the third COSPAR meeting in 1962, in Washington DC. *Two* Argentinians presented their credentials to the COSPAR President and claimed to be 'the' official representative of the country - one designated by the National Space Research Commission, and myself, appointed by the National Research Council ! After some initial consternation and some hours of deliberation, thanks to the good offices of representatives from the two host organizations, the US National Academy of Sciences and NASA, COSPAR recognized me as 'The One'. I confess to having savoured a sweet revenge when the other not-so-official delegate had to sit way back in economy class on the trip to the Cape Canaveral launch complex, hosted by NASA, while I got to sit up front ...

At the time of these first COSPAR meetings, it was quite difficult for scientists from Latin America to get manuscripts past the peer-review process of a certain prestigious geophysical journal. The peer reviewers from our big brother up north seemed determined to demand from their Latin American colleagues the use of pristine Shakespearean English, presentation of unrealistic amounts of statistical data, and fancy graphs worthy of a prize in any art exhibition. The editors of *Space Research*, where the proceedings of COSPAR symposia are published, were far less nit-picking, and some of our first scientific results on space-related research were published in the COSPAR Volumes II and III.

I may be accused of having presented my friends from the Argentine Space Research Commission in a bad light. I must make up for that. First, the Commission had far more funds to support space research than did the Research Council. Second, had it not been for them, the 1965 COSPAR meeting in Argentina - the first such meeting in the southern hemisphere - would have ended in total disaster. Just a few days before the start of the meeting, which was to have taken place on the University of Buenos Aires campus, a student revolt closed down all university premises. The Space Commission (backed by the full power of the Argentine Air Force) managed to move the entire meeting to a famous summer beach resort just *two* days before the beginning of the sessions (luckily it was winter, so the hotels were empty). The skill displayed in managing the nightmarish logistics of the entire operation was unparalleled. None of the arriving scientists knew of the change of the meeting location to a city 400 km away from their intended destination! They were met individually on arrival at the Buenos Aires airports and bused or flown directly to Mar del Plata without any questions asked (or answered). After the initial shock (some delegates reportedly thought they were being kidnapped), all participants unanimously expressed their admiration and gratitude to the National Space Research Commission. (It was at that meeting that I presented magnetically conjugate point maps purposely drawn upside down, with the South on top - something that the editors of *Space Research* did not approve for publication, however).

Science, and space science in particular, was one of the few open bridges between East and West during the difficult years of the Cold War. COSPAR was always a focal point for truly international science, a science without political and ideological boundaries. Of course, the meetings were not free from ideological undercurrents, but seldom did they transcend into the personal scientist-to-scientist domain. I could tell many stories, some funny and some not-so-funny, from later times when I was involved in COSPAR-sponsored international cooperative space projects and in the COSPAR Council. Let me just relate one event that happened at the 1974 COSPAR meeting in Sao Paulo, a couple of years after I had become a full-fledged 'gringo'. After a

reception, a small group of us walked back to the hotel. Two or three thugs appeared and targeted their harassment very specifically on Dr. Alla Massevitch, the Soviet scientist in our group; clearly, they were following instructions from some local security organization. It got a bit ugly, especially when these thugs entered unhindered our hotel behind us. Alla asked me for temporary protective asylum in my room, which I was only too glad to grant. I am sure both her KGB and my CIA would have approved.

Finally, and no longer pertaining to the title of this piece, from 1979 to 1987 I was a member of the COSPAR Executive Council in representation of the International Union of Geodesy and Geophysics (IUGG). During that time COSPAR was reorganized and a new Charter and Bylaws were adopted. My task was not easy, for I represented one of the largest Unions of ICSU, composed of seven Associations, several of which felt that COSPAR was intruding into their own scientific territory. At the same time, some scientists in COSPAR were of the opinion that it was the IUGG which, because of the increasing relevance of space measurements for geophysics, was intruding into COSPAR's territory. I found myself in a no-win situation, triggered by the fact that, indeed, space observations had become routine in many natural sciences, making it unrealistic to trace a sharp boundary between that which is truly 'space' and that which is not! So my role in the Executive Council was mainly that of the devil's advocate, the devil of course being the IUGG.

Since I was also a full-fledged gringo, during the 1986 COSPAR Council meeting in Toulouse I proposed that the two nominees for President be invited to give a 'campaign speech a la Americana' telling us about their vision of COSPAR's future. This proposal was accepted and the candidates were invited to make a presentation. One of the candidates protested and refused to appear - and lost the election by a large margin.

A further set of reminiscences will be prepared for the 50th Anniversary of COSPAR!

My Start in Space

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Looking back to my start into space, there were three different paths that I was able to take and which were essential for me to get actively involved in space activities.

The first path was prepared in Germany at the Max-Planck-Gesellschaft with the Max-Planck- Institut für Physik und Astrophysik. The second path was the European one in the form of COPERS, the European Preparatory Commission for Space Research (COPERS from its French initials) the forerunner of the European Space Research Organization (ESRO). The third path had its origins in France.

After the launch of the first Russian Sputnik satellite on 4 October 1957 and the first US Explorer satellite early in 1958, Prof. Edoardo Amaldi from Rome initiated the discussion on how Europe could become involved in space research. At around the same time, the two Directors of the Max-Planck-Institut für Physik und Astrophysik, Prof. Werner Heisenberg and Prof. Ludwig Biermann, met with the German Minister Siegfried Balke to consider how Germany should participate in future space activities. I was a member of the Max-Planck-Institut as a theoretical astrophysicist, having just returned from a one-year stay as a Visiting Professor for mathematics at the Courant Institute of New York University.

My interest in space research was triggered by the detection of the radiation belts by Jim van Allen, as at the beginning of the fifties I had worked with Arnulf Schlüter on the orbits of cosmic rays in the geomagnetic field. I continued these studies in John Simpson's

group at the Enrico Fermi Institute of the University of Chicago as a Fulbright Fellow from 1955 to 1956.

However, due to the pioneering work of Ludwig Biermann on cometary tails, there was another interest. Already in 1951 he had predicted a continuous solar corpuscular radiation - later called the 'solar wind' - from the appearances of the ionized tails of comets. In 1960, Ludwig Biermann and I discussed the possibility of creating an artificial comet in space to study the physics of the interaction of the solar wind with such an artificial plasma cloud.

Finally, at the end of 1960 plans had been developed to set up a new group at the Max-Planck-Institut to develop the necessary techniques for space experiments. I was asked to lead this new group in Garching, where the Max-Planck-Institut für Plasmaphysik was also located. Gerhard Haerendel was among the first members of our group.

At the same time, the initiative of Edoardo Amaldi had an impact, which Prof. Pierre Auger took up. After a first discussion among European physicists at the first COSPAR Meeting in Nice in January 1960 (Prof. Henk van de Hulst was the President of COSPAR at the time), Prof. Auger invited a small group to his home in Paris in February 1960. This was followed by a number of other meetings, culminating in a technical working group for preparing an intergovernmental meeting. This technical working group had a decisive meeting in the rooms of the Royal Society in London from 3 to 6 October 1960. I was sent as a German delegate, although a complete newcomer. Some of the participants I had met before at astronomical and cosmic-ray conferences. It was already at this meeting that a detailed plan was developed for the future of the European Space Research Organization. It was the basis for building-up the new European organization.

At the end of 1960, an Intergovernmental Meeting took place in Meyrin (CH) at CERN. There the delegates of 10 countries agreed to form the European Preparatory Commission for Space Research (COPERS). The first meeting of COPERS took place in Paris on 13

and 14 March 1961. At this first meeting, a scientific and technical working group (GTST) was created with Prof. Lamek Hulthén from the Royal Institute of Technology in Stockholm as its Chairman. For the various tasks, the Commission appointed certain delegates from the different member countries. Somebody from Germany was needed as a Scientific Secretary.

Van der Hulst has described what happened:

'The first link between Reimar Lüst and European Space Research was forged on a grey afternoon in March 1961 at 36 rue la Pérouse in Paris, the headquarters of the month-old COPERS, the 'Comité Préparatoire' that led to ESRO's birth (1964), which in turn led to ESA's coming into being (1975). We were brainstorming about suitable persons to serve as Scientific Secretary. I had to spell out this unknown name to the German delegation. To us in the astrophysics and plasma-physics field, the name was well-known indeed, for Lüst had already received an offer of a Chair at Utrecht University (which he declined). Lüst, fortunately, did not decline this COPERS job, for a month later the meeting of the ISTWG (Interim Scientific and Technical Working Group) charged him with the task of visiting the member countries to appraise their hopes and plans.'

So this was how I got involved in European space activities. From then until 1990, I tried to help in the planning and execution of the European space programme on quite a number of different levels, as:

- Coordinating Secretary of COPERS 1961 - 1962
- Scientific Director of COPERS and ESRO 1962 - 1964
- Chairman of the Launching Programme Advisory Committee (LPAC) of ESRO 1962 - 1970
- Chairman of the Scientific and Technical Committee of ESRO 1964 - 1965
- Vice Chairman of the ESRO Council 1969 - 1970
- Director General of ESA 1984 - 1990.

I have never regretted the fact that Henk van de Hulst spelled out my name to the Germans at that first COPERS meeting in Paris !

My third path also had its origin at the above-mentioned meeting at the Royal Society in October 1960. There I met Prof. Jacques Blamont, a delegate from France, for the first time. Our first encounter had a very important impact on my space activities and also led to a very fine friendship. I told Blamont about our plans for creating an artificial comet. He was very interested as he launched sounding rockets to create sodium clouds to study the upper atmosphere. He offered me the possibility of piggy-backing our barium container on one of his sounding rockets.

The first joint payload was launched with a French Centaure rocket from the French naval base at the Ile du Levant in France in November 1962. Unfortunately, both sounding rockets went off course and had to be destroyed. But in the following years we were able to launch quite a number of sounding rockets from the French base at Hammaguir in the Sahara. This was how our new group in Garching was able to develop the barium-cloud technique.

The group in Garching expanded and in 1963 the Max-Planck-Gesellschaft established a new Institute for Space Research called the Max-Planck-Institut für Extraterrestrische Physik. This institute is now actively and very successfully involved in quite a number of space activities, with its Directors Reinhard Genzel, Gerhard Haerendel, Gregor Eugen Morfill and Joachim E. Trümper.

A Window to the West

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For us - people from behind the Iron Curtain - COSPAR presented an outstanding opportunity to look through it to the free World, to freely meet colleagues from western countries, and to get some updated and undeformed knowledge about what was happening in the outside World. COSPAR Assemblies were much less formal than those of other ICSU bodies, and even the Soviet delegates appeared relaxed and much more tolerant. The COSPAR Programme Committee meetings in the spring in Paris, in particular, were extremely pleasant and somehow let us forget for two or three days that the World was divided into two strikingly different parts, each with hostile feelings towards the other.

Of course, just because of this rather extraordinary nature of the COSPAR cooperation between West and East, from time to time one encountered some problems. As people living freely elsewhere in the World never had this kind of experience, I would like to share a few stories about things that happened during the quarter of a century when I was involved in COSPAR activities. It is amusing to think about them now, when the difficult period is over, but it was often not very amusing when these things were actually happening.

The most embarrassing situation that I remember occurred in Rome in 1963 - actually not at a COSPAR Plenary, but at the joint meeting of the IQSY Committee and COSPAR, which I attended as COSPAR representative. On the evening of 19 March, Loran Dezsö, Hungarian delegate, brought me a message from the Czechoslovak Embassy which arrived during my absence, that I

should call the Embassy 'as soon as possible on an extremely urgent matter'. It was too late then for a call, and I did not sleep at all that night, afraid that something horrible had happened to someone in my family. I called the Embassy first thing in the morning and learned that there would be a discussion about Taiwan and China, and that I was ordered to vote for an expulsion of Taiwan from the Committee and an acceptance of China instead of Taiwan.

Well, that was certainly a relief. I expected that delegates from other Soviet-block countries got similar instructions and I was not concerned, because I was quite sure that the majority of delegates would be against it anyway. The voting occurred on 21 March in the morning. Everything could have gone smoothly, but then somebody - I do not remember who it was, but I suspect Father Cardus, who liked to irritate the Soviets - proposed that the vote should be secret. So it was, and then the results were recorded, one vote after another, on a blackboard. More than half of the votes were already counted and there was still only one vote supporting the proposal - that one by the Soviet delegate, I supposed. Loran Dezsö, sitting next to me, leaned over and whispered in my ear: 'Zdenek, we must not go home'! A look at the Polish and Rumanian delegates showed that they clearly shared this feeling. Fortunately, towards the end some more positive votes appeared on the board and we were saved. But for a few minutes we really were desperate.

This rebellious secret voting actually signalled the beginning of a period of some relaxation in the 'socialist' countries, which eventually peaked in the Prague spring in 1968. Thus in 1966 I was allowed to use my own car to attend, with my wife, the COSPAR Assembly in Vienna. But, of course, nothing was perfect in those days: we did not get our visa in time and as a consequence the session in which our talk should have been presented was already in progress when we finally parked our car in front of the Hofburg Palace, where the COSPAR sessions took place. Still worse, the Chairman was a Canadian, and it took us some time to be sure that the language he was using really was English. We had no time to register, so we had no programme and

no idea when our contribution was planned. But then, while announcing the next speaker, the Chairman began to stammer. After two unsuccessful attempts to introduce the next lecture, we concluded that he had tried to say 'Svestka and Fritzová-Svestková', and so I took the floor and delivered the talk.

One year later, in London in 1967, I was appointed Chairman of the Organizing Committee of the 1968 COSPAR Symposium on 'Solar Flares and Space Research' in Tokyo. My nomination was proposed by Prof. Lauter from Eastern Germany, which was a real surprise for me: shortly before that, during a visit to Ondrejov Observatory, the wife of Dr. Guth, not informed properly about the high position of Prof. Lauter in Communist East Germany, began to speak openly in front of him and it took us, with her husband, quite some time to stop her. Lauter must have known very well that Mrs Guthova would never have dared to say such things in front of me if I had been a strong believer in the Soviet system. Still, although I considered him always to be a hard-line Communist, he proposed, to the enormous surprise of myself and a few other people present, that I should be the organizer of the Tokyo Symposium.

During the period of the Prague spring, when the 1968 Programme Committee meeting took place in Paris, Czechs tried to irritate the Soviets as little as possible, to avoid their eventual interference in Czechoslovak matters (unsuccessfully, as we know now). Therefore, following this line, I gave a few invited talks to Soviet scientists and accepted many contributed talks from that country. However, when the Tokyo Symposium began, almost none of these speakers arrived, although the Soviet delegation was quite large. Some talks had to be cancelled, other contributions were offered to be presented by other Soviet participants who actually knew nothing about the topic, so that they could not answer any questions after the talk, not to mention the quality of their English. The worst problem was the absence of Prof. Mandelshtam, who should have presented an invited talk that was crucial for the whole Symposium; fortunately, Herb Friedman very kindly stood in for him and thus saved the show.

The only invited Soviet speaker who could come was Prof. Severny, Director of the Crimean Observatory, whom I knew quite well because we both worked on very similar problems in solar physics (surprisingly getting similar results) and also because he selected me in 1964, after Dr. Ellison died, as his Vice-President of IAU Commission 10, on solar activity; during the Tokyo COSPAR meeting I was, as his successor, the Commission President. That selection, by the way, was also very surprising for me: like Lauter, Severny must also have known very well that I was not an enthusiastic supporter of the Soviet system, while he himself had high political status in the USSR. Still, both selected me for important international functions - something that until today remains a mystery to me. Thus, knowing Severny well, I dared to approach him during one coffee break with a question: 'Prof. Severny, don't you think that it is very embarrassing when your Academy sends here people completely different from those who agreed to give talks at the Symposium? I am afraid that it may create for the Japanese and others quite a bad image for your Academy'. Severny stirred his coffee, was silent for a while, and then said: 'Do you know what? I will go from here to Prague and you will go instead of me to Moscow, and tell them! OK?'

This was an amusing and innocent conversation, but a worse incident happened when the Soviets invited Czechoslovak delegates to an evening reception at their Tokyo Embassy. The invitation came very late and the head of the Czechoslovak delegation, Dr. Link, already had an appointment at the Toyokawa Ionospheric Institute, from where he could not return to Tokyo in time. He apparently did not care, because he believed that the two remaining Czechoslovak delegates would be there. But they were not, because we had an invitation for dinner at the Mitaka Observatory, which was far more attractive for us than a reception at the Soviet Embassy. Not knowing that Link was in Toyokawa that day, we just spent a very pleasant evening with our astronomical colleagues at Mitaka. But this had bad consequences: the Secretary of the Soviet delegation attacked us the next day, emphasising that our complete absence showed very well the real character of the present situation in Czechoslovakia. I do not remember whether he used the word 'counter-revolution',

but he was certainly very close to it. It was painfully embarrassing, the more so since our complete absence was really not intentional, but still - with the freedom blooming in Prague in those days - we did not take his words too seriously. But we did - or at least Dr. Link did - when the Red Army occupied Prague three months later, on 21 August. His absence at the Soviet Embassy at Tokyo was surely one on the reasons why he eventually emigrated to Paris.

It was not easy - after a few months of relative freedom - to accommodate ourselves to the Soviet occupation of our country. Everybody was depressed, with no prospects for the future. Therefore, the following 1969 COSPAR Assembly in Prague was a sort of balm for the shocking blow we had all suffered. Once again, for two weeks we had open contacts with western people, we could talk freely with them, and at least partially heal our wounds. We spent pleasant evenings in our house in Prague with many visitors, among them the Friedmans, Prof. Beynon from Aberystwyth who had very close links with Czech music, Japanese colleagues whom we had met the year before in Tokyo, COSPAR and SCOSTEP Secretaries Niemirowicz, Dyer, and Mme Brault, and we spent other encouraging evenings at the American, British, and Canadian Embassies, while very few attended a reception at the Soviet Embassy, this time intentionally. With Dr. Porter, the leader of the US delegation, we made a visit to the Ondrejov Observatory, driving him there in our car, which probably was less than half the size of the one he had at home. These were a very emotional two weeks for the Czechs and Slovaks, although I suspect that only a few foreign COSPAR participants fully realised what was going through our minds during those days. Those who surely did were the Soviet participants, and some of them seemed to be almost as depressed as we were.

The next COSPAR meeting, in 1970, was in Leningrad and the contacts between the Czechoslovak delegation and the Soviet hosts were still rather strained. One evening I was invited with the Friedmans for dinner at the home of Prof. Michailov, Director of the Pulkovo Observatory. His wife Zdenka Kadla-Michailova

A. Massevitch and I. Zhulin, behind them E. Dyer and Dr. and Mrs Porter, and behind her L. Dezsö and C. de Jager, and behind them the author, at the Memorial to the Defenders of Leningrad - Leningrad, 1970

was Czech by origin, and she spoke quite openly about 'the horrible thing which the Soviets did to us' and, of course, both I and the Friedmans agreed. Prof. Michailov made no contribution, but he did not object. However, there were also two other guests: Dr. Mustel and his wife; Dr. Mustel was actually a good friend of Czech astronomers who helped us to get a Russian grating of high quality for our unique flare spectrograph at Ondrejov Observatory, but he also held a high position in Astrosoviet, the highest astronomical institution in the USSR. Because of that, I suppose, he considered it his duty to oppose Zdenka's point of view. He began to explain how the occupation of Czechoslovakia was inevitable, to save the country so that it would not be swallowed up by Western Germany, and mentioned a few other official positions. Then, quite suddenly, his wife interrupted him: 'Please, stop this nonsense and tell them what you really think about it!' There have been very few moments in my life that I have enjoyed as much as that one.

During the Leningrad COSPAR meeting there were a few other things which might be worth recounting; let me mention just two of them.

First, all delegates were placed in the big, but barrack-like Hotel Oktoberskaja near Moscow railway station, at the top of the Nevsky Prospekt. Only members of the COSPAR Bureau were accommodated in the much better Hotel Europejskaja, farther down towards the Neva River, close to the Russian Museum. That hotel, however, accepted only 'foreign currency'. One of the members of the Bureau was a Hungarian. He was also accommodated in 'Europejskaja', but just for a few hours; soon he joined us in our shabby quarters: Hungarian forints were not considered 'foreign currency' in the Europejskaja.

Another interesting event happened when we invited into one of our hotel rooms for evening drinks three Soviets (one Russian, one Ukrainian, and one Kazach) who earlier - separately - had visited the Ondrejov Observatory. We knew, from their earlier visits, that none of them was a Communist, so we began to talk quite openly about all the touchy problems. But they became shocked and scared. None of them said a single word, as obviously each was afraid of the other two. Only then did we realise how difficult it must be for western people to understand our problems, when we ourselves - after having lived for more than 20 years under Communist rule - could have made such a blunder when visiting the Soviet Union.

Emotional times continued in the second half of 1970 when the regime in Czechoslovakia began to return to the pre-1968 years. I spent that summer with my family in a little cottage at Balaton Lake in Hungary, found for us by Dr. Dezsö. One day we were visited there by Prof. Somogyi (later a member of the COSPAR Bureau) and his family. Somogyi and I entered the lake going for a swim, but instead of swimming we discussed all the political problems and unpromising prospects for the future, while walking into the shallow lake. After some time, people on a boat that passed by indicated to us that somebody on the shore was calling us. Thus we finally stopped our exciting discussion,

turned and discovered that we were perhaps a mile from the shore, where our wives were trying unsuccessfully to attract our attention.

Still later in 1970, I went as a Visiting Scientist, with my family, to ESTEC in Noordwijk in Holland. At about the same time, several other Czech scientists moved to similar positions elsewhere in the World, actually sent there by the Czechoslovak Academy. These were all people, like myself, who in various academic functions signed protests against the Soviet invasion. As the Soviet screw gradually tightened, the new leadership of the Academy became frightened that such people might cause problems in further negotiations with the Soviets, and that it would therefore be better to get rid of them for some time, until the situation 'settled down'.

I still attended one more COSPAR Assembly as a Czechoslovak delegate, in Seattle in 1971, this time travelling from the Netherlands, but I no longer had any right to officially represent the country - this function was given to Dr. Sehnal. His choice as my replacement was actually not an extremely good one, because the attitude of Sehnal to the system at home was at least as bad as mine, if not worse (later he became the first Director of the Astronomical Institute at Ondrejov after the Velvet Revolution). However, he had the great advantage that he had not signed anything during the 1968 occupation, because he could not: at that time he was in the last months of a two-year stay at Harvard.

Shortly after the COSPAR Assembly in Seattle my situation changed completely. In spite of my contract with ESTEC for a two-year stay, I was ordered to return home. But because in between I was fired from all my functions in Czechoslovakia, among them the position of Chairman of the Czechoslovak COSPAR Committee, I was afraid to go home, and decided to stay abroad as a political refugee.

The emigration was a great relief for me, because I always hated acting against my conscience, which I often had had to do before. To raise my hand in support of a Soviet point of view when several other western delegates knew very well that I was against

it was a horrible feeling; but one could not do anything about it, because I knew that my family and, in particular, my children would be punished if I - as an official Czechoslovak delegate - cast my vote against the Soviets. Now, finally, I was free, but of course the freedom also had negative aspects. When Igor Zhulin first met me after my decision to stay abroad, he said to me: 'How is it possible that you could do anything like that, Dr. Svestka? You will now be fired from all the international functions you are holding in COSPAR!' Astonishingly enough, this did not happen. I had to leave ESTEC because my boss there was afraid that my presence could 'endanger their cooperation with the Soviets', but my emigration had no consequences at all in COSPAR. In 1973, one year after my emigration, I was appointed Chairman of COSPAR Working Group 3 and stayed in this function for five years. Thereafter, from 1978 I continued as Chairman of COSPAR Sub-commission E.2, and from 1982 to 1986 was COSPAR representative to SCOSTEP's SMA Program, even when I could not attend COSPAR Assemblies which took place in Soviet-dominated countries: 1975 in Varna and 1980 in Budapest. My deep gratitude to COSPAR, its President Kees de Jager, Vice-President Herb Friedman, Secretary Zdzislaw Niemirowicz and many others never ends. It is true that the Soviet delegates ignored me completely as long as anybody else was around, but most of them became very friendly and sympathetic as soon as we were alone. Prof. Mandelshtam even offered himself as a babysitter for our two little children at the COSPAR Assembly in Constance in 1973, when both my wife and I had different programmes at the same time. I must say that it was really a very pleasant feeling for me to see that so many of them understood my decision.

Of course, there were exceptions. One of them was Dr. Massevitch who did not like me much after 1967, when in Budapest I refused to dance a csardas with her! I can - after a bottle of wine - imitate some movements which slightly resemble a tango or waltz, but a csardas? Nevertheless, she seemed offended by my refusal and thereafter always behaved rather coolly when we met. After I emigrated, she ignored me completely - she had a high position in the Astrosoviet. Then, there came the COSPAR Assembly in Sao

Paulo in 1974, with a reception on the highest floor in the highest building of the city (now there are many higher skyscrapers, as I saw on my way to Iguazu in 1991), and it was an extremely dangerous reception: they served Scotch there, and smoothly moving waiters, with bottles in their hands, filled your glasses without your even noticing. I doubt whether I was ever as drunk as I was there. In any case, I do not remember how I got out: I must have taken one of the many lifts, found the door to the street, and went quite some distance to my hotel, before the fresh air allowed me slowly to realise where I was. This eventually happened three blocks from the reception building and, next to me, walked Alla Massevitch. She looked as much surprised by her companion as I was, but despite that I could not suppress the unpleasant feeling that I could not remember at all what we had been talking about. After all, Russian ladies are trained in drinking vodka, so she might not have been as drunk as I was. But perhaps I did not say anything terribly bad, or she indeed did not remember it either, because afterwards she seemed to be a little less icy than before this encounter!

The author (left) with H. Tanaka (right) and another Japanese delegate - Sao Paulo, 1974

But still another, more serious, thing happened there. Prior to COSPAR I attended the IAU/COSPAR Colloquium on Solar Gamma-, X-, and EUV Radiation in Buenos Aires, and I travelled there using Aerolineas Argentinas from Madrid. The flight was very slow and very long, and the plane very small. When we finally landed, I believed that we were in Buenos Aires, but actually it was Rio; the stewardesses explained that the reason was a very strong wind, but as they spoke only Spanish, I missed this information. Later on, Marcos Machado told me that he did not remember any flight from Madrid that would make it down to Buenos Aires, but Aerolineas Argentinas nevertheless stayed optimistic and continued to plan and announce direct flights. After this experience I was rather reluctant to use the same airline on my way back, and I left the return flight open.

That turned out to be a bad mistake. Exactly at that time, there was a Soccer World Championship in Germany. It was very exciting to follow the reactions of Brazilian fans in the streets, celebrating each Brazilian goal with their car horns, and throwing rolls of unwinding coloured toilet paper from upper-floor windows down into the street. But another, much less amusing effect of the Championship was that up to 8 July all flights to Europe were fully booked. For me, this was a big problem, because in less than a week I should have moved from Europe to the States, to start my new job at American Science and Engineering in Cambridge, Massachusetts.

There was a counter in the central hall of the Convention Centre where a lady could be asked for flight reservations. I tried many times to get a seat on anything going to anywhere in Europe, got on an extremely voluminous waiting list, but never on a plane. Soviet delegates were in a similar situation - with open return flights and no seats available. They were quite desperate, because their Soviet exit visas were expiring and they could not get home. It happened only once to me that my Czechoslovak exit visa expired before I returned home (due to bad weather and cancelled flights) and as a consequence of this I had to stay for five hours at Prague Airport to fill in various forms and answer inquisitive questions; and that was a return trip from Moscow. I could easily

imagine that a late return from a western country could have much more serious consequences. So, in spite of my status as a political refugee, I shared and discussed our troubles with the Russians. Then, one morning, one of them met me with a broad smile and announced: 'We are going back this afternoon!' I asked how many. 'All of us', said the Russian. I did not believe it: 'How is it possible? I just asked that lady and not a single seat was available!' The Russian's smile broadened still more: 'That's because you have no bottles of vodka with you!' Well, I did not have vodka, but I took the hint. I bought a large box of chocolates in a nearby candy shop and donated it to that lady at the counter. The next day I was sitting on a Varig plane bound for Zurich.

However, this was not the end of my troubles. I got the job in Massachusetts, bought a house in a Boston suburb, sent all our furniture to that American house and sold everything in Europe that could not be used overseas, including my car, TV set and refrigerator. Then a brief printed form letter arrived from the US Consulate in Frankfurt, informing me that I was not eligible for US immigration. It was a terrible shock. I was already paying a mortgage on a house in Framingham and my salary at AS&E should begin in a few days. I rented a car to go to the US Consulate in Frankfurt to try to find out the reason, but the trip was unsuccessful. They said that they did not know why my immigration was denied, only Washington knew it, but that the institution that hired me in the States could ask for a revision of this decision if I so wished. I certainly did. We moved to a cottage of a friend of mine in Switzerland and waited there for the reconsideration. Three times I was called to Frankfurt, twice the Consul himself discussed the matter with me, but the questions were always the same ones that I had already answered in my application. To my question about the reason for the negative decision, the Consul replied that he 'was not at liberty to say', whatever that might mean. It reminded me strongly of Kafka's 'The Castle', which you may perhaps have read.

AS&E in Cambridge, who were already paying my salary at that time, sent a letter to Senator Edward Kennedy asking him to look into the matter, but it was clear to me that - if anybody in his

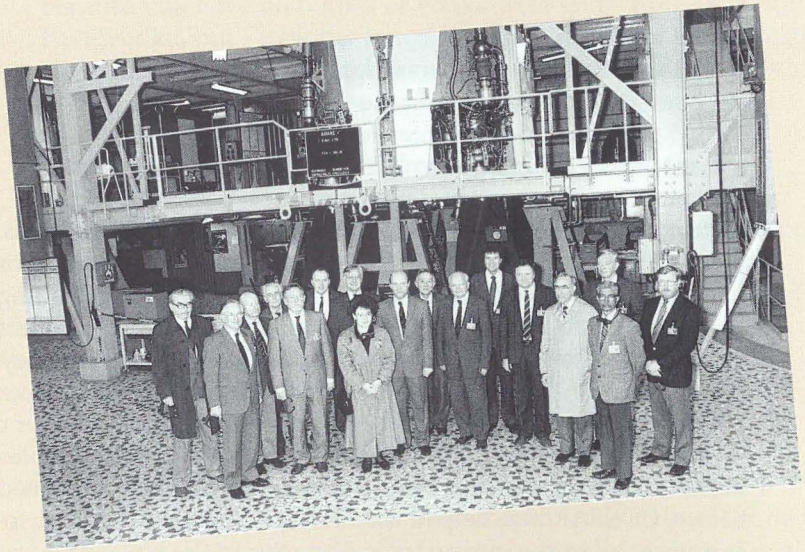
office looked into it at all - it might take weeks. So I remembered my friendly COSPAR and SCOSTEP relations with Herb Friedman and suggested to the AS&E people that they ask him for help. He was in Washington where, according to the Frankfurt Consulate, the problem was rooted. He might therefore know somebody to ask about where the obstacle lay. And I was right: in a few days I got a call from the American Consulate in Frankfurt that the immigration visas for my family were ready for collection.

The reason for the rejection of my immigration application was very simple: when attending the COSPAR Assembly in Seattle in 1971, I got a G-4 visa for entering the United States. These are special visas given to government officers and I got it because I worked for an intergovernmental organisation, ESTEC. Unfortunately, I have got this kind of visa in my Czechoslovak passport. Thus for the immigration officers in Washington I must have been associated with the Communist government in Prague, and hence ineligible for immigration. Clearly, one simple question at the consulate in Frankfurt could have cleared it up, but they never asked it. Now, as soon as Herb Friedman helped uncover the reason, a call to ESA's Headquarters in Paris, and another call from there to the Frankfurt Consulate easily solved the problem. Thus, in addition to all of the other benefits which I mentioned before, COSPAR also helped me, through its Vice-President, to surmount all of the bureaucratic obstacles in the United States.

In 1977, I returned to Holland and gradually more or less became a Dutchman. In 1988 the Dutch representative proposed me as Chairman of the Programme Committee at the XXVIIIth COSPAR Assembly in The Hague in 1990. This brought me again, after many years, to the Programme Committee meetings in Paris, which I had enjoyed so much when attending them from behind the Iron Curtain. Only now, after the Velvet Revolution in Prague, there was no Iron Curtain anymore.

I will never forget those ten years, between 1962 when COSPAR first nominated me as its representative to the International IQSY Committee, and 1972 when I became a political refugee, during

which COSPAR meetings were our open window to the free World. COSPAR certainly contributed a lot to the cooperation between East and West. With this article, although concerned only with unimportant personal matters, I would like to express my gratitude, and also that of many others.



Visiting Aerospatiale during a COSPAR Programme Committee Meeting in Paris in March 1990, from left to right: the author, S.J. Bauer, S. Grzedzielski, J.F. Dennisse, R. Wilson, Z. Niemirowicz, W.I. Axford, B. Wieser, J.-M. Contant, K. Hirao, A.J. Somogyi, L.E. Peterson, R.A. Sunyaev, H. Friedman, R.R. Daniel, D. Kastel and R.C. Hart

When COSPAR Was a Teenager*

Zdzislaw Niemirowicz
Past Executive Director of COSPAR

The COSPAR Meeting in Tokyo

The eleventh COSPAR Meeting was to be held in Tokyo from 9 to 21 May 1968 in the modern Keidauren Kaiku Building. This Meeting was crucial for my career in COSPAR. Retired four-star French General M. Gazin, COSPAR Executive Secretary at the time, resigned for health reasons shortly before the Meeting and was not present in Japan. Mr. Truelle, the candidate proposed to become the new Executive Secretary, was Ingénieur Général de l'Air, which is a very high technical grade in the French Air Force.

From the moment of my arrival in Tokyo, I experienced problems with my accommodation. I was booked into the Dai-ichi Hotel which, although modern, was peculiar in that the majority of its rooms had no windows. In addition, the size of my room reminded me of the space available in a rather large wardrobe drawer. Due undoubtedly to wartime experiences such as hiding in cellars during bombings and sojourns in bunkers and trenches during the Warsaw Uprising in 1944, as well as to post-war prison-cell accommodation, I quickly developed claustrophobia. Another inconvenience, although of a different nature, was that I could not plug in my electric shaver because its European plug did not correspond to the American-style fixtures of the hotel. I called reception asking for an adapter and was rather pleased that my Polish-tinted English had been so easily understood by the Japanese staff. Therefore, I was expecting the knock on my door a

** This article is a follow-up to 'A Marriage to COSPAR: Part I B 1957-1967', published in COSPAR Information Bulletin No. 127, August 1993, pp. 77-88.*

short while later. On opening the door, however, I was somewhat taken aback to find a short, middle-aged gentleman, who announced in a heavy accent that he was the doctor I had been expecting. The doctor was able to help me obtain the desired adapter, however, down at reception, and hence I suppose I was 'cured'.

After quickly shaving I hurried down to meet Professor Kunio Hirao, our most hospitable host, who was waiting to take me and other members of the COSPAR Secretariat out to a Japanese restaurant. Upon removing my shoes, as is the custom, I realised with horror that emerging from an enormous hole in one of my socks was a protruding big toe. I felt quite ashamed, but the kind waitress, delicious food, warm sake and the nice company were all so agreeable that I soon forgot about my sock's etiquette transgression.

The Meeting programme included, in addition to the open scientific sessions detailing the latest significant results in various fields of research, three specialised symposia on: (i) Solar Flares, (ii) Biological Effects of Radiation in Space, and (iii) Small Rocket Instrumentation Techniques. The latter was organised on the initiative of the Japanese National Committee on Space Research and co-sponsored by COSPAR. The business activities of the Working Groups were intense and resulted in a fair number of resolutions and recommendations. In addition, the Consultative Group on Potentially Harmful Effects of Space Experiments was invited by the Executive Council to reactivate its 'Panel of Standards for Space Probe Sterilisation' under the name 'Panel on Planetary Quarantine', whose purpose would be to determine 'whether launching nations are taking effective precautions to avoid biological contamination of Mars and other planetary objects by space probes....'. A total of 240 papers were presented in Tokyo, and 503 participants were registered.

The Meeting in Japan included some unusual attractions. I remember sitting in my large office, situated somewhere up around the twentieth floor, gazing at a potted palm that decorated the space, when the plant begun to slide in my direction. After a

few moments the palm very efficiently reversed direction and slid back approximately to its original position. I had lived through my first, but not last, earthquake. Also memorable was a reception organised for Meeting participants and accompanying persons in a lovely garden whose trees were strung with colourful Chinese lanterns. The spouses of our Japanese hosts were dressed in beautiful kimonos, the food was delicious, and the ambience was completed by barrels of fire-warmed sake. Each guest was presented with a souvenir box of nicely scented wood that lends a special flavour to sake, and everyone became very joyful and friendly. The reception lasted long into the night, but the reserves of sake exceeded the capacities of the thirsty guests.

The next day the newspapers carried stories of two tremors which occurred during the reception. None of the reception guests had felt them, and to this day I still wonder why!

Mr Truelle and I had been replacing Mr Gazin, and our relationship was good as we jointly carried out the Secretariat's work. I was sure that he would be the next Executive Secretary. However, during the second Bureau Meeting both of us were excused, and when called back I was informed by Prof. Roy, COSPAR President at that time, that the Bureau had decided to entrust to me the responsibility of the Secretariat. Later, I learned that Mr Truelle had not been really interested in the position and had heartily recommended me as the best successor to Mr Gazin.

The Secretariat's staff from Paris had made arrangements to visit as many sites of interest as possible, since it was not often then that Europeans had a chance to visit the Far East. During the Meeting we had already had an opportunity to see the most interesting sites in Nikko and Nara. Although sad to see the Meeting end because of our excellent relationship with the local staff, we were anxious to be off on our visits to Kyoto and Osaka. We returned to Europe, accompanied by Dr. Z. Svestka and a middle-aged German scientist whose name now escapes me, by way of Hong Kong and Cambodia. I believe that 1968 was the last year, until recently, that it was possible to visit in safety the magnificent site of Angkor Wat.

In fact, the greatest difficulty we had was caused by events back in France. In May 1968 most of France was on strike, and the only UTA plane that was leaving from Phnom Penh was under siege. It was extremely difficult to obtain a seat on the plane, and it was not known when there would be another flight. Benefiting from Mr Truelle's military title, we were able to wangle seats on the UTA flight, but the plane was diverted to Brussels. The Paris airports were closed to traffic. Mr Truelle returned to Paris by military plane, while the rest of the Secretariat was transported by bus. Upon entering the city, I was amazed to find the streets transformed into narrow corridors by garbage piled almost one storey high. The air was unbreathable. The bus dropped us off at the Gare d'Orsay, located in the centre of Paris, and with no transportation, phones, or taxis in service I was obliged to walk, carting two heavy suitcases, to Boulogne in the suburbs where I lived at the time.

The COSPAR Meeting in Prague

At the invitation of the Czechoslovak Academy of Sciences, the twelfth COSPAR Meeting was held in Prague at the Hotel International from 11 to 24 May 1969. My recollection is of a sad country, despite the hospitality shown to us both officially and in our private contacts. There was a lingering feeling of hopes crushed by Warsaw Pact tanks during the Prague spring. I recall following the news of the invasion by radio and newspapers while driving toward Seville on vacation with my family. The reports detailed the manoeuvres of Soviet and other 'brethren' country troops, including those of Poland, and I was shocked, sick and unable to drive for an entire day. Polish troops, of which we were always proud for their participation in battles defending the freedom of Poland and other countries, this time took part in the infamous suppression of liberty and helped kill the hopes, on the rise at the time in the majority of communist 'satellite' countries, of gaining a greater measure of independence from the Soviet Union.

A majority of our Soviet colleagues gave the impression of being embarrassed to be in Prague under the circumstances and kept a

low profile. I remember going to dine in a restaurant, and some of them joined me. They asked me to speak English and no Russian. I complied but, judging from the suspicious glances of the waiters, do not think that our group appeared to be either American or English.

The Hotel International was not an ideal place to hold a meeting such as COSPAR's, but our Czechoslovak hosts showed a great deal of ingenuity, and in the end everything worked out well. The Meeting was opened by Prime Minister O. Cernik, who disappeared from the political scene shortly after our Meeting as 'normalization' continued.

The scientific programme included three symposia, on: (i) Thermospheric Property; (ii) Life Sciences, and (iii) Dynamics of Satellites. The open meetings of COSPAR Working Groups covered a number of latest results from various space-research disciplines, and the participation differed little from the previous year, with 519 participants and 270 papers presented.

During the Prague Meeting, a new Working group structure was approved as is reproduced below:

Working Group 1 on Tracking, Telemetry, and Dynamics, with the following Panels: 1A on Optical Tracking;1B on Radio Tracking and Real-Time Telemetry, and 1C on Dynamics of Artificial Bodies in Space.

Working Group 2 on Experiments in Interplanetary Space and the Magnetosphere, composed of the following Panels: 2A on Interplanetary Medium; 2B on Solar Wind Interaction with the Earth; 2C on Structure of the Magnetosphere, and 2D on Magnetic Disturbances and Polar Substorms.

Working Group 3 on Space Techniques as applied to Astrophysical Problems, including the following Panels: 3A on Galactic and Extragalactic Astronomical Measurements; 3B on Solar Flares and Forecasts, and 3C on Asteroids, Meteoroids, and Cosmic Dust.

Working Group 4 on Experiments in the Upper Atmosphere, with the following Panels: 4A on Structure of the Upper Atmosphere (including sub-committee for CIRA); 4B on Interactions of the Neutral and Ionized Atmosphere, and on Polar Ionosphere (including Polar Cap and Auroral Zone Phenomena).

Working Group 5 on Space Biology.

Working Group 6 on Application of Space Techniques to Meteorology and Earth Surveys, composed of the following Panels: 6A on Satellite-supported Local Observations; 6B on Observations by Remote Sensing; 6C on Meteorological Rocket Observations and Networks, and 6D on GARP Systems.

Working Group 7 on Space Programs for the Study of the Moon and Planets, including the following Panels: 7A on the Moon, and 7B on the Planets.

The Consultative Group on Potentially Harmful Effects of Space Experiments continued to be active, and the former Working Group 3 became *The Advisory Committee on Data Problems and Publications.*

The media covered the meeting sufficiently, but public interest centred on Frank Borman, US Astronaut. Only five months earlier he had been the commanding officer of Apollo-8, which was the first manned spacecraft to orbit the Moon ten times. Mr Borman was interviewed on and displayed at every possible occasion, and even inaugurated the dancing at the receptions. In addition, he was honoured with several enormous goblets made of Czech crystal and the attentions of hordes of autograph hunters. I quite admired this West Point graduate, for he performed faultlessly the mission entrusted to him of representing a democratic country in a nation where liberty had just been suppressed. Despite the warmth of his reception in Czechoslovakia, I can imagine the loud 'uff' of relief he must have made as he sat down in the plane to return home.

During the meeting it was for me especially unpleasant to see several of the host-country participants whom I knew to be hard-

core communists, for they were trying to give the impression of real liberals who favoured democratic change. In fact, a few months later, as the future would show, they became the persecutors of their colleagues who really contributed to the experiment of building 'socialism with a human face'.

I recall the splendid Hradcany Castle where COSPAR officials were received by the President of Czechoslovakia, General Svoboda. We were also received at several other lavish palaces. The impressions made by these sights contrasted starkly with the queues of Prague inhabitants seen before the food stores in the mornings on the way to the meeting site. I returned to France by car and on the way to the German border, driving through

COSPAR Officials being received by the President of Czechoslovakia at the Hradcany Castle on 22 May 1969. In the foreground, left to right: M. Roy, President of COSPAR, L. Perek, Chairman of the Local Organizing Committee and President L. Svoboda. In the background, left to right: M. Nicolet (Belgium), E. Buchar (Czechoslovakia), L. Jacchia (USA), Z. Svestka (Czechoslovakia), L. Sehnal (Czechoslovakia), J. Kovalevsky (France) and Z. Niemirowicz, COSPAR Executive Secretary - Prague, 1969

numerous small towns and villages, I remember seeing partially destroyed and completely neglected churches. Torn-down crosses and broken stained-glass windows indicated a degree of religious persecution and imposed ideology much more severe than that I knew to exist in Poland.

The COSPAR Meeting in Leningrad

The Soviet Academy of Sciences invited COSPAR to organize its thirteenth Meeting in Leningrad in 1970. The Inter-Union Commission on Solar-Terrestrial Physics (IUCSTP) was also asked to hold its second Solar-Terrestrial Physics (STP) Symposium at the same location just before the COSPAR Meeting. Our Committee agreed to exclude from its programme topics covered by the STP Symposium, and the organizers of the latter were to receive a share of each registration fee collected. The two events took place at the historical Taurida Palace* . Normally the building was occupied by the Higher School of the Soviet Communist Party.

Dr. Ned Dyer, IUCSTP Secretary and a friend whom I met for the first time in Warsaw in 1963, and I travelled together to Leningrad a few months before the meeting in order to examine the conference facilities and to negotiate on the export of the registration fees to be paid in convertible currency by Western participants. At the time very severe restrictions made it difficult to take out 'valuta' from the Soviet Union. It was agreed that Soviet and other communist-country participants would pay their registration fees in roubles. All others were to pay in US dollars. We received assurances from the Secretary of the Local Organizing Committee that the matter had been settled with the state bank and that we would be able to export all dollars collected.

*** At the time of Catherine the Great, the Crimean Peninsula was often referred to as Taurida. This name is derived from the word Tauri, the name of an ethnic group which once lived in the region. This Palace was built for Prince Potiomkin, the favorite of Catherine the Great, in 1789 by the architect Ivan Starov. Commander in Chief of the Russian Army during the war with Turkey, which took place on the Crimean Peninsula, Potiomkin was given the title Prince of Taurida.*

As for reproduction facilities, in spite of our requests, they were not shown to us, but we were assured that sufficient equipment, meeting our specifications, would be installed in the building and that it would be at our exclusive disposal during the meeting.

The Taurida Palace had enough room for the planned parallel sessions. The only problem was with the main amphitheatre, which had an enormous glass ceiling, the light from which could not be dimmed to make the projection screen visible. We were therefore forced to enter into long discussions with delegates from the Academy's Moscow headquarters, people from the Taurida Palace, and the authorities from the Leningrad chapter of the Academy of Sciences. The answer was always the same. It was impossible to do any work whatsoever on this historic building. In despair I said that I could not believe that, in a country like the Soviet Union where one could move mountains and reverse the flow of rivers, the word 'impossible' existed and that, therefore, I could not be convinced that it was not possible to make an amphitheatre dark. Evidently, this argument worked, for the next day we were told that the problem would be solved, as indeed it was.

Our hosts were very hospitable; the trip was very useful, and it looked as if everything would work well. On a personal level, I had the opportunity to establish a friendly relationship with Prof. Kiril Ya. Kondratyev, at the time pro-Rector of Leningrad University, and I am most pleased that this friendship has endured until the present day.

During this trip, I witnessed the miracle of 'white becoming red'. I had already visited the Soviet Union a few times previously on COSPAR business, and my experience had shown that this country's laundry service in hotels was rather poor. Two days after having once given my shirts to be washed, I was presented with something that only very remotely reminded me of the original product, for the size of the collars had shrunk and from half-stiff they had became soft, as well as changing colour from white to light grey. I couldn't wear them as they no longer fitted my torso. I suppose that they had been boiled or at least washed

in extremely hot water. Since then, I have avoided Soviet hotel laundry services and always take with me washing powder and more shirts than when travelling to other countries. Unfortunately, when leaving for Leningrad from Moscow I forgot two clean shirts in my hotel room and was obliged to wash my one shirt in a bathroom. In the evening, in the dim light of a 40 Watt bulb, I filled up the bathtub, performed the washing job and left the shirt to dry. The next morning when dressing I realised with horror that my only shirt, although supposedly clean, had changed to a reddish colour; the water contained so much rust that in the light of day it was brownish-red. This happened in the enormous Oktyabrskaya Hotel. For accommodation during the COSPAR Meeting itself I chose a much smaller and nicer hotel that was built before the First World War called the Yevropeyskaya. The problem, however, was that the quality of water there was the same.

This was my second visit to Leningrad. I had first visited the city in 1964 on the occasion of a visit to my aunt, whom I had not seen since 1939. My aunt and her husband lived in Grodno, a region of Poland that became a part of the Byelorussian Soviet Republic after the invasion in 1939 of Poland by Soviet troops. This invasion, resulting from the Ribbentrop-Molotov agreement, took place while the Polish army was still resisting Hitler's attack. During that stay with my relatives, I had applied to the local militia for permission to go to Leningrad, and after a week my request was granted. I had some emotional ties to Leningrad because my parents lived there when this city was still known as Petrograd*. My parents were also there during the February and October 1917 revolutions. The names of streets and buildings were familiar to me from stories told by my mother, and indeed when visiting certain sites I had the impression of being somewhere I had already set foot. It is the most western Russian city, and many of the buildings and monuments were constructed by Italian and French architects. However, I felt there enormous

** The city was first called Petersburg or St. Petersburg. In 1914 the old name gave way to Petrograd, which in turn was changed to Leningrad in 1924, a name the city kept until recently.*

suffering emanating from the city, for it was built on marshes by serfs, and its foundations were the bones from their fellow workers who died while labouring for the greater glory of the tyrant who decided to open the country to the West. During the following centuries the tsarist oppression filled the numerous prisons with those striving for more liberty, and then followed the unimaginable Bolshevik terror. As if all this were not enough, Leningrad was also home to 600 000 people killed or starved to death during the 900 days of the World War II Nazi siege.

The COSPAR Meeting programme consisted of open meetings of all Working Groups and of a specialised symposium on Remote Sensing of the Atmosphere, which was cosponsored by WMO and IUGG/IAMAP. In addition, the organisation of annual reviews of space research, initiated by the COSPAR Working Groups, was already well established by the time of the Leningrad Meeting. During these reviews, no parallel sessions were scheduled in order to allow maximum attendance. The scope of these reviews can be appreciated by listing the topics discussed in Leningrad:

- Development in Space Meteorology during the Past Year, by F. Möller (FRG)
- X-Ray and Gamma-Ray Astronomy, by H. Friedman (USA)
- Exploration of Mars by Mariners-VI and VII, by S.I. Rasool (USA)
- Results of Apollo Missions, by J.A. Wood, G. Wasserburg et al. (USA)
- Problems of Cosmochemistry, by A.P. Winogradov (USSR).

When arriving in Leningrad several days before the Meeting, we were faced with some rather unpleasant surprises. We were informed that the Soviet financial authorities had refused permission to export the registration fees to be collected from western participants, and instead insisted that this money be converted into roubles. We could not agree to this and a 'war council' consisting of the COSPAR and IUCSTP Presidents and Secretaries was formed. Ned Dyer and I proposed that instead of having westerners pay registration fees, we would ask them to sign promissory notes obliging them to send payments directly to

The President of COSPAR, Maurice Roy, using an ordinary hammer to close the Leningrad Meeting in 1970 as no gavel was available. Seated on the left is A.A. Blagonravov, COSPAR Vice-President (USSR)

Paris after the Meeting. The 'war council' accepted this solution, and it was later confirmed by our respective Finance Committees*.

The second surprise concerned the reproduction facilities. Although the promised services existed, the problems the COSPAR Secretariat encountered at the Warsaw Meeting in 1963 were small in comparison**. We had no direct access to the room

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** Of the 365 participants who were to pay the registration fee in US$, only two neglected to honour their signature and did not send payment to Paris.*

*** See my article 'Marriage to COSPAR: Part I B 1957-1967', in COSPAR Information Bulletin No. 127, August 1993, pp. 77-88 (Z.N.).*

where the offset machine was installed. We were supposed to submit our copy request through a local member of staff who was to be available at a predetermined location. In fact, we could almost never find this person on whom we should have relied. When we were able to locate him, we never knew how long it would be before our copies would be returned, but I suppose that this was normal since he also, undoubtedly, had to find somebody who could, in turn, authorise him to make our reproductions. To produce 400 copies of a form detailing the obligation of participants to pay their registration fees in US$ directly to Paris, four lines of text in all, took almost two whole days, so we were already prepared to start writing such forms by hand when the printed versions were finally brought to the Secretariat. Because of this situation, the reproduction of documentation was limited to an absolute minimum in Leningrad, and I still like to imagine the censor trying to discover the possibly subversive meaning in the announcement for the session of the RTRTT Panel (Panel on Radio Tracking and Real Time Telemetry).

Dr. I. Zhulin, Secretary General of the Local Organising Committee, who was a key person in our previous agreements, disappeared from the scene very early and we were told that he had become seriously ill. His absence was quite convenient for the local organisers, because it served as an explanation for all of the difficulties the Secretariat encountered in the everyday running of the Meeting. To be just, however, it must be said that all of the shortcomings were more than compensated for by the exceptional hospitality offered to the participants by our hosts. The receptions were lavish, the social programme excellent, and the interest of the public in our Meeting great. Four Soviet cosmonauts participated - G.T. Beregovoy, K.P. Feoktistov, Ye. V. Khrunov and V.N. Volkov - but the focus of participants' attention was US astronaut Neil A. Armstrong, 'the first man on the Moon'. Seeing how he was besieged by autograph hunters at all of his appearances), one could only admire his ability to survive in this most friendly, but body-contact- full environment.

A very important result of the close cooperation between IUCSTP and COSPAR during the Leningrad Meeting was the decision to

Seated left to right: American Astronaut Neil Armstrong, first man on the Moon, Academician A.A. Blagonravov, COSPAR Vice-President (USSR), and Russian Cosmonaut G.T. Beregovoy. Standing left to right: G.S. Balayan, Secretary USSR Committee for COSPAR, and Z. Niemirowicz - Leningrad, 1970

The "fight" for autographs from the 'first man on the Moon', S Astronaut Neil A. Armstrong, in the main auditorium of the Taurida Palace - Leningrad, 1970

submit for final approval in 1971 the draft programme for the International Magnetospheric Survey, planned for the years 1974 - 1976. Responsibility for leading this programme was to remain with the IUCSTP in close cooperation with COSPAR and the participating international unions.

The Consultative Group on Potentially Harmful Effects of Space Experiments was not able to meet in Leningrad. During the Meeting, however, the Panel on Planetary Quarantine formulated two recommendations. One of them urgently requested the Soviet Academy of Sciences to take the necessary steps to communicate the contamination reports of Soviet probes to Mars and Venus, and the other recommended that the same quarantine requirements as then applied to Mars also be applied to Jovian planets (for flybys, orbiters or entry probes). These recommendations were approved by the Consultative Group on Potentially Harmful Effects of Space Experiments at a later date.

Participation in the Leningrad Meeting and the number of papers presented were higher than at previous meetings: 940 and 300, respectively. There were 574 participants who paid the registration fee in roubles, and the amount collected in this non-convertible currency was very high. With the blessing of the COSPAR Finance Committee, our President Prof. Maurice Roy gave a lavish reception in the hotel Yevropeyskaya for officials and distinguished scientists from the host country, the heads of national delegations, and union and other organisation representatives. The total number of invited persons was about 150. This reception was paid for from the roubles collected in Leningrad, but prices in the local currency were so low that only a small portion of the funds collected was spent for this purpose*.

** In following years, the remaining funds were used to purchase air tickets in the Soviet Union and for per diem expenses of COSPAR officials on mission in this country. The cost of air travel of some Soviet participants attending COSPAR Meetings was also covered. Later, the Soviet financial authorities restricted the use of these funds to per diem payments only. Because of these restrictions, the roubles collected in Leningrad were entirely exhausted only at the beginning of the eighties.*

Used to different sanitary conditions, participants from the USA, particularly those used to drinking tap water, did not fare very well in Leningrad. During the Meeting some of them developed stomach troubles. Some time after my return to Paris I learned that almost the entire US delegation had become sick. The enquiry showed that their digestive system had been attacked by the bacteria residing in city water, to which Americans, living in a much more sterile environment, had no resistance.

Some Thirty-Five Years of Personal Recollections of COSPAR Activities

Michael J. Rycroft
International Space University, Illkirch, France

During my career development, COSPAR activities were especially important in enabling me not only to meet and discuss with colleagues from all over the World, but also to broaden my research interests significantly. I would like just to share some of my reminiscences of key events and of some of the influential personalities in COSPAR.

COSPAR Plenary Meetings and Scientific Assemblies have played a crucial role during the development of my career. So also have the regular meetings of other ICSU bodies, such as the IUGG (especially IAGA), URSI, SCOSTEP and SCAR. All of these organisations give each and every research scientist the opportunity to meet new colleagues. These opportunities, necessary in every scientific field, are particularly important in space activities which, by the very nature of orbiting satellites, are global in coverage. The chance to hold international discussions and to energise collaborations between scientists from different nations was even more important during the years of the Cold War than it is today, when e-mails, faxes and telephone calls provide the means for instantaneous global communications.

The first major international scientific conference which I attended was the COSPAR meeting in 1963, held in Warsaw. I was then in the final stages of my PhD research on Schumann resonances of the Earth-ionosphere cavity, and appreciated the chance to hear about high-altitude rocket observations. I also remember

attending a biological talk, and being not very impressed by the speaker's statistics. This meeting provided the occasion for my first visit to an Iron Curtain country, and my memory of the huge 'wedding-cake' style building where the discussions were held remains vivid today.

During 1964 and 1965, my induction into space physics was swift, as a Postdoc at the NASA Ames Research Center in California. At this time, many exciting discoveries were being made; I especially remember meeting Norman Ness and hearing about the magnetopause and its characteristics at first hand.

By 1967, I was a lecturer in the Physics Department of Southampton University, and attended the COSPAR meeting held at Imperial College in London. The sixties were the heyday of British activities in space, led by the small, wiry and most distinguished Australian, Prof. Sir Harrie Massey, a COSPAR founder. But even he had time to talk with a young space enthusiast like myself, as did Philip Wigley, ex Royal Air Force, his dapper "right-hand man" from the Royal Society, who was always - deferentially - one step behind Sir Harrie. I remember their presence at the 1969 meeting in Prague, and a most gracious lunch given by the British Ambassador. I presented a paper with my research student, Phil Alexander, on diffusive equilibrium models of plasmaspheric parameters; this has since been much referenced, in preprint form.

During the 1970s, my links with COSPAR became strong. This was due to my organisational work, with Chris Russell from UCLA, on magnetospheric topics for Commission-D. I remember the meetings held at the elegant COSPAR Headquarters in Paris in the early spring each year, arranging the submitted abstracts into sessions for the oral presentations. I also recall being a member of the British National Committee for Space Research, under the auspices of the Royal Society, and meeting distinguished scientists like Prof. Sir Robert Boyd and Desmond King-Hele.

In the seventies, while building up a Space Radiophysics research group at Southampton, I edited the large tomes of *Space Research*,

the proceedings of the annual COSPAR meetings. This task further broadened my interests in space, and I was pleased to collaborate, as joint Editor, with Carl Sagan (in 1970), Sidney Bowhill (in 1971) and Keith Runcorn (in 1972). Christine Stickland was a most able, experienced and dedicated Executive Editor during this period.

It is instructive to look again at these thick, printed volumes. Arising from the 1970 meeting held in Leningrad, *Space Research XI* has an image of a man's footprint on the Moon on the cover; here are historic photographs from the Apollo-11 and 12 missions, papers on remote sensing of the Earth's atmosphere using satellites, and papers on very energetic charged particles by S.N. Vernov and colleagues. Several papers are written in French. The 1971 Seattle meeting led to *Space Research XII* being the largest ever volume, with 1815 pages. Lunar investigations with Lunahkhod are reviewed, as are the results of lunar laser-ranging experiments. Cosmic dust, the upper atmosphere and ionosphere, and high-angular-resolution astronomical observations made from space are other dominant themes. Papers dealing with Life Sciences and Space Research are published as a companion series.

In 1972, the Madrid assembly had three specialised symposia, on Critical Problems in Magnetospheric Physics, X-ray and Gamma-ray Astronomy, and Planetary Atmospheres and Surfaces. In *Space Research XIII*, attention is focused on the results from tracking satellites, the Earth's upper atmosphere and ionosphere, the results from barium-cloud releases in the ionosphere and magnetosphere (with a spectacular colour photograph on the cover), the Sun (a review of the corona by Richard Tousey), and Apollo-15 and Luna-16 results. COSPAR remained in Europe for its 1973 assembly, held in Constance. The cover photograph of *Space Research XIV* shows a solar-flare source on the limb of the Sun, in X-rays at 16 Angstroms (1.6 nm), together with a photospheric magnetogram and iso-lines of 9 cm radio emissions. Also covered are Aladdin II studies of the atmosphere at heights from 50 to 150 km, recent advances in cometary physics and chemistry (by Ludwig Biermann), Venera-8 results on Venus, and noctilucent clouds, zodiacal light and interplanetary dust.

The 1974 assembly took place in South America for the second time, on this occasion in Brazil. Geodesy from space was a particular theme, as was meteorology from space, magnetic-storm effects on the upper atmosphere and the International Reference Ionosphere. With a student, Roger Usher, I presented a paper on the refraction of downcoming VLF chorus signals, observed on a Petrel rocket, by a sporadic-E layer. HEOS-2 results on the high-latitude magnetosphere, Mariner-10 studies of Venus and Mercury, and Skylab experiments on cosmic dust are also reported. *Space Research XVI*, arising from the meeting in Varna, Bulgaria, was the last to be published by Akademie-Verlag in Berlin; later volumes are published by Pergamon Press. Remote-sensing observations of the Earth's atmosphere and surface are reviewed by William Nordberg. Several European and Soviet satellite results on the thermosphere and ionosphere are presented; active experiments in the magnetosphere are considered for the first time. Solar proton events, various Skylab results, and Soviet studies of Mars are covered in some detail here.

COSPAR returned to the USA in 1976, the bicentennial year. In the historic city of Philadelphia, a special session was held on the Space Shuttle, and another on using balloons for space research. Results on the stratosphere, thermosphere and ionosphere are presented. Regarding the planets, attention is centred on Pioneer-10 and 11 investigations of Jupiter. *Space Research XVIII*, from the Tel Aviv meeting of 1977, has typed, camera-ready papers for the first time. It starts with a comprehensive, 25-page overview of space research by Cornelis de Jager, and continues with papers on remote sensing, the atmospheric response to solar and geomagnetic activity, the Sun and interplanetary medium, and materials-science under microgravity conditions, as well as more standard fare. With my research student, Alan Theobald, I estimate the stratospheric temperature variation in response to changes of the flux of solar ultraviolet radiation. *Space Research XIX* follows a similar format - and range of topics - for the proceedings of the 1978 meeting held in Innsbruck.

Space Research XX, arising from the Bangalore meeting in 1979, contains Yash Pal's welcoming address which gives his rationale

for space research, plus papers on the Earth's neutral atmosphere, the Earth's plasma envelope, planetary science (especially Venus) and astronomy. It was the tenth - and last - volume which I edited. I moved to the British Antarctic Survey, and the publication changed to become a journal, *Advances in Space Research*. As Publication Coordinator, I advised Pergamon Press on both the order of papers, and words for the covers; Peggy Shea is now the Editor of this journal.

My attendance at COSPAR meetings has been less regular during recent years. At the Toulouse meeting in 1986, however, I presented a paper with Ian Jones on the International Reference Ionosphere. Particularly memorable are the receptions at the Air and Space Museum in Washington, DC, which seems to me to be one of the best museums in the world, and at Birmingham. With Paul Craven, my research student from Cranfield University, we reported modelling work on the damage to DNA molecules caused by decelerating energetic heavy ions, work which is important to astronauts, at least.

It is clear that my interests in space have broadened considerably since 1963, and continue to do so now that I am at the International Space University - I gave a paper on its new interdisciplinary Master of Space Studies course at the 1996 Birmingham meeting.

I am most grateful for the opportunities that COSPAR has presented to me. I have greatly appreciated my discussions with four very different COSPAR Presidents - Maurice Roy, Cornelis de Jager, Sir Ian Axford and Gerhard Haerendel - and numerous Commission Chairmen. The best memories are of the friendly spirit of all COSPAR meetings, and of the generous help received from Zdzislaw Niemirowicz, Debbie Kastel and her helpers, and now from Stan Grzedzielski. I wish COSPAR continuing success in the years to come, catalysing interactions between the scientists of different nations for the benefit of all peoples on Earth.

Recollections from My COSPAR Years

Jorge Sahade
Observatorio Astronomico, Univ. Nacional de La Plata, Argentina

My first contact with COSPAR was at its Xth Plenary held in London in 1967, having been sent over by the former Argentine National Commission for Space Research (CNIE). It was most interesting to be exposed to space activities in an international forum for the first time in my life. My next Plenary was the XIIIth in Leningrad in 1970, and from then on I attended without interruption all of the Plenaries until 1980, always as a member (as President only in 1976 and 1980) of the Argentine delegation to COSPAR, representing the Argentine National Research Council (CONICET), an organization that was then contributing half of Argentina's yearly dues to COSPAR, the other half being provided by the CNIE. Then thanks to UNCOPUOS I could attend the 1982 COSPAR Plenary as a member of the Organizing Committee and a speaker at the Symposium on the 'Role and Impact of Space Research in Developing Countries'. My last 'physical' contact with COSPAR was as President of the Argentine National Commission of Space Activities (CONAE) in Washington, DC in 1992, during the World Space Congress.

Of those Plenaries, I still remember with a smile that in Leningrad the COSPAR President had a serious problem when trying to leave the Soviet Union at the end of the meeting, because he reported that he was taking out a number of guilders that happened to be one unit higher than the amount he had reported when entering the country. How did he obtain that extra guilder?

The Plenaries were always pleasant and the Resolutions that were passed at the end of each one of them reflected a forward-looking

attitude and a consensus that were always carefully pursued. For us, balloon activities were of particular interest because, in the beginning, we were carrying out experiments with such balloons at the Institute of Astronomy and Space Physics (IAFE), in Buenos Aires.

At the XVIIth COSPAR in São Paulo, Brazil, in 1973, the points being made by a few of the interested participants coming from developing countries led the President of COSPAR to establish an Advisory Panel on Space Research and Developing Countries, which would report to him and which was later replaced by the present formal Panel on Space Research in Developing Countries. I was appointed President of the Advisory Panel, a body that I left in 1979 or 1982. I still remember with pleasure the cooperation that I had with Ruth Gall, the well-known Mexican geophysicist, who was a member of the Panel. Every year the Advisory Panel would meet and propose several Resolutions that were always considered sound and, therefore, adopted by the Plenary. The establishment of the Advisory Panel by COSPAR made it clear that space activities were not an exclusive privilege of the rich countries, and that the Developing Countries could make valuable contributions to progress in the field in many ways. It was a truly enriching experience.

During my presence in COSPAR, I had the privilege of being appointed a member of what was later called the Advisory Committee on Problems on Data and Publications, of the Special Editorial Board for popular books, a project that unfortunately had to be abandoned because of the difficulties that were encountered, of the Panel on Astronomical, Galactic and Extragalactic Measurements, of the Editorial Board, and of the ad hoc Committee that was supposed to analyze the political problems associated with conducting experiments with stratospheric and high-pressure balloons. I represented COSPAR at five COSTED meetings, and I was also greatly honored by being one of the five invitees to speak at the Symposium, held in Bangalore in 1979, on Space Research and Development, in honour of the late Prof. Vikram A. Sarabhai, a pioneer and a champion of Indian space activities.

I was also given the opportunity to contribute to two COSPAR documents for UNISPACE '82, namely, those on the 'Expected future role of developing countries in space research' and on the 'Training of staff for space research'.

I enjoyed my association with COSPAR very much and felt quite at home throughout the different Plenaries. Such a long and extremely pleasant association with such a forum was highlighted by the warm friendship that was born with Cornelis de Jager and Zdzislaw Niemirowicz, the hyperactive soul of the organization until his retirement. Actually, everything and everybody, including of course the Secretaries, contributed to create a friendly atmosphere throughout.

A COSPAR Reminiscence

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The most interesting COSPAR meeting that I can recall was in Varna, Bulgaria, in 1975. At the reception given by our Bulgarian hosts, there were large dishes of food. One of these consisted of cooked songbirds about the size of an American Robin. I did not partake, but they were rapidly consumed by other guests.

On Tuesday afternoon, 2 June, the Secretary of the US Working Group decided to go into the Black Sea for a swim because it was so hot. She is an expert swimmer and she swam out to sea for a considerable distance. When she returned and emerged, she was immediately surrounded by males who jostled her. She escaped by running back to our hotel, which was only about 200 yards from the water. I asked her if she would repeat the performance the next day whilst the rest of us took pictures, but she refused to do so!

While we were there, the president of North Korea arrived for a ceremonial visit. He was escorted by eight motorcycle policemen, and the highways were closed to ordinary traffic. The stores were closed and high-school students were marched out to cheer the visitor. This served to remind us that we were in a communist country.

Adventures of a COSPAR Vice-President

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Introduction

As a scientist involved in space research from the very beginning, and a firm believer in collaborative efforts on an international scale, I had a natural involvement with COSPAR early in my career. In this memoir I present some personal recollections of a long association with the organization both as a scientist, and as an officer and Commission Chair. In particular, many of these notes relate to the 1980-1986 period, when I was a Vice-President of COSPAR.

The Committee on Space Research, as an organization under the umbrella of the International Council of Scientific Unions (ICSU), relies almost entirely on the voluntary efforts of practicing scientists for its operation. I am always impressed with the effort and time eminent scientists are willing to devote to such organizations, all for the greater good of science, and therefore humanity. COSPAR is a prime recipient of this benevolence. I have seen space research grow from a small activity supported by a group of enthusiasts, to a large endeavour in the mainstream of scientific research. COSPAR has been central to this evolution, and has similarly developed. In addition to a many-fold increase in the number of people attending its Plenaries, there has been a corresponding increase in the quality and breadth of the scientific presentations. Somehow, the scientific participation in COSPAR evolved almost independently of the official and policy part of COSPAR, which was very entangled in the East-West conflict, at least until the late 1980s.

I want to apologize at the outset for any failure to indicate contributions of individuals or inaccurate recollection of events in this writing. I did, however, rely on the personal notebooks I have a habit of keeping regarding meetings and events, and on extensive materials relating to COSPAR now archived in the Special Collections Library at the University of California, San Diego (USCD).

Early COSPAR Associations

I arrived at UCSD in 1962 soon after receiving my PhD at the University of Minnesota, to develop a programme in X-ray astronomy, which was a fledging activity supported mostly by NASA at that time. As such, I attended several IAU and COSPAR meetings which had sessions on space astronomy during the 1960s. In particular, I remember the COSPAR meeting that was held in the summer of 1965 in Argentina. This was scheduled to be held in Buenos Aires, but was moved to Mar del Plata at the last minute, because of security reasons associated with the US Marine activity in the Dominican Republic. The meeting was held in a hotel/casino which had been closed for the southern hemisphere winter, and it was several days before the building was warmed up and the organization running smoothly. I was a young scientist presenting some early results on gamma-ray astronomy from the Orbiting Solar Observatory-1 at the time. A session had been organized by S. Hayakawa, and it was one of the very first meetings on an international scale of scientists trying to develop the field.

M. Roy - Mar del Plata, 1965

Of course, most of the results presented were only upper limits on cosmic fluxes. I remember meeting many distinguished scientists and a wonderful barbecue prepared by a group of gauchos.

I also remember the Madrid meeting in 1972, where many new results in the rapidly developing area of X-ray astronomy were discussed. I presented some rather controversial results on the spectrum of cosmic diffuse X-rays and gamma-rays which had been obtained with instruments developed at UCSD. Also associated with this meeting was a fascinating day tour to the old walled city of Toledo, where El Greco lived and worked.

My first introduction to the 'officialdom' of COSPAR was at the 1976 Plenary in Philadelphia, which coincided with the bi-centennial of the American Revolution. I became a member of the Working Group 3 (WG.3), chaired by S. Hayakawa. This resulted in my involvement in planning the COSPAR Plenary to be held in Tel Aviv in 1977. I remember vividly, in the spring of that year, my first visit to the COSPAR Secretariat at 51, Bde. de Montmorency, at the Hotel de Noailles, which houses the International Council of Scientific Unions (ICSU), and associated organizations. It is an elegant building located in an up-market neighborhood, and I had only visited Paris once previously.

The XX Plenary in Tel Aviv also provided new experiences. Z. Svestka, who was then Chair of WG 3, was unable to attend that meeting because of travel restrictions, and he designated me to handle some of his duties. I remember attending a meeting of the Executive Council. My friend Cornelis de Jager was then COSPAR President, and I was completely overwhelmed by the formality of the meeting - I live and work in Southern California! A weekend tour of Jerusalem was another event forever imprinted in my mind.

I organized a Symposium on X-ray astronomy for the XXI Plenary in Innsbruck in 1978. The High-Energy Astronomical Observatory-1 (HEAO-1) had just been launched and many new results were presented. This symposium resulted in 'X-ray Astronomy', edited by W.A. Baity and myself, which became Volume 3 of the Pergamon series *Advances in Space Exploration.*

This series later led to the creation in 1980 of the regular journal *Advances in Space Research*, where Proceedings of COSPAR meetings are now published.

I also attended the COSPAR Plenaries XXII and XXIII in Bangalore and in Budapest, and was involved in High-Energy Astronomy Symposia held in conjunction with the Plenaries at both places. In particular, the Budapest symposium marked a turning point for some scientists from Eastern countries. Many of these prominent scientists, particularly from the then Soviet Union, found it difficult or impossible to attend scientific meetings outside their country. The organizing committee invited several well-known Soviet scientists to participate in a Symposium on High-Energy Astrophysics. R.Z. Sagdeev, who was then USSR Vice-President to COSPAR, urged me to write a letter to the USSR Academy of Sciences as an officer of ISC-E requesting that a selected set of astrophysicists be allowed to travel to Hungary. It worked and such luminaries as R.A. Sunyaev, Ya. B. Zeldovich and I.G. Mitrofanov, to mention only a few, were able to participate in the Budapest meeting. For several of them, it was the first time that they had left the country. This set a precedent for a very successful COSPAR-sponsored symposium on High-Energy Astrophysics and Cosmology held in the Rojan mountains in Bulgaria in July 1983.

During the period 1977-1980, considerable changes were made to COSPAR. C. de Jager was President, with appointed instructions to improve, among other matters, the scientific content of COSPAR. Apparently the US, through the National Academy of Sciences (NAS), actually considered pulling out its support around this time. I remember attending a meeting at the NAS to discuss this matter. F.S. Johnson was then US Vice-President of COSPAR, and he agreed to work with C. de Jager to initiate changes. These apparently were very difficult, considering the nature of East-West relations at the time. At least two decisions affected those of us at the working level: (a) the COSPAR Plenary was to be changed to a two-yearly instead of a yearly event, and (b) the 'Working Groups' were to be replaced by a set of Interdisciplinary Scientific Commissions (ISCs).

R.Z. Sagdeev (left), COSPAR Vice-President (USSR), presenting F.S. Johnson, COSPAR Vice-President (USA) with a model of the Venera Venus Lander, in the presence of C. de Jager (centre), COSPAR President - Philadelphia, 1976

Therefore, with effect from the Bangalore meeting in 1979, parts of WG.3 became ISC-E, 'Research in Astrophysics from Space', and I became Chair of its Subcommision E-1, 'Galactic and Extragalactic Astronomy'. S.L. Mandelstam remained Chair of ISC-E and R.M. Bonnet became Vice-Chair of subcommission E-1. The second ISC-E sub-commission included Solar Physics research. The structure of ISC-E remains the same as of this writing.

Selection of a COSPAR Vice-President

The COSPAR charter was created in 1958 to be a carefully crafted document allowing scientists doing space research from the then highly polarized Eastern and Western blocks to meet each other, exchange ideas and results, and arrange cooperative programmes. Unlike many organizations under the umbrella of the International Council of Scientific Unions (ICSU), the members of COSPAR are the scientific Academies of countries involved in space research and the sponsoring Unions. The Committee was initially organized with an 'elected' Bureau under the umbrella of

the Unions and the National Representatives. The Bureau, which was the main policy-setting and operating arm of COSPAR, consisted then of a President, two Vice-Presidents, one from each of the principal space-faring nations at the time, the US and USSR. Four additional Bureau members were elected, two from a 'slate of candidates' proposed by the USSR, and two from a similar slate proposed by the US. In practice, the two countries each appointed a Vice-President, each selected two Bureau members supportive of their views (and who could travel), and the President was agreed on by the Vice-Presidents after appropriate consultation. There were many difficult times in the over twenty years of COSPAR's existence before I arrived on the scene; others can write of this era much better than I. The COSPAR Secretariat Headquarters in Paris carried on the day-to-day operations of the Committee, oversaw the organization of the Plenary, including the collection of abstracts, prepared meeting reports and mediated many East-West differences.

The National Academy of Sciences (NAS), which is advisory to the US Government and NASA, is the US official member of COSPAR. The internal organization in the NAS responsible for COSPAR is the Space Science Board (SSB, presently called the Space Studies Board), which consists of appointed active scientists representing a broad view of US space science activities. NASA employees are not permitted to be members, because of the possible conflict of interest. The US representative to COSPAR, appointed by the Space Science Board, automatically became the US Vice-President to COSPAR. This arrangement held until about 1992, when the COSPAR Charter was modified to reflect the realities of the changing political World.

I had been a member of the SSB since about 1978; when Frank Johnson was the US COSPAR Vice-President. As such, he routinely gave a report to the SSB on COSPAR activities. I remember one somewhat contentious meeting of the SSB where the role of the US in COSPAR was fiercely debated. After the meeting, going back to California, I happened to be on the same airplane as Fred Scarf and Charlie Kennel, also SSB members. After a few drinks we got into a discussion about COSPAR, and

apparently I voiced some ideas about how the organization could be changed, partially unaware of its long history. Shortly thereafter, in 1979, Frank Johnson had to resign as US representative because he accepted an administrative position in the National Science Foundation. Al Cameron, then Chair of the SSB, appointed a small committee to select a new representative. Unfortunately, Charlie Kennel was on the committee, and somehow I got recommended for the job. I took over from Frank Johnson after the 1980 Budapest COSPAR Plenary. I have since learned to chose my airplane drinking companions more carefully!

The Vice-President Years

The work of a COSPAR officer is not possible without staff support. I had known Dean Kastel, Secretary of the SSB, and Dick Hart, one of the programme officers, for many years. Dean Kastel was the liaison officer between the SSB and COSPAR and was familiar with the history of COSPAR and its entanglement with East-West relations. Dick Hart soon became his close assistant in the area of the international relations activities of the SSB. We formed a good working team during my years as Vice-President and had many enjoyable working and social dinners in Washington, Paris and in various COSPAR meeting cities. It was also a privilege to work with Z. Niemirowicz, Executive Secretary of COSPAR and the Paris Secretariat. We worked particularly closely during the preparation of the Ottawa meeting.

R.Z. Sagdeev had been the Soviet Vice-President for a number of years before 1980, and he wanted to make COSPAR a more open organization, and to improve the scientific content. I knew him from COSPAR Plenaries before Budapest, and from the various meetings of the programme committees, and furthermore we had a number of common scientific interests. I regard him as one of the great scientists I have had the pleasure of working with, even if mostly in a programmatic capacity. The tradition was that the US and Soviet Vice-Presidents alternated as Chair of the Scientific Programme Committee; Sagdeev had this function for the Budapest Plenary, so it was my task to organize the 1982 meeting scheduled for Ottawa.

Since this was the first Plenary on the two-year schedule, whole new procedures had to be worked out. Furthermore, I had also set as my primary goal to improve the scientific content of the meetings. Traditionally, the two-week COSPAR Plenary had been divided into two parts; the first week was a series of symposia co-sponsored by the various adhering Unions, and the second week, scientific and business meetings of the COSPAR Working groups. The scientific strengths of Plenaries was largely in the Symposium week. The Working Group meetings were often poorly organized and attended, with talks given by people who could travel, but were often not familiar with the scientific and technical details of the work. Starting with Budapest, the Symposia and meetings of the ISC's became intermingled over the two-week period. I regarded the key to having a good scientific meeting was to attract high-level invited speakers, and I remember working hard with the individual session organizers to this end.

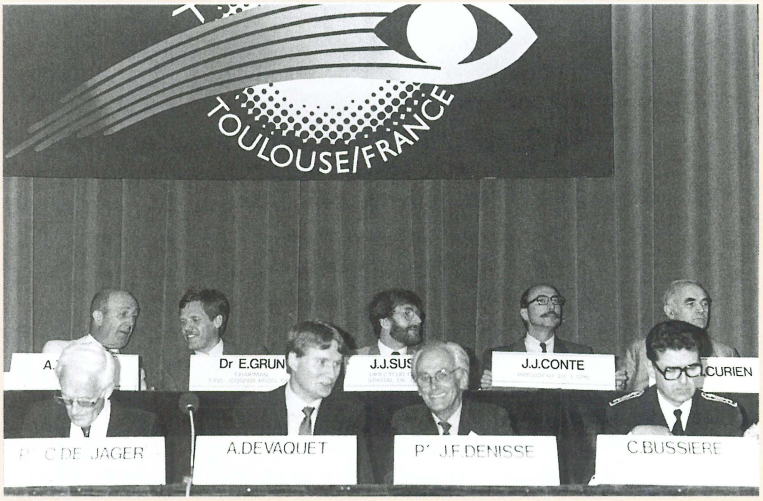
I also developed a fine working relationship with J-F. Denisse, who was President during my first term. I had a cooperative scientific project with some French scientists and was appointed by the SSB to liaison with the European Science Foundation Space Science Committee, then chaired by J. Geiss. Both activities took me to Europe and Paris three or four times yearly, and I always managed to find a day or so to work with the Secretariat and Prof. Denisse on COSPAR matters. I have very good memories of pleasant dinners with Denisse in the Latin Quarter, discussing COSPAR and other matters over food and wine.

Preparation of the Ottawa meeting was a very intense time because of the conversion from the one-year to two-yearly format. I had spent the spring of 1982 on sabbatical leave from UCSD to the Institute d'Astrophysique in Paris, which allowed me to work closely with the Secretariat. I found myself rather exhausted at the meeting. For relaxation, I do remember a wonderful reception put on by the Canadians, and a number of dinners with interesting people. One of the conclusions I drew from the Ottawa Plenary meeting was that it was inappropriate for a COSPAR Vice-President to also be a Programme Chair. I felt Bureau members should devote themselves to policy and administrative matters, so

Left to right: N.S. Kardashev, V. Migulin and R.Z. Sagdeev - Graz, 1984

I recommended that an independent Scientific Programme Chair be designated for the next Plenary. The Bureau accepted this idea, and E. Grün was appointed to organize the meeting in Graz in 1984. He did such a commendable job at this task that he was also recommended to organize the meeting at Toulouse in 1986. The appointment of an independent Programme Chair has now become a firm COSPAR tradition.

One of the serious East-West issues during my early tenure as Vice-President had to do with planning cooperative activities in space for the Comet Halley perihelion in March 1986. COSPAR was the obvious organization to initiate the scientific cooperation between the space agencies on various potential missions. A carefully worded resolution was presented at the Budapest Plenary which urged cooperation, and constituted an ad hoc COSPAR committee under J. Blamont to provide a forum for discussion. The various National agencies were very protective of their turf, and somewhat secretive about their plans. At a meeting of the Blamont Committee in April 1981, scientific representatives



Front row, left to right: C. de Jager, A. Devaquet, J.F. Denisse and C. Bussière. Back row: A. Turka, E. Grün, J.J. Sussel, J.J. Conte and H. Curien - Toulouse, 1986

R.M. Bonnet (left) and D. Baudis - Toulouse, 1986

of ESA, Japan, USSR, and the US met to discuss plans and collaborations. As the meeting unfolded, the ESA planning for the Giotto mission became clear, as well as the Japanese plans. The US had to reveal they had no plans for a major mission, since such activity, although seriously proposed to NASA, was not supported by either the administrations of President Carter or Reagan. At the end, Roald Sagdeev revealed the Soviet plans, based on a modified Venera mission. Out of this meeting came the framework for scientific collaborations and ESA took the lead in forming the Inter-Agency Consultative Group (IACG). The rest is history; the encounter was very successful, three spacecraft passed close to Halley and hundreds of scientists around the World were involved. The US contributed scientists, instruments, and the use of the deep-space tracking network (DSN).

Another issue was the appointment of a President following the end of the term of J-F. Denisse in 1982. No obvious candidate seemed to be both acceptable and willing, so it was agreed to ask Kees de Jager, who had served so well in the trying times of the late 1970s, to serve again, this time for a four-year term. The terms of the President and Bureau member were changed from three to four years in about 1980, so elections could coincide with the two-yearly Plenaries. De Jager agreed and assumed office at the end of the Ottawa meeting. Roald Sagdeev stepped down at that time, and N. Kardashev became the USSR Vice-President. I was re-appointed for a full four year term. After 1982, Kees initiated a regular series of telephone conferences on issues between himself, the Vice-Presidents, and the Secretariat. These would be scheduled late in the day European time and I would receive these calls at home around six or seven a.m. in San Diego. This worked wonderfully and smoothed lots of potential mis-understandings, despite the fact I am hardly a 'morning type'!

Another matter which generated considerable discussion and debate at Bureau level was the idea of awards and medals. I think Kees de Jager raised the issue: Why doesn't a mature organization like COSPAR have a series of medals to present to individuals for exemplary scientific or programmatic contributions to the goals of the organization? Three awards were decided on: an award for

International Cooperation in Space Research, a COSPAR Space Science award for contributions to space science, and the William Nordberg medal for applications of Space Science. K. Serafimov of Bulgaria volunteered to have his Space Research Center in Sofia design and produce the International Cooperation and COSPAR Space Science medals. I was asked to oversee the Nordberg Medal, which was named after a recently deceased NASA scientist who made many contributions to meteorology and atmospheric physics, and was very active in COSPAR. I took one of the Serafimov's medals as a model, asked an artist to design a similar medal based on a photograph of Nordberg, and had the NASA/Goddard Space Flight Center produce the medal. It was unveiled in a ceremony at Goddard in the Spring of 1988, with Nordberg's family present. The International Cooperative and COSPAR Space Sciences medals were first awarded in Graz in 1984, and the Nordberg Medal in Espoo in 1988. Many additional COSPAR-sponsored medals have been commissioned as of today.

The unique arrangement of two rather powerful Vice-Presidents, one from the US and one from the USSR, essentially determining the officers and directions of COSPAR existed for nearly twenty-five years. Around 1982, however, the emerging power of European and Japanese Space Science, together with demands from Developing Countries, required a change. East-West tensions had also begun to relax, and particularly due to the efforts of R.Z. Sagdeev, the Eastern countries in COSPAR were more open and forthright in their relations with the West, and therefore with COSPAR. Accordingly, under Kees de Jager, constitutional changes for COSPAR were openly discussed by the Bureau. By the Toulouse meeting in 1986, several modifications were agreed on. The Bureau would be increased from seven to nine members, with the extra two to be elected from a slate of candidates proposed by the President. The two Vice-Presidents each continued to propose a slate for the remaining positions. Therefore six members had to be elected from the three proposed slates, and it was agreed each slate would contain the names of at least four candidates. Furthermore, it was agreed upon that the President would be elected from candidates proposed either by the Vice-Presidents or the Executive Council.

The first true election took place at the Toulouse meeting. J. Blamont was proposed as candidate for President by both Vice-Presidents; I. Axford was nominated by a member of the Executive Council, and there were candidates from the three lists for the Bureau positions. Democracy in action! Axford was elected President; and I remember the feeling of power the Union and National representative felt after that watershed event in COSPAR's history. Later, after the collapse of the Soviet Union in the early 1990s, even more changes were made and now every Vice-President is elected, and there is a Nominating Committee for the President and the Bureau. COSPAR was not ready for that step in 1986.

COSPAR, as a Scientific Committee of ICSU, is organized under the auspices of the Unions comprising ICSU. Because much of the scientific research covered by COSPAR overlaps the activities of the various Unions adhering to COSPAR, conflicts of various nature arose. These were to be negotiated by the Union representatives to COSPAR, and members of the ISCs appointed as a liaison function. The sensitivity to COSPAR activities within the related Unions varied from Union to Union, and with the personalities involved. It was my experience that the International Astronomical Union (IAU) was particularly sensitive to COSPAR symposia and meetings which overlapped regular Union events. In principle, symposia were co-sponsored by a relevant Union, and a COSPAR commission meeting was an independent event. I found that conflicts with the IAU were often dependent on the views of the IAU General Secretary. It seemed re-negotiation of principles was a constant activity for me during the period when I was either on a Commission or a COSPAR officer. Finally a written agreement between the IAU and COSPAR was approved at the Washington meeting in 1992. I hope the issue is settled; good will on both sides is the primary ingredient.

I had gone on leave from UCSD to NASA Headquarters in January 1986, so special arrangements were made for me to continue my term through the Toulouse Plenary. The SSB then elected H. Friedman to be the US national representative, and therefore a COSPAR Vice-President. Herb, who had made

enormous contributions to space astronomy while at the US Naval Research Laboratory (in fact I regard him as the father of Space Astronomy), had also been a previous COSPAR Vice-President. He had been one of those who steered the organization through many earlier difficult times. My tenure as a COSPAR Vice-President terminated at the Toulouse Plenary in July 1986.

Life After the Vice-Presidency

I had no official position in COSPAR during the 1986-1988 period due to my commitments at NASA, but did attend the 1988 COSPAR in Espoo, Finland to present a paper. I then found my official connection with COSPAR was not quite over. First, I was elected to Chair Commission-E, which I did until 1994 in Hamburg, when I was succeeded by Len Culhane. These were more pleasant years. I had found that the Plenaries where I was Vice-President were rather demanding, with little opportunity for other than meetings, official dinners, receptions and the necessary time for homework. I gave very few scientific talks at COSPAR meetings in the 1980-1986 period. I also missed the associated tours and the relaxed evenings with friends. But, the opportunity to present papers and truly enjoy the scientific meetings came back after 1988.

The second 'opportunity' for further service to COSPAR came at Espoo. Under a suggestion first proposed by the US Congress, plans were laid for a world-wide celebration among the World's space-faring nations in 1992. Called the International Space Year (ISY), it would celebrate the 500th year of Columbus' voyage to America, and the 35th year after the International Geophysical Year, which ushered in the Space Age. COSPAR was asked by the Space Agency Forum for the ISY (SAFISY) to form a 'Panel of Experts' on Space Science, and organize activities in that area. I was asked by Ian Axford to chair the Panel and organize the efforts. Although no specific programme funds were allocated, travel and administrative monies were available through NASA and various other agencies. The efforts were primarily on-going programmes which were given an ISY focus and a special public-

relations emphasis. A series of meetings of the Panel of Experts was organized, and we reported to the main SAFISY, which was Chaired by H. Curien of France. The COSPAR Panel and SAFISY met in many different cities, among them Moscow and Kyoto. The final meeting of the Panel was held in Washington, DC at the 1992 Joint IAF/COSPAR Plenary where the many results of the 30 or so projects were presented.

Acknowledgements

I want to acknowledge many outstanding scientists and administrators not mentioned here whom I have known and hopefully served during my years of association with COSPAR. I particularly want to recognize the association with D. Kastel and R. Hart of the Space Science Board, and Z. Niemirowicz and all in the COSPAR Secretariat, without whose cooperation my work with COSPAR would not have been possible. I also want to recognize the essential help competently and generously given by my secretary at UCSD, Cheryl Matson. The work in COSPAR has defined a certain portion of my life, which I feel has been most rewarding. Finally, it was through my activities at COSPAR that I met the woman who is now my wife. I owe a lot to COSPAR!

COSPAR During the Period 1986 - 1994

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COSPAR was formed as a 'Special Committee' at the General Assembly of ICSU in October 1958. This was a reaction to the launch of the first Sputnik in October 1957 and was supported by the IGY Committee at its meeting in Moscow in August 1958 and by the United Nations Organization and UNESCO in particular. The essential reason for this rather abrupt action was that there was a fear that in the Cold War era, space would become over-politicized and its peaceful and scientific aspects would be neglected.

As a consequence of the peculiar nature of its conception, COSPAR developed some quite unique characteristics. As a Committee it ranks below the Unions comprising ICSU and is reviewed periodically by ICSU with respect to its performance and continuing existence. COSPAR has observer status at meetings of the UN Committee on the Peaceful Uses of Outer Space. The original Charter of COSPAR gave special status to the two major space powers, the USA and the USSR, represented by their Academies. These two countries provided much of the financial support, were each represented by one of the two Vice-Presidents, and they controlled nominations to the COSPAR Bureau. Despite these peculiarities, COSPAR functioned rather well during the first 30 years of its existence until the Cold War ended around 1990. It then became necessary to anticipate the changes that might be required in the organization and to respond positively in the interests of science. This was the main task of the Officers and Bureau during the period 1986 to 1994.

Left to right: M. Tiuri, G. Mueller, H. Curien and W.I. Axford - Espoo, 1988

The meetings of COSPAR, which were held annually until 1980 and biennially thereafter, were originally devoted mainly to administrative and quasi-political matters and the introduction of resolutions, which would be forwarded to the relevant Space Agencies and others. Science made an appearance in sessions entitled 'Latest Results', this being appropriate at a time of expanding horizons when several new missions were being launched each year. More general scientific sessions gradually appeared in the form of 'Special Symposia', which were loosely associated with the formal programme, usually taking place either before or after the formal meeting. The proceedings of these scientific sessions were published in book form and later, as the contents became too large, in a series of paperback volumes entitled *'Advances in Space Research'*.

During the first decade COSPAR meetings were quite grand affairs, not only because there were the latest scientific results to report, but also because the two most important members habitually sent their astronauts and cosmonauts, creating great interest in the host countries. However, after the Apollo era the situation changed and this custom declined, perhaps because space flight had become more routine and those involved were relatively anonymous. During the 1970s, when there were fewer very exciting missions and developments to report, interest and participation seemed to drop and this was the main reason for the change to biennial meetings. The situation changed again in the 1980s as the results from the Voyager mission to the outer planets became available and, especially, with the encounters with Halley's Comet when, for the first time, there was a very substantial contribution from countries other than the USA and USSR. Since then COSPAR has grown in terms of meeting size, and interest in its activities has increased.

With the growth of the space programmes of Europe and Japan in particular, and also with the end of the Cold War, it was necessary to make changes in the organization and the manner in which it carries out its business. In effect, a swot analysis (strengths, weaknesses, opportunities, threats) was carried out and a small committee was set up to devise appropriate reforms. In particular, a committee chaired by Prof. Antal Somogyi re-wrote the Charter and By-laws in such a way that it became more flexible and, in some sense, more democratic. With the agreement of the USA and USSR, the special status of these two leading space powers with respect to the Vice-Presidents was put aside and the rules concerning nominations to the Bureau were relaxed and became much less politicized. This has not necessarily led to the Officers and Bureau members being better, but it has given the COSPAR community a feeling that the organization as a whole is much more open and transparent.

The new Charter had to be approved by ICSU and its members. This gave rise to some concern since, at the same time, COSPAR had also to undergo one of its periodic reviews as a non-permanent Committee of ICSU. Since URSI (radio-science), IUGG

(geophysics) and IAU (astronomy) have overlapping interests with COSPAR, there was a certain degree of tension and a need for good diplomacy. Prior to the late 1970s there was no great difficulty in this respect since URSI was turning away from its earlier emphasis on 'natural' radio-science (which included ionospheric and magnetospheric physics), IUGG had not yet extended its domain to include the heliosphere and the planets and space astronomy was only beginning to develop, so that the IAU was dominated by ground-based astronomy. However, by the 1980s the IUGG was concerned to protect its newly-found interests, which led to the requirement that COSPAR should keep to a two-year cycle and not interfere with IAGA meetings in particular. Similarly, there was continual friction between COSPAR and the IAU concerning symposia on the results of space astronomy, and there always had to be an agreement concerning the content of the programmes of COSPAR meetings in this respect. Nevertheless, COSPAR survived the threat of being discontinued, perhaps because it was clearly thriving and well-organized and also because of its successful diplomacy which suggested that the political reasons for its existence remained to a large extent valid. The new Charter was simultaneously approved by ICSU.

The strengths of an organization such as COSPAR are mainly associated with the willing participation of scientists in its meetings. The new arrangements have emphasized this by trying to make scientists who attend the meetings feel that they 'belong' to COSPAR in some sense. This is not easy in an international organization whose formal members are in fact national bodies such as Academies of Science. However, by creating COSPAR 'Associates' this has been achieved in principle at least. No membership fees are required (they would be too difficult to administer in any case), and to become an Associate it is sufficient to have registered an interest in COSPAR by attendance at its meetings. All Associates are listed in the COSPAR Directory, and they also receive personal copies of the COSPAR Information Bulletin without payment. In this way, it is possible to keep a large group of interested people informed about the activities of COSPAR while definitely giving them the sense of belonging to the organization.

Although COSPAR meetings are held biennially and at widely-dispersed locations, it has been possible to maintain a high level of participation. The number of attendees has increased steadily during the past decade, and it is now not unreasonable to expect an attendance of 1500-2000 at any meeting, even in relatively expensive and distant places. A serious attempt has been made to tighten up the organization of the meetings and to make them attractive to the participants. The length of the meeting has been reduced to one week, which has the advantage of reducing local costs and encouraging attendees to remain for the full duration. The two-week meetings that prevailed until 1990 were in fact a heritage of earlier times when politics and diplomacy rather than science were paramount, and the scientific symposia were considered as 'add-ons' to the main meeting. A ballot held at the Birmingham meeting confirmed that this was the preferred option, and it would appear that future meetings will be kept to one week. This will require good organization, but COSPAR is certainly capable of providing it by one means or another.

It is unlikely that the meetings will ever again be held annually, which is a slight disadvantage in terms of maintaining contact and interest. Furthermore, it is becoming increasingly more difficult to arrange to have meetings in smaller countries. For these reasons, the concept of specialized COSPAR 'Colloquia' has been introduced, so that small meetings (with typically 50 - 200 participants) can be held regularly at a variety of locations. For such Colloquia COSPAR provides publicity (mainly through the COSPAR Information Bulletin), a means of publication for the proceedings (the COSPAR Colloquia Series published by Elsevier Science) and a small financial contribution towards the organization of the Colloquium itself. The result has been a series of successful small meetings in places where it is unlikely that a COSPAR meeting would otherwise take place, and a corresponding enhancement of interest in the activities of COSPAR generally.

Paying respect to the contributions of its scientists is an important component of an organization such as COSPAR. During the past few years, the number of awards available for distribution at

COSPAR meetings has increased noticeably with the addition of the Massey, Sarabhai and Zeldovich awards. This has helped deal with something of a backlog, which has arisen because there has been a lack of awards previously in this relatively new field. It is especially fortunate because many of the leading figures of the golden era of space research are approaching the ends of their careers and might otherwise leave the scene before their contributions could be recognized.

The publications of COSPAR include the *COSPAR Information Bulletin*, *Advances in Space Research*, and the *COSPAR Colloquia Series* already mentioned. These publications are not intended primarily as profit-making enterprises. However, they have become valuable assets which contribute significantly to COSPAR's income. They are important also for other more scientific reasons, and it is therefore necessary to ensure that they remain in the hands of COSPAR and are run as efficiently as possible. Scientific publication has never been more difficult than it is today, and with fewer but larger players demanding steadily increasing profits, it is not going to be easy in future to maintain a publication policy which is sound from the point of view of the COSPAR Associates and space science as a whole.

Financial problems recur continually. The membership fees required of countries wishing to belong to COSPAR have been increased occasionally, but usually lag behind inflation and real costs. The internal financial problems which are now being suffered by the former Soviet Union and several other countries have given rise to a threatened loss of income for COSPAR which may be difficult to overcome, but it must be faced. One of the strengths of COSPAR lies in the fact that it has a permanent office and staff in Paris, one of the few ICSU bodies to so do. This is a major cost, but one which should be carried if it is at all possible. However, there are probably savings to be made and as a first step it will be important to formulate a detailed business plan to ensure that all costs are justified and can be met. In particular there is a case to be made for a clear separation of the internal administrative costs of COSPAR and its Bureau on the one hand, and the costs of meetings on the other.

The future of COSPAR ought to be assured on the basis of the success of the importance of space science and the effectiveness of the organization but, unfortunately, there are other forces at play. Not only has the end of the Cold War caused financial hardship to a number of countries, but it has also led to a downturn in the level of activities in the field of space science in every country. This is a serious threat, but with vision and careful planning it should be possible to overcome it. The value and importance of international organizations such as COSPAR is as great as ever, and we must do everything possible to ensure its good health and survival into the next millennium.

The Revision of the COSPAR Charter

R.R. Daniel
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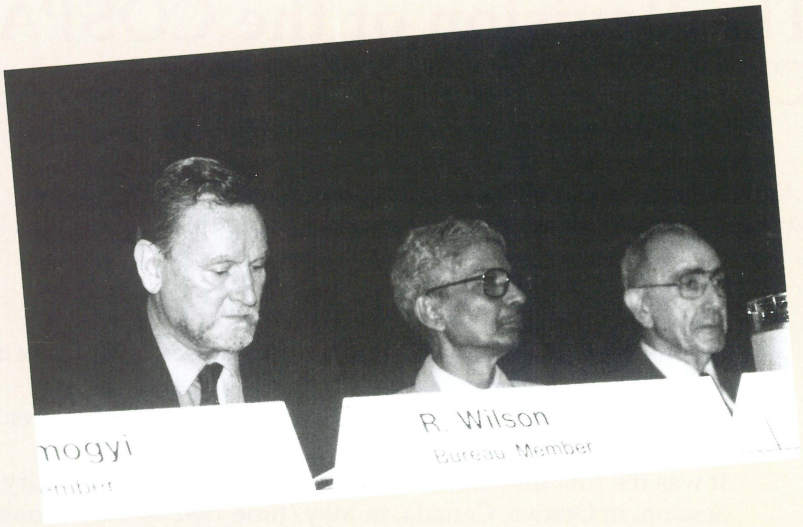
Members of the COSPAR family may be interested to know about an incident that took place way back in 1982 and which subsequently led to a major revision of the COSPAR Charter.

It was the first time that I had attended the COSPAR Plenary Session, in Ottawa, Canada, in May/June 1982 as the national representative of the Indian National Science Academy, a National Scientific Institution Member of COSPAR. In Ottawa, whilst preparing for the meeting of the COSPAR Council, it came to my attention that the COSPAR Bureau had an unusual composition and structure in which the President was nominated jointly by the US National Academy of Sciences and the (erstwhile) USSR Academy of Sciences, one Vice-President was nominated by the US Academy and the other by the USSR Academy; and of the other four members, two were nominated by the US Academy and two by the USSR Academy. The rest of the contributing National Members of COSPAR had neither a role nor any power in constituting the Bureau, which was strangely different from any ICSU Interdisciplinary Scientific Committee. Being much surprised by this, I pointed it out in the business meeting of the COSPAR Council, which consisted of the President, representatives of COSPAR National Members and concerned representatives of the International Scientific Unions of ICSU. To my great surprise, there was a long uneasy silence in the room. Then, Sir Harrie Massey, the distinguished UK representative and a founder member of COSPAR, stood up and cryptically remarked that he shared the Indian concern and suggested the matter for further consideration. Thereafter, Prof. J.F. Denisse,



Left to right: R. Wilson, R.R. Daniel and H. Friedman

then President of COSPAR, announced briefly that the matter would be discussed by the Bureau and closed the discussion for the time being.

I do not know what transpired at the Bureau meeting, but it is clear from what followed that the Bureau acted quickly and without delay. At the Graz Plenary in 1984, under the Presidency of Prof. C. de Jager, the first revision to the Charter was formally approved. The revision retained the earlier procedure of inducting the President, two Vice-Presidents and four members, but required that at least two candidates be presented for each available position. But importantly, the membership was increased from four to six, with the two additional members to be selected in a democratic manner from among all of the members. Prof. K. Hirao of Japan and I were privileged to be selected as the two additional members of the Bureau. I might also record that both of us served as members of the Bureau for two terms.

Furthermore, I was selected to serve as the Chairman of the reconstituted COSPAR Panel on Space Research in Developing Countries for two terms.

COSPAR kept the ball rolling and a second revision of the Charter was adopted at the Washington Plenary in 1992, under the Presidency of Prof. W.I. Axford. Under this revision, all positions including the President, two Vice-Presidents and six members are to be selected through democratic procedures. A very happy ending!

It might be appropriate here to recall the background to the first Charter. The first Earth satellite Sputnik-1 was successfully orbited by the USSR in 1957, when the USA and the USSR were the two superpowers in space technology. When, therefore, the Committee on Space Research (COSPAR) was established by ICSU at the close of the most successful and rewarding International Geophysical Year 1957-58, the COSPAR Charter seems to have been drafted reflecting the USA - USSR supremacy in space. But the interesting thing to note is that it took 26 long years for the first revision, in spite of major developments in the space capabilities of many other countries in the World in the meantime.

It is a great pleasure for me to acknowledge here the privilege and pride of working for and participating in COSPAR programmes and activities for many years, in the most friendly atmosphere of the international COSPAR family.

COSPAR and the Preservation of Near-Earth Space in the 21st Century

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As COSPAR approaches the 21st Century it is important to recognize that one of its goals must be support for the preservation of near-Earth space in order to protect basic and applied research, man in space and commerce. My following remarks are drawn mainly from my thoughts on this subject[1].

We know that the space-faring nations are introducing man-made debris (extending in size from dust particles to rocket casings) in ever-increasing quantities into the space around Earth. Within the next decade or two the almost exponential increases in the amounts of these materials will present serious hazards for the survival of spacecraft, space stations and astronauts occupying near-Earth orbits [1-4]. Radiation from radioactive materials and particles will gradually close important windows for astronomical observations. In contrast to the efforts to provide solutions to some of our environmental problems, which benefit some nations but not others (e.g. reduction in use of fossil fuels), in the case of the preservation of space all nations are beneficiaries of a solution - there will be no loser nations now or in the future, whether or not they are active in space. This factor will be important in negotiating any international agreement for the control of orbital debris. At a time when all nations perceive that preservation of space is in their own best interests, it is important for those most concerned - those nations with active space programmes - to take immediate steps towards such an international agreement.

J. Simpson (left) and W.I. Axford - The Hague, 1990

Personally, I find encouragement from the legacy of the International Geophysical Year for attempting to develop an international agreement on near-Earth space. As one of the twelve organizers for science programmes (cosmic physics and space sciences) for the sixty-eight nations of the IGY (1957-1958) I found, as did others, that the preservation of our last continent, Antarctica, was high on the list of IGY's achievements. The first Antarctic Treaty was completed in 1959. Its recent renewal was a reaffirmation of the overriding concerns of nations to avoid damaging exploitation of the continent. Another, more restricted example which avoids damaging exploitation is the third United Nations Convention on the Law of the Sea (1982): See also Appendix 1.

With these successes in mind, I am convinced that an effective international agreement could be achieved for near-Earth space and that we should strive for an international agreement or treaty.

It is vital to recognize that any effective effort in this direction must include both civil and military participation. It also should be interdisciplinary so as to consider not only the technical aspects, but also economic factors, legal issues[1,5,6,] and international cooperation for future civil and military uses of space.

Beginning with defining the problem and projections for the future, there are many publications that review the impact of space debris and radioactive material in space for future human exploration, for the space sciences (mainly X-ray and gamma-ray astronomy), for commercial applications, and for military uses of space.

The solutions for the preservation of the near-Earth space environment must be cost-effective over the long term and within the capabilities of the poorer space-faring nations. It is vital to decide on cost vs. benefits, and economic and insurance incentives.

The international legal issues concerned with establishing a framework for a world-wide solution to this space problem, respecting the rights of individual nations, must be addressed. We have precedents, for example, in the Antarctic Treaty and more recently for the control of atmospheric pollution (e.g. the ozone layer). Lessons learned from environmental treaty making must be studied (see Appendix 1).

The regulation of orbital debris, including the effects from nuclear reactors in space, will depend upon alternate policy choices - namely, multinational, national, or laissez-faire concepts.

What should be the elements of an international agreement? A framework treaty must recognize the importance of enforcement and of resolving disputes.

The need for additional measurements of space debris is critical. NASA, the Department of Defense and ESA, among others, are already working to develop policies and actions for minimising debris. However, the call for more measurements and modelling[1,7-10] should not inhibit forward movement towards an international agreement. Too often, governments use a ploy of more and more study, instead of action.

If COSPAR establishes a blueprint or framework convention, will governments use it as a guide? Least understood is how to address the question of identifying a suitable international agency capable of embracing and carrying forward an international agreement and monitoring it.

In writing about his trip to the Antarctic, Walter Sullivan (New York Times Magazine, 1 November 1992) noted:

"Because of international provisions against degradation of Antarctica's pristine beauty, all elements of the camp had to be removed in June when the Akademik Fedorov and the Nathaniel B. Palmer (the Russian and American ice-breakers) reached the flow as it drifted toward the South Atlantic. Tin cans were stamped flat and bottles saved. So were garbage and non-burnable waste."

Can we establish equally effective international provisions against the degradation of near-Earth space?

Appendix 1

United Nations (UN) Treaties (2)

In the past, international space laws have been created under the auspices of the UN Committee on the Peaceful Uses of Outer Space (COPUOS). To date, three treaties with potential relevance to orbital-debris issues have entered into force:

- the Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, including the Moon and Other Celestial Bodies, October 10, 1967 (the Outer Space Treaty);

- the Convention on International Liability for Damage Caused by Space Objects, September 1, 1972 (the Liability Convention); and
- the Convention on Registration of Objects Launched into Outer Space, September 15, 1976 (the Registration Convention).

Although these three UN treaties deal with some of the issues raised by the presence of orbital debris, many other debris-related issues are not addressed. For example, the treaties do not address the potential need for measures to reduce the creation of new debris. (The only reference that may be applicable is Article IX of the Outer Space Treaty, which calls for 'consultations' if member states believe activities or experiments would cause potentially harmful interference with other space activities). In addition, some of the issues that are raised in the treaties are difficult to apply to debris. For example, the liability convention assigns liability based on ownership of the objects involved, but the origin of the vast majority of debris objects that are not catalogued cannot be determined. Even where the treaties may be applicable to debris issues, interpretation is often difficult because the legal definitions of 'space debris' and 'space objects' are not entirely clear.

Expectations still exist that the UN may eventually create formal rules regarding the creation of orbital debris.

A number of activities outside the UN may affect future laws and policies on orbital debris issues. These include efforts by such organizations as the International Telecommunications Union, the IAA, the International Law Association, the NIADC, and others.

Some Recent Books, Reports, and Collections of Papers on Space Debris

1. Preservation of Near Earth Space for Future Generations, Ed. J.A. Simpson, Cambridge University Press, UK, 1994.
2. Orbital Debris: A Technical Assessment, Committee on Space Debris, National Research Council (US), National Academy Press, Washington DC, 1995.

3. Space Debris, Ed. W. Flury, Advances in Space Research, 19, No. 2, 1997.
4. Protecting the Space Shuttle from Meteoroids and Orbital Debris, Aeronautics and Space Engineering Board, National Research Council, National Academy Press, Washington DC, 1997.
5. Space Debris: Legal and Policy Implications, Baker, Howard A., Utrecht Studies in Air and Space Law, 6, Kluwer Academic Publishers, Dordrecht/Boston, 1989.
6. Position Paper on Orbital Debris, International Academy of Astronautics, Paris, 1995.
7. Orbiting Debris: A Space Environmental Problem, Congress of the US Office of Technology Assessment, OTA-BP-ISC-72, US Govt. Printing Office, Washington DC, 1990.
8. Proceedings of the Second European Conference on Space Debris, ESOC, Darmstadt, Germany, Eds. B. Kaldeich and R.A. Harris, ESA SP-393, 1997.
9. Cosmic Dust and Space Debris, Proceedings of the Topical Meetings of the COSPAR Interdisciplinary Scientific Commission B (Meetings B1 & B2) and of Workshop VI of the COSPAR Twenty-sixth Plenary Meeting, Toulouse, France, Eds. J.A.M. McDonnell, M.S. Hanner, and D.J. Kessler, Pergamon Press, Oxford/New York, 1987.
   (a) LDEF - 69 Months in Space: First Post-Retrieval Symposium, Space Environments: Meteoroids and Debris (Part 1, pp. 399-594), NASA Conference Publication CP-3134, 1991.
   (b) LDEF - 69 Months in Space: Second Post-Retrieval Symposium, Space Environments: Meteoroids and Debris (Part 2, pp. 277-724), NASA Conference Publication CP-3194,1993.
   (c) LDEF - 69 Months In Space: Third Post-Retrieval Symposium, Space Environments: Meteoroids and Debris (Part 1, pp. 255-535), NASA Conference Publication CP-3194, 1993.

Recollections of COSPAR

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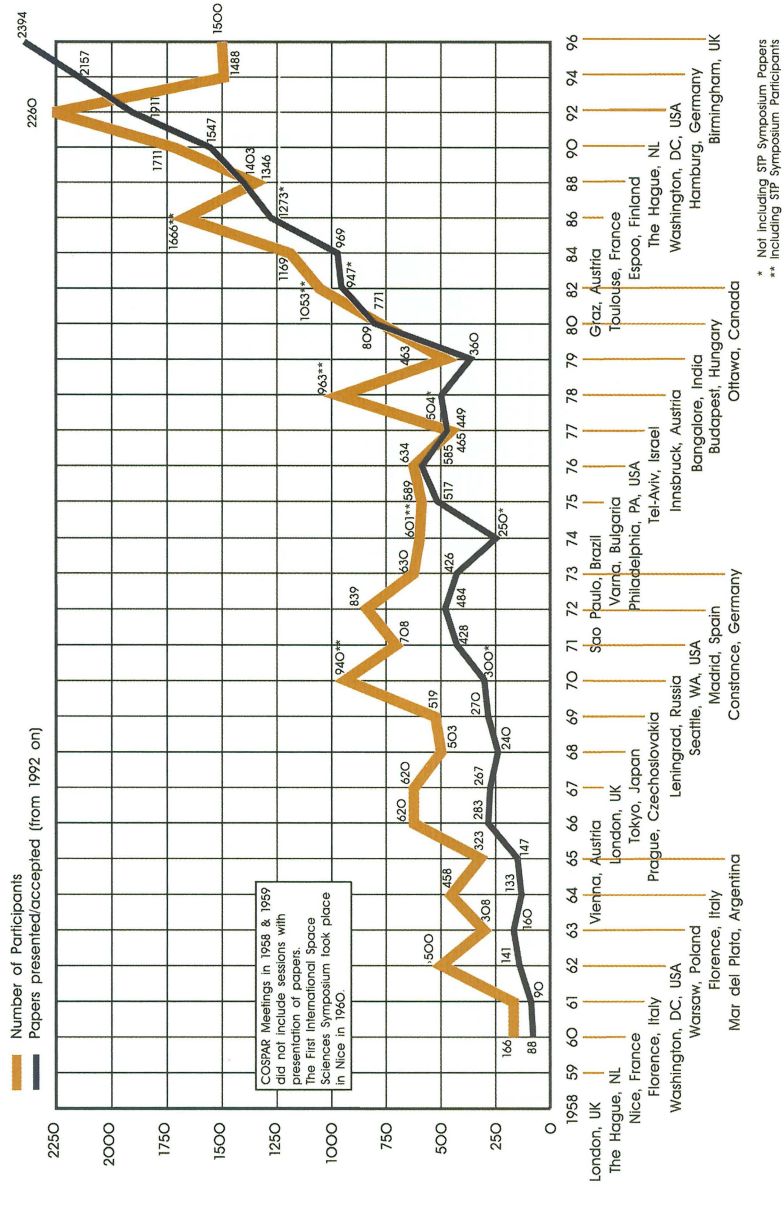
COSPAR is a community of scientists, with personal friendships that go back for 40 years or more. Its committee activities and publications provide authoritative information to scientists around the globe. More than a scientific focal point, it has also become a place to meet old friends and collaborators.

COSPAR started in the early years of artificial satellites, at a time when my personal research was concentrated on cosmic rays and upper-atmosphere physics, the magnetosphere and trapped radiation. But COSPAR serves much broader scientific interests, and gradually I moved into some of these. For me, it has now become a good meeting place for the science of planets, planetary atmospheres and satellites, meteorites, comets, and interplanetary dust, and for climate studies involving our own planet.

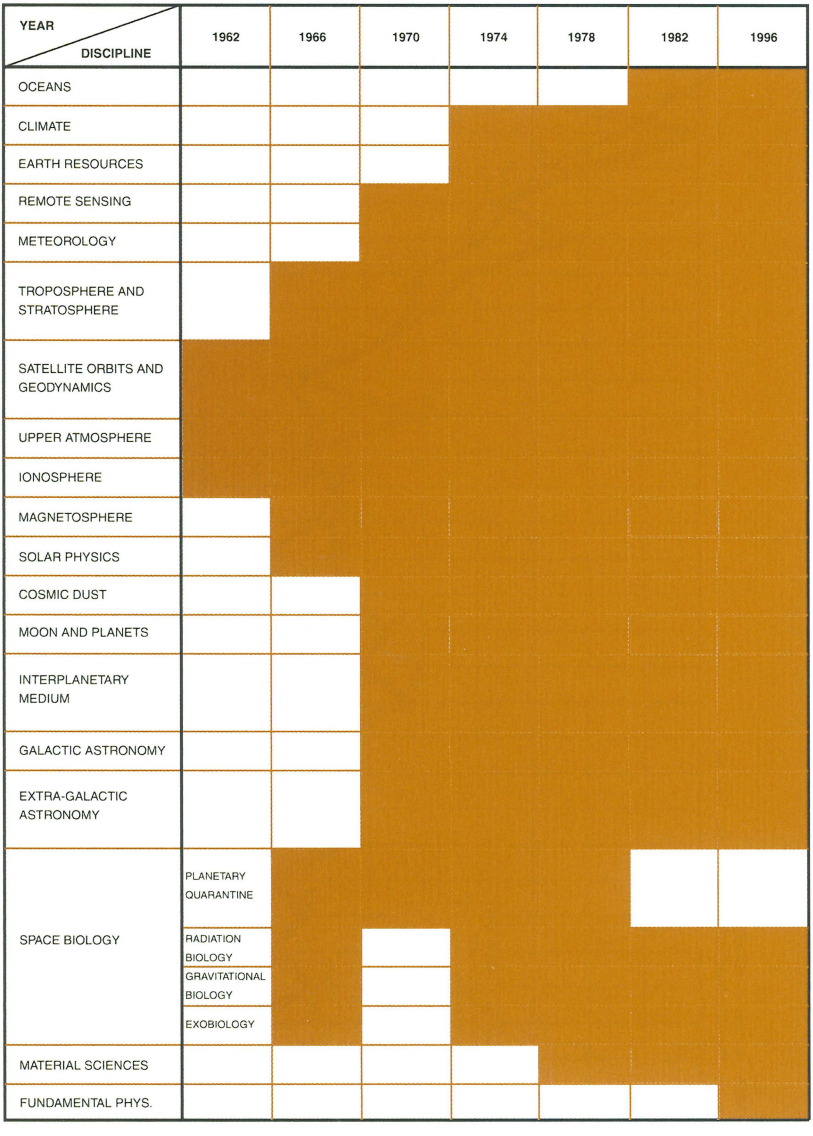
As scientific interests develop, COSPAR has kept pace with the changes. I look forward to its Jubilee meeting in 2008.

PART 2
STATISTICAL DATA

COSPAR Assembly Statistics
1958 - 1996



Growth of Scientific Disciplines within COSPAR*



** As indicated by development of appropriate formal bodies (Working Groups, Panels, Scientific Commissions, etc.)*

Overview of Current COSPAR Scientific Structure

SC A on Space Studies of the Earth's Surface, Meteorology and Climate

- Sub-Commission A1 on Atmosphere (incl. Troposphere and Stratosphere), Meteorology and Climate
- Sub-Commission A2 on Ocean Dynamics and Productivity
- Sub-Commission A3 on Land Processes and Morphology

SC B on Space Studies of the Earth-Moon System, Planets, and Small Bodies of the Solar System

  - Working Group on Cartographic Coordinates and Rotational Elements of the Planets and Satellites - Joint IAU/IAG/COSPAR Body (CCREPS)

- Sub-Commission B1 on Space Related Studies of Small Bodies in the Solar System
- Sub-Commission B2 on International Coordination of Space Techniques for Geodesy and Geodynamics (Joint Sub-Commission with IUGG/IAG Commission VIII)

SC C on Space Studies of the Upper Atmospheres of the Earth and Planets Including Reference Atmospheres

- Sub-Commission C1 on the Earth's Upper Atmosphere and Ionosphere
- Sub-Commission C2 on the Earth's Middle Atmosphere and Lower Ionosphere
- Sub-Commission C3 on Planetary Atmospheres and Aeronomy
  - Task Group on the International Reference Atmospheres of Trace Species (IRATS)
  - Task Group on Reference Atmospheres of Planets and Satellites (RAPS)
  - Task Group on Reference Atmospheres of Planets and Satellites/ Venus International Reference Atmosphere (RAPS/VIRA)
  - Task Group on Reference Atmospheres of Planets and Satellites/ Mars International Reference Atmosphere (RAPS/MIRA)
  - Task Group on Reference Atmospheres of Planets and Satellites/ Outer Planets and Satellites (RAPS/OPS)

- URSI/COSPAR Task Group on the International Reference Ionosphere (IRI)
- Sub-Commission C5/D4 on Active Experiments

SC D on Space Plasmas in the Solar System,Including Planetary Magnetospheres

- Sub-Commission D1 on the Three Dimensional Heliosphere
  - Task Group on the International Heliospheric Study (IHS)
- Sub-Commission D2/E2 on Solar Physics
- Sub-Commission D3 on Planetary Magnetospheres
- Sub-Commission C5/D4 on Active Experiments

SC E on Research in Astrophysics from Space

- Sub-Commission E1 on Galactic and Extragalactic Astrophysics
- Sub-Commission D2/E2 on Solar Physics

SC F on Life Sciences as Related to Space

- Sub-Commission F1 on Gravitational Biology
- Sub-Commission F2 on Radiation Biology
- Sub-Commission F3 on Planetary Biology and Origins of Life
- Sub-Commission F4 on Natural and Artificial Ecosystems

SC G on Materials Sciences in Space

SC H on Fundamental Physics in Space

Technical Panel on Satellite Dynamics (PSD)

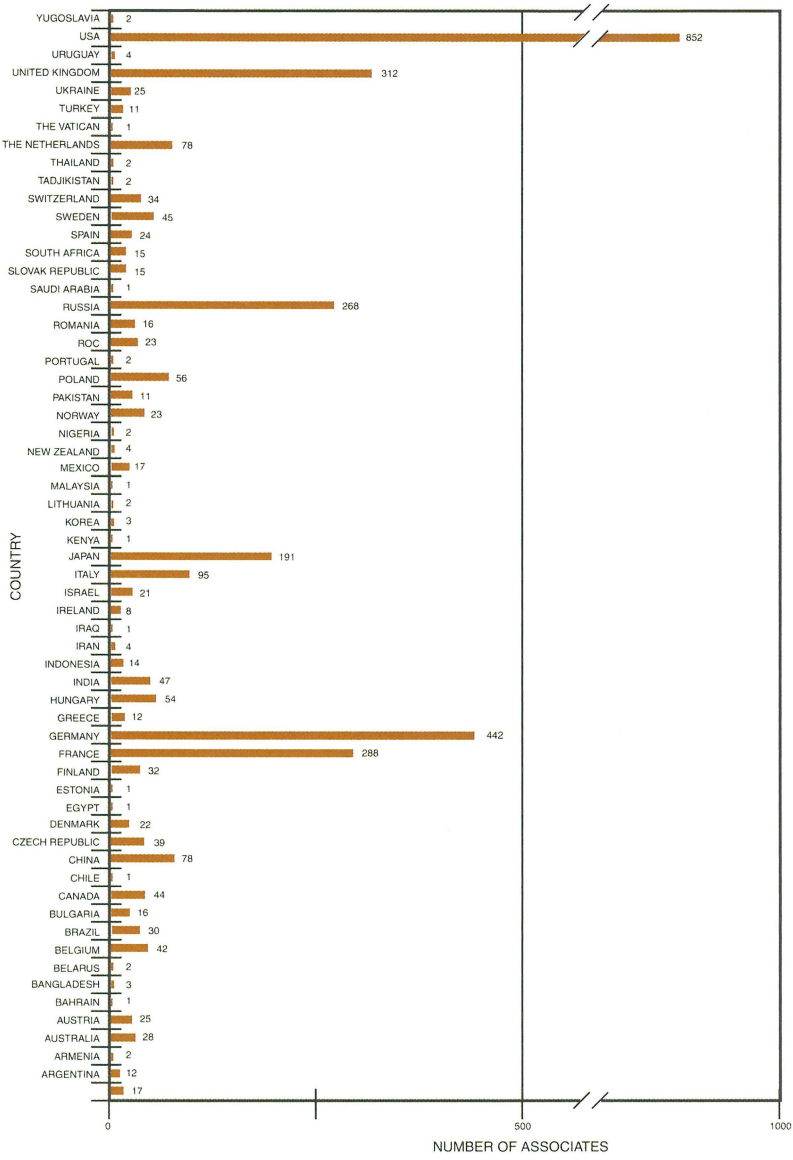
Panel on Technical Problems Related to Scientific Ballooning (PSB)

Panel on Potentially Environmentally Detrimental Activities in Space (PEDAS)

Panel on Space Research in Developing Countries (PSRDC)

Panel on Standard Radiation Belts (PSRB)

Distribution of COSPAR Associates



COSPAR Colloquia Held Since 1989

13. **Space Weather Study Using Multi-point Techniques**
Taipei, Taiwan, China, 2000

12. **The Outer Heliosphere: The Next Frontier**
Europe, 2000

11. **Microsatellites as Research Tools**
Tainan, Taiwan, China, 1997

10. **Asteroids, Comets, and Meteors (ACM)**
Versailles, France, 1996

9. **Magnetospheric Research with Advanced Techniques**
Beijing, China, 1996

8. **Space Remote Sensing of Subtropical Ocean**
Taipei, Taiwan, China, 1995

7. **Low-Latitude Ionospheric Physics**
Taipei, Taiwan, China, 1993

6. **Int. Round Table on Radiation Risk in Humans on Exploratory Missions in Space**
Bad Honnef, Germany, 1993

5. **Solar-Terrestrial Energy Program: Initial Results from STEP Facilities and Theory Campaigns**
Johns Hopkins Univ., MD, USA, 1992

4. **Plasma Environments of Non-Magnetic Planets**
Ann Arbor, MI, USA, 1992

3. **Solar Wind Seven**
Goslar, Germany, 1991

2. **The Environment Model of Mars**
Sopron, Hungary, 1990

1. **Physics of the Outer Heliosphere**
Warsaw, Poland, 1989

COSPAR Presidents and Vice-Presidents

Years	President	Vice-Presidents
- 1963	H.C. van de Hulst (Netherlands)	R.W. Porter (USA) A.A. Blagonravov (USSR)
1963 - 1972	M. Roy (France)	R.W. Porter (USA) A.A. Blagonravov (USSR)
1972 - 1975	C. de Jager (Netherlands)	H. Friedman (USA) A.A. Blagonravov (USSR)
1975 - 1978	C. de Jager (Netherlands)	F.S. Johnson (USA) R.Z. Sagdeev (USSR)
1978 - 1981	J.-F. Denisse (France)	F.S. Johnson (USA) R.Z. Sagdeev (USSR)
1981 - 1982	J.-F. Denisse (France)	L.E. Peterson (USA) R.Z. Sagdeev (USSR)
1982 - 1986	C. de Jager (Netherlands)	L.E. Peterson (USA) N.S. Kardashev (USSR)
1986 - 1994	W.I. Axford (N. Zealand/Germany)	H. Friedman (USA) R.A. Sunyaev (USSR/Russia)
1994 -	G. Haerendel (Germany)	L.J. Lanzerotti (USA) A. Nishida (Japan)

COSPAR Awards/Medals

SPACE SCIENCE AWARD

The COSPAR Award honours a scientist who has made outstanding contributions to space science. All scientists working in any field covered by COSPAR are eligible for this award.

Previous recipients:

1984	James A. Van Allen	1992	Edward C. Stone Jr.
1986	Ludwig F. Biermann	1994	Gerhard Haerendel
1988	Konstantin I. Gringauz	1994	Joachim E. Trümper
1988	S.L. Mandelshtam	1996	Norman F. Ness
1990	John A. Simpson	1996	Minoru Oda

INTERNATIONAL COOPERATION MEDAL

This medal is awarded to a scientist who has made distinguished contributions to space science and whose work has contributed significantly to the promotion of international scientific cooperation. All scientists working in any field covered by COSPAR are eligible for this medal. This medal may also be awarded to a group of scientists.

Previous recipients:

1984	Roald Z. Sagdeev	1990	Bengt Hultqvist
1986	The Inter-Agency Consultative Group	1992	Hubert Curien
		1994	Ranjan R. Daniel
1988	Cornelis de Jager	1996	Anatoli I. Grigoriev

WILLIAM NORDBERG MEDAL

This medal commemorates the work of the late William Nordberg and is awarded to a scientist who has made a distinguished contribution to the application of space science in a field covered by COSPAR.

Previous recipients:

1988	S. Ichtiaque Rasool	1994	Pierre Morel
1990	Desmond G. King-Hele	1996	Charles Elachi
1992	John Theodore Houghton		

DISTINGUISHED SERVICE MEDAL

This medal recognizes extraordinary services rendered to COSPAR over many years.

Previous recipients:

1992	Zdzislaw Niemirowicz	1994	Antal J. Somogyi
1993	Jean-François Denisse	1996	Richard C. Hart

Joint Awards

MASSEY AWARD

The Royal Society of London Massey Award honours the memory of Sir Harrie Massey, FRS, past Physical Secretary of the Society and past member of the COSPAR Bureau. The award consists of a gold medal and a prize of 500 guineas. This award recognizes outstanding contributions to the development of space research, interpreted in the widest sense, in which a leadership role is of particular importance. These are the only requirements, and the award is open to all candidates from any country.

Previous recipients:

1990	Hendrik C. van de Hulst	1994	Robert Wilson
1992	Herbert Friedman	1996	Johannes Geiss

VIKRAM SARABHAI MEDAL

This medal is awarded by the Indian Space Research Organization (ISRO) in honour of Vikram Sarabhai, considered one of the architects of modern India. The medal is awarded for outstanding contributions to space research in developing countries. For a candidate to be eligible for this award, her or his relevant work must have been carried out mainly in the five-year period ending one year before the COSPAR Scientific Assembly at which the medal is to be presented. This medal is open to candidates from any country.

Previous recipients:

1990	Vladimir A. Kotelnikov	1994	Jacques E. Blamont
1992	C.-Y. Tu	1996	U.R. Rao

ZELDOVICH MEDALS

The Zeldovich Medals are conferred by the Russian Academy of Sciences on young scientists for excellence and achievements. They honour the memory of the distinguished astrophysicist Academician Yakov B. Zeldovich.
These awards consist of a medal and a certificate.

These medals are normally presented at the open business meetings of COSPAR Scientific Commissions at the Committee's biennial Assemblies. Previous recipients:

	1990	**1992**
Commission A	Bernard Pinty	Robert R. Leben
Commission B	Jonathan I. Lunine	N.G.M. Thomas
Commission C	Michael Lockwood	Dmitry V. Titov
Commission D	Karl-Heinz Glassmeier	Yoshiharu Omura
Commission E	Michiel van der Klis	Marat R. Gilfanov
Commission F	Alexey M. Alpatov	R. Hemmersbach-Krause
Commission G	Johannes Baumgartl	Stefan van Vaerenbergh

	1994	**1996**
Commission A	Iván Csiszár	Franz H. Berger
Commission B	Philippe Zarka	Emmanuel Lelouch
Commission C	Oleg L. Korablev	Shun-Rong Zhang
Commission D	Sandra C. Chapman	Michele K. Dougherty
Commission E	Eugene Churazov	Tadayasu Dotani
Subcom. D2/E2		Gary P. Zank
Commission F	David T. Smernoff	Dimitry O. Meshkov
Commission G	No award	No award

COSPAR Publications

1. Space Research Series

	Editor(s)	Year	Publisher
Volume I	H. Kallmann-Bijl, 1195 pp	1960	North-Holland Publ. Co.
Volume II	H.C. van de Hulst, C. de Jager and A.F. Moore, 1241 pp	1961	North-Holland Publ. Co.
Volume III	W. Priester, 1275 pp	1963	North-Holland Publ. Co.
Volume IV	P. Muller, 997 pp	1964	North-Holland Publ. C
Volume V	D.G. King-Hele, P. Muller and G. Righini, 1248 pp	1965	North-Holland Publ. Co.
Volume VI	R.L. Smith-Rose, 1129 pp	1966	Spartan Books
Volume VII	R.L. Smith-Rose, 1479 pp	1967	North-Holland Publ. Co.
Volume VIII	A.P. Mitra, L.G. Jacchia and W.S. Newman, 1096 pp	1968	North-Holland Publ. Co.
Volume IX	K.S.W. Champion, P.A. Smith and R.L. Smith-Rose, 770 pp	1969	North-Holland Publ. Co.
Volume X	T.M. Donahue, P.A. Smith and L. Thomas, 1049 pp	1970	North-Holland Publ. Co.
Volume XI	K. Ya. Kondratyev, M.J. Rycroft and C. Sagan, 1415 pp	1971	Akademie Verlag
Volume XII	S.A. Bowhill, L.D. Jaffe and M.J. Rycroft, 1815 pp	1972	Akademie Verlag
Volume XIII	M.J. Rycroft and S.K. Runcorn, 1198 pp	1973	Akademie Verlag
Volume XIV	M.J. Rycroft and R.D.Reasenberg	1974	Akademie Verlag
Volume XV	M.J. Rycroft, 737 pp	1975	Akademie Verlag
Volume XVI	M.J. Rycroft, 1077 pp	1976	Akademie Verlag
Volume XVII	M.J. Rycroft, 860 pp	1977	Pergamon Press
Volume XVIII	M.J. Rycroft, 543 pp	1978	Pergamon Press
Volume XIX	M.J. Rycroft, 615 pp	1979	Pergamon Press
Volume XX	M.J. Rycroft	1980	Pergamon Press

2. Life Sciences and Space Research Series

	Editor(s)	Year	Publisher
Volume I	R.B. Livingston, A.A. Imshenetsky and G.A. Derbyshire, 184 pp	1963	North-Holland Publ. Co.
Volume II	M. Florkin and A. Dollfus	1964	North-Holland Publ. Co.
Volume III	M. Florkin, 258 pp	1965	North-Holland Publ. Co.
Volume IV	A.H. Brown and M. Florkin	1966	Spartan Books
Volume V	A.H. Brown and F. Favorite	1967	North-Holland Publ. Co.
Volume VI	A.H. Brown and F. Favorite	1968	North-Holland Publ. Co.
Volume VII	W. Vishniac and F.G. Favorite	1969	North-Holland Publ. Co
Volume VIII	W. Vishniac and F.G. Favorite, 317 pp	1970	North-Holland Publ. Co
Volume IX	W. Vishniac, 202 pp	1971	Akademie Verlag
Volume X	W. Vishniac, 228 pp	1972	Akademie Verlag
Volume XI	P.H.A. Sneath, 308 pp	1973	Akademie Verl
Volume XII	P.H.A. Sneath	1974	Akademie Verlag
Volume XIII	P.H.A. Sneath	1975	Akademie Verlag
Volume XIV	P.H.A. Sneath, 368 pp	1976	Akademie Verlag
Volume XV	R. Holmquist, 316 pp	1977	Pergamon Press
Volume XVI	R. Holmquist, 157 pp	1978	Pergamon Press
Volume XVII	R. Holmquist, 306 pp	1979	Pergamon Press
Volume XVIII	R. Holmquist, 220 pp	1980	Pergamon Press

3. Other Proceedings

1. Rocket and Satellite Meteorology, 441 pp
   Editors: H. Wexler and J.E. Caskey, Jr.
   Publisher: North-Holland Publishing Company, 1963

2. The Use of Artificial Satellites for Geodesy, 424 pp
   Editor: G. Veis
   Publisher: North-Holland Publishing Company, 1963

3. The Use of Artificial Satellites for Geodesy, Vol. II, 647 pp
   Editor: G. Veis
   Publisher: National Technical University of Athens, 1967

4. Problems of Atmospheric Circulation
Editors: R.V. Garcia and T.F. Malone
Publisher: Spartan Books, 1965

5. Moon and Planets, 325 pp
Editor: A. Dollfus
Publisher: North-Holland Publishing Company, 1967

6. Moon and Planets, Vol. 2, 196 pp
Editor: A. Dollfus
Publisher: North-Holland Publishing Company, 1968

7. COSPAR International Reference Atmosphere, 177 pp
Editors: H. Kallmann-Bijl, R.L.F. Boyd, H. Lagow, S.M. Poloskov and W. Priester
Publisher: North-Holland Publishing Company, 1961

8. COSPAR International Reference Atmosphere
Publisher: North-Holland Publishing Company, 1965

9. COSPAR International Reference Atmosphere
Publisher: Akademie Verlag, 1972

10. Small Rocket Instrumentation Techniques, 231 pp
Editor: K.-I. Maeda
Publisher: North-Holland Publishing Company, 1969

11. Solar Flares and Space Research, 419 pp
Editors: C. de Jager and Z. Svestka
Publisher: North-Holland Publishing Company, 1969

12. Dynamics of Satellites
Editor: B. Morando
Publisher: Springer-Verlag, Berlin, FRG, 1969

13. Approaches to Earth Survey Problems through Use of Space Techniques, 502 pp
Editor: P. Bock, assisted by S. Ruttenberg and F.W.G. Baker
Publisher: Akademie-Verlag, Berlin, 1974

14. Methods of Measurements and Results of Lower Ionosphere Structure, 462 pp
Editor: K. Rawer
Publisher: Akademie Verlag, 1974

15. Workshop and Seminar on Space Applications of Direct Interest to Developing Countries
Editor: F. de Mendonça
Publisher: INPE, 1974

16. Satellite Dynamics
Editor: G.E.O. Giacaglia
Publisher: Springer-Verlag, Berlin, FGR, 1975

17. Trajectories of Artificial Celestial Bodies
Editor: J. Kovalevsky
Publisher: Springer-Verlag, Berlin, FGR, 1966

18. Development of the Implementation Plan for the International Satellite Land-Surface Climatology Project (ISLSCP) - Phase I, 97 pp
June-December 1983

19. Report from the North American Working Group Meeting on the ISLSCP Retrospective Analyses Project (IRAP) - ISLSCP Report No. 2, 50 pp
Editors: D.L. Toll and R.G. Witt
Publisher: Univ. Corporation for Atmospheric Research, October 1984

20. Report of the Design Workshop for the First ISLSCP Field Experiment (FIFE) - ISLSCP Report No. 3, 62 pp
Editors: G. Ohring and P. Sellers

21. Proceedings of Workshop V (COSPAR 25th Plenary Meeting - 25 June to 7 July 1984), 118 pp
Organizing Committee: A.A. Abiodun, R.R. Daniel, Y.S. Rajan and K.B. Serafimov

22. Critical Problems of Magnetospheric Physics (Proceedings of the joint COSPAR/IAGA/URSI Symposium - 11-13 May 1972), 264 pp
Editor: E.R. Dyer

4. COSPAR Information Bulletin (published 3 times a year)

Nos. 1 - 141 are available from the COSPAR Secretariat.

1984:	No. 99	April Issue - 107 pp
	No. 100	August Issue - 78 pp
	No. 101	December Issue - 115 pp
1985:	No. 102	April Issue - 133 pp
	No. 103	August Issue - 126 pp
	No. 104	December Issue - 96 pp
1986:	No. 105	April Issue - 134 pp
	Nos. 106/7	Aug./Dec. Issue - 188 pp
1987:	No. 108	April Issue - 138 pp
	No. 109	August Issue - 100 pp
	No. 110	December Issue - 80 pp
1988:	No. 111	April Issue - 101 pp
	No. 112	August Issue - 114 pp
	No. 113	December Issue - 98 pp
1989:	No. 114	April Issue - 98 pp
	No. 115	August Issue - 114 pp
	No. 116	December Issue - 106 pp
1990:	No. 117	April Issue - 112 pp
	No. 118	August Issue - 82 pp
	No. 119	December Issue - 92 pp
1991:	No. 120	April Issue - 91 pp
	No. 121	August Issue - 51 pp
	No. 122	December Issue - 110 pp
1992:	No. 123	April Issue - 63 pp
	No. 124	August Issue - 73 pp
	No. 125	December Issue - 89 pp

1993:	No. 126	April Issue - 119 pp
	No. 127	August Issue - 96 pp
	No. 128	December Issue - 73 pp
1994:	No. 129	April Issue - 45 pp
	No. 130	August Issue - 34 pp
	No. 131	December Issue - 76 pp
1995:	No. 132	April Issue - 58 pp
	No. 133	August Issue - 107 pp
	No. 134	December Issue - 64 pp
1996:	No. 135	April Issue - 68 pp
	No. 136	August Issue - 45 pp
	No. 137	December Issue - 95 pp
1997	No. 138	April Issue - 52 pp
	No. 139	August Issue - 67 pp
	No. 140	December Issue - 77 pp
1998	No. 141	April Issue - 48 pp

5. COSPAR Technique Manual Series (published by COSPAR Secretariat)

No. 1 A Guide to Stratospheric Temperature and Wind Measurements, 117 pp
By H.N. Ballard, 1967

No. 2 Falling Sphere Method for Upper-Air Density, Temperature and Wind, 124 pp
By L.M. Jones, 1967

No. 3 Electron Density and Temperature Measurements in the Ionosphere
By K. Maeda, 1967

No. 4 Sterilization Techniques for Instruments and Materials as Applied to Space Research, 246 pp
Editor P.H.A. Sneath, 1968

No. 5 Satellite Imagery Interpretation: Suggestions for Laboratory Design, 19 pp
By T.T. Alföldi and R.A. Ryerson, 1976

No. 6 How to Use Transparent Diazo Colour Film for Interpretation of Landsat Images, 36 pp
By O.G. Malan, 1976

No. 7 Intercomparison/Compilation of Relevant Solar Flux Data Related to Aeronomy (Solar Cycle 20), 105 pp
Compiled by P.C. Simon et al, 1978

No. 8 Introduction to Monitoring Dynamic Environmental Phenomena of the World using Satellite Data Collection Systems-1978, 21 pp
By W.D. Carter and R.W. Paulson, 1979

No. 9 How to use Transparent Diazo Colour Film for Interpretation of Landsat Images (revised version of Manual no. 6), 33 pp
By O.G. Malan, 1981

6. COSPAR Transactions Series (published by COSPAR Secretariat)

No. 1 Reports of National Institutions on Space Research Activities, 1967, 534 pp
No. 2 World List of Satellite Tracking Stations, 1967 (see also No. 9), 108 pp
No. 3 Status Report on the Application of Space Technology to the World Weather Watch by COSPAR Working Group VI, Dec. 1967
No. 4 Part I, COSPAR Guide to Rocket and Satellite Information and Data Exchange; Part II, Unified Synoptic Codes for Rapid Communication of Satellite Orbital Data, 1967 (see also No. 8), 30 pp
No. 5 Reports of National Institutions on Space Research Activities, 1968, 414 pp
No. 6 Bibliographies on Space Research Activities of National Institutions, 1968, 224 pp
No. 7 Reduction of Satellite Photographic Plates, 1970, 278 pp
No. 8 Part I, COSPAR Guide to Rocket and Satellite Information and Data Exchange; Part II, An International Mechanism for Rapid

Communication of Satellite Orbital Data, December 1972.
Revised Version of COSPAR Transactions No. 4, 26 pp

No. 9 World List of Satellite Tracking Stations, March 1974.
Revised Version of COSPAR Transactions No. 2, 82 pp

7. COSPAR Directory (published by COSPAR Secretariat)

1962	May - 101 pp	1971	Dec. - 90 pp	1983	Mar. - 117 pp
1963	Nov. - 128 pp	1973	Jan. - 90 pp	1985	June - 128 pp
1964	Dec. - 121 pp	1974	Feb. - 94 pp	1987	June - 139 pp
1966	Mar. - 126 pp	1975	Oct. - 102 pp	1989	Apr. - 144 pp
1967	Jan. - 125 pp	1976	Nov. - 107 pp	1991	June - 156 pp
1968	Jan. - 84 pp	1977	Nov. - 104 pp	1995	Aug. - 137 pp
1978	Nov. - 91 pp	1978	Nov. - 103 pp	1997	Apr. - 160 pp
1970	Jan. - 95 pp	1980	Feb. - 84 pp		
1970	Dec. - 91 pp	1981	Mar. - 106 pp		

8. COSPAR Working Group 6 - Report to JOC

Systems Possibilities for an Early GARP Experiment, January 1969, 55 pp

Comments on the Observing and Data Processing Systems for FGGE, as given in GARP Publication No. 3, February 1970, 37 pp

The Feasibility of the First GARP Global Experiment (FGGE) and the Criticality of Initiating Systems Planning, January 1971

Status of Satellite Observing Possibilities for Studies of Climate Physical Processes, May 1978, 113 pp

Toward an Internationally Coordinated Earth Radiation Budget Satellite Observing System: Scientific Uses and Systems Considerations, September 1978, 76 pp

SC A - Report to WMO/ICSU Joint Scientific Committee for the World Climate Research Program

Space-Based Observations in the 1980s and 1990s for Climate Research: A Planning Strategy, November 1980, 110 pp

9. Advances in Space Exploration (Publisher: Pergamon Press, Oxford, U.K.)

	Title	Editor(s)	Year
Vol. 1,	New Instrumentation for Space Astronomy	K.A. van der Hucht and G.S. Vaiana	1977
Vol. 2,	Contribution of Space Observations to Global Food Information Systems	E.A. Godby and J. Otterman	1977
Vol. 3,	X-Ray Astronomy	W.A. Baity and L.E. Peterson	1979
Vol. 4,	Remote Sounding of the Atmosphere from Space	H.J. Bolle	1979
Vol. 5,	Scientific Ballooning	W. Riedler	1979
Vol. 6,	Space and Development, 97 pp	Y. Pal	1980
Vol. 7,	Non-Solar Gamma-Rays	R. Cowsok and R.D. Wills	1980
Vol. 8,	Low Latitude Aeronomical Processes, 306 pp	A.P. Mitra	1980
Vol. 9,	Contribution of Space Observations to Water Resources Studies and the Management of these Resources, 280 pp	V.V. Salomonson and P.D. Bhavsar	1980
Vol.10,	Remote Sensing and Mineral Exploration, 173 pp	W.D. Carter, L.C. Rowan and J.F. Huntington	1980

10. Advances in Space Research - The Official Journal of COSPAR
(Publisher : Pergamon Press, Oxford, U.K.)

Proceedings of the 23rd COSPAR Meeting, Budapest, Hungary, June 1980

	Title	Editor(s)
Vol. 1, No. 1	Physics of Planetary Magnetospheres, 388 pp	K. Knott
Vol. 1, No. 2	Active Experiments in Space Plasmas, 468 pp	C.T. Russell and M.J. Rycroft
Vol. 1, No. 3	Cosmic Rays in the Heliosphere, 178 pp	A.J. Somogyi, J. Kota and K. Kecskemety
Vol. 1, No. 4	First FGGE Results from Satellites, 332 pp	T. Tänczer, G. Götz and G. Major

Vol. 1, No. 5	Materials Sciences in Space, 172 pp	A. Bewersdorff
Vol. 1, No. 6	Satellite Perturbations and Orbital Determination, 95 pp	P. Lala
Vol. 1, No. 7	Planetary Interiors, 265 pp	H. Stiller and R.Z.Sagdeev
Vol. 1, No. 8	Progress in Planetary Exploration	R.W. Shorthill, M.Ya. Marov and J.A.M. McDonnell
Vol. 1, No. 9	Planetary Aeronomy and Astronomy, 215 pp	S.K. Atreya and J.J. Caldwell
Vol. 1, No. 10	Sessions on Remote Sensing 1980, 314 pp	A.B. Kahle, G. Weill and W.D. Carter
Vol. 1, No. 11	Scientific Ballooning II, 274 pp	W. Riedler and M. Friedrich
Vol. 1, No. 12	The Mesosphere and Thermosphere, 238 pp	G. Schmidtke and K.S.W. Champion
Vol. 1, No. 13	High-Energy Astrophysics, 290 pp	H.S. Hudson
Vol. 1, No. 14	Life Sciences and Space Research XIX, 232 pp	W.R. Holmquist
Vol. 2, No. 1	Solar System Plasmas and Fields	J. Lemaire and M.J. Rycroft
Vol. 2, No. 2	The Mars Reference Atmosphere	A.J. Kliore
Vol. 2, No. 3	Detrimental Activities in Space, 161 pp	K. Rawer

Proceedings from the symposia, workshops, and topical meetings held in Ottawa, in conjunction with the 24th Plenary Meeting of COSPAR (May-June 1982)

Vol. 2, No. 4	Advanced Space Instrumentation in Astronomy, 324 pp	R.M. Bonnet
Vol. 2, No. 5	Space Observations of Aerosols and Ozone, 213 pp	M.P. McCormick and J.E. Lovill
Vol. 2, No. 6	Weather Satellites: Stereoscopy and Sounding, 179 pp	H. Yates and A.F. Hasler
Vol. 2, No. 7	Instruments & Analysis Techniques for Space Physics, 178 pp	D.R. McDiarmid and R. Gattinger
Vol. 2, No. 8	Study of Land Transformation Processes from Space and Ground Observations	R.M. Ragan and M.G. Wolman
Vol. 2, No. 9	Achievements in Space Astrophysics, 299 pp	H.S. Hudson, A.K. Dupree and J. Linsky

Vol. 2, No. 10	The Upper Atmospheres of the Earth and Planets, 298 pp	C.A. Barth, D. Offermann, K. Labitzke, J.I. Vette, K. Rawer and H.A. Taylor
Vol. 2, No. 11	Solar Maximum Year, 294 pp	Z. Svestka, D.M. Rust and M. Dryer
Vol. 2, No. 12	Recent Researches into Solid Bodies and Magnetic Fields in the Solar System, 281 pp	J.I. Vette, S.K. Runcorn, E. Grün and J.A.M. McDonnell
Vol. 3, No. 1	The Terrestrial Upper Atmosphere, 139 pp	K.S.W. Champion and M. Roemer
Vol. 3, No. 2	Remote Sensing and Mineral Exploration 1982, 324 pp	W.D. Carter, L.C. Rowan and G. Weill
Vol. 3, No. 3	The Giant Planets and Their Satellites	M.G. Kivelson
Vol. 3, No. 4	Gamma-Ray Astronomy in Perspective of Future Space Experiments, 222 pp	G. Vedrenne and K. Kurley
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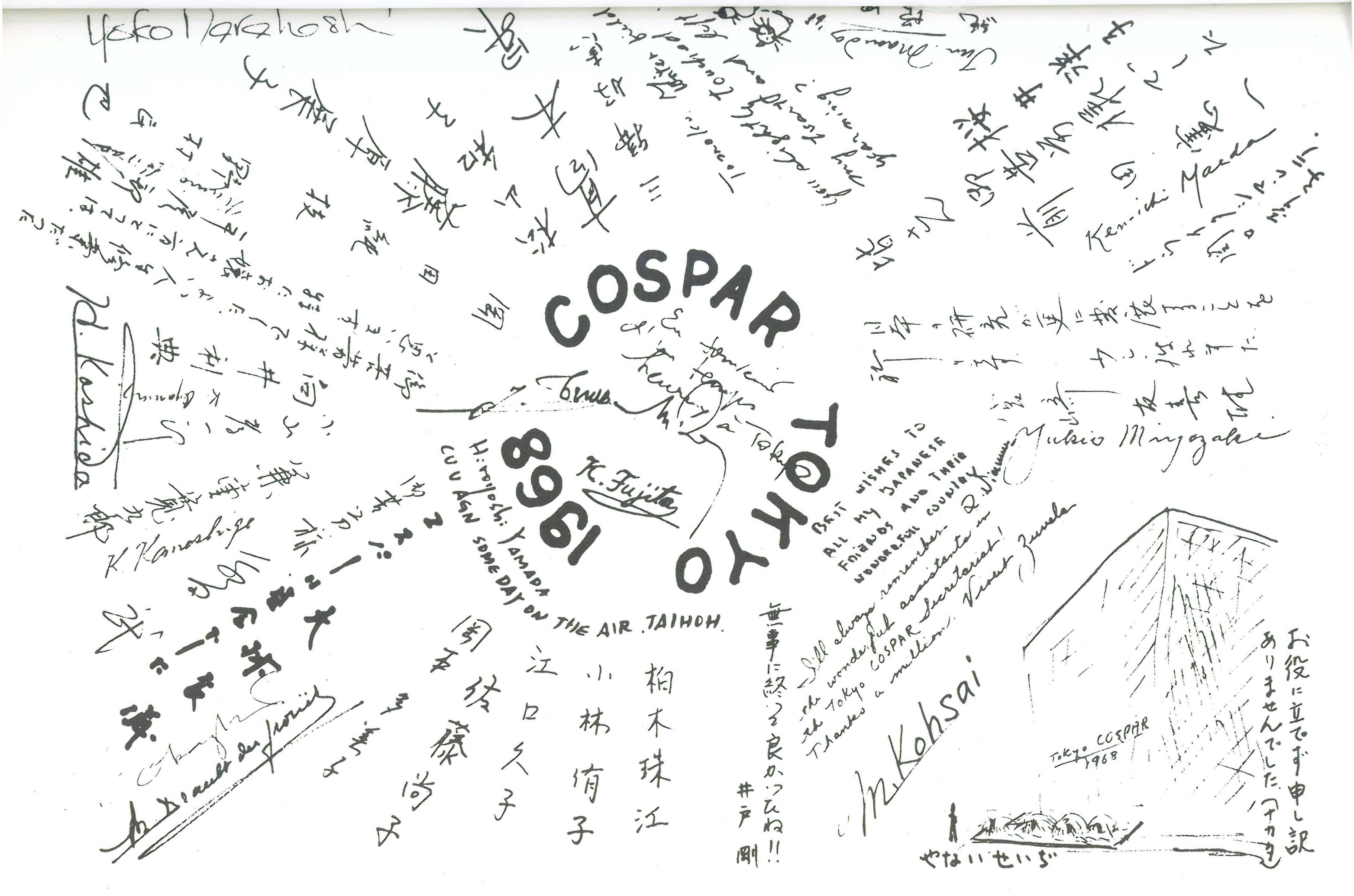
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I'll always remember the wonderful assistants in the Tokyo COSPAR Secretariat! Thanks a million.
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やないせいぢ
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