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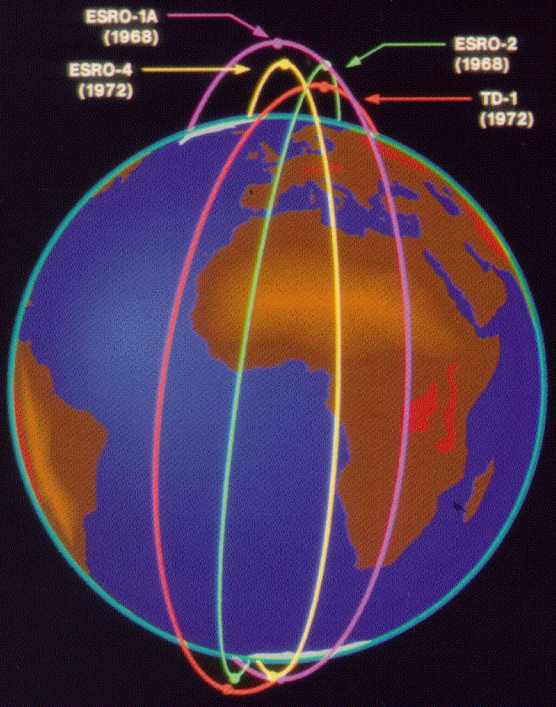
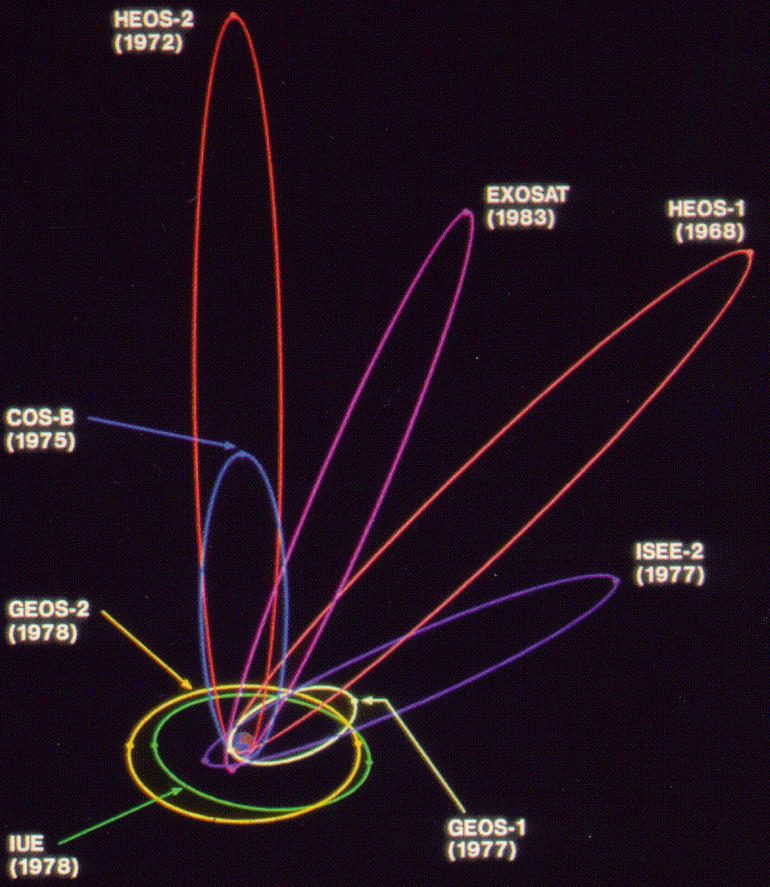
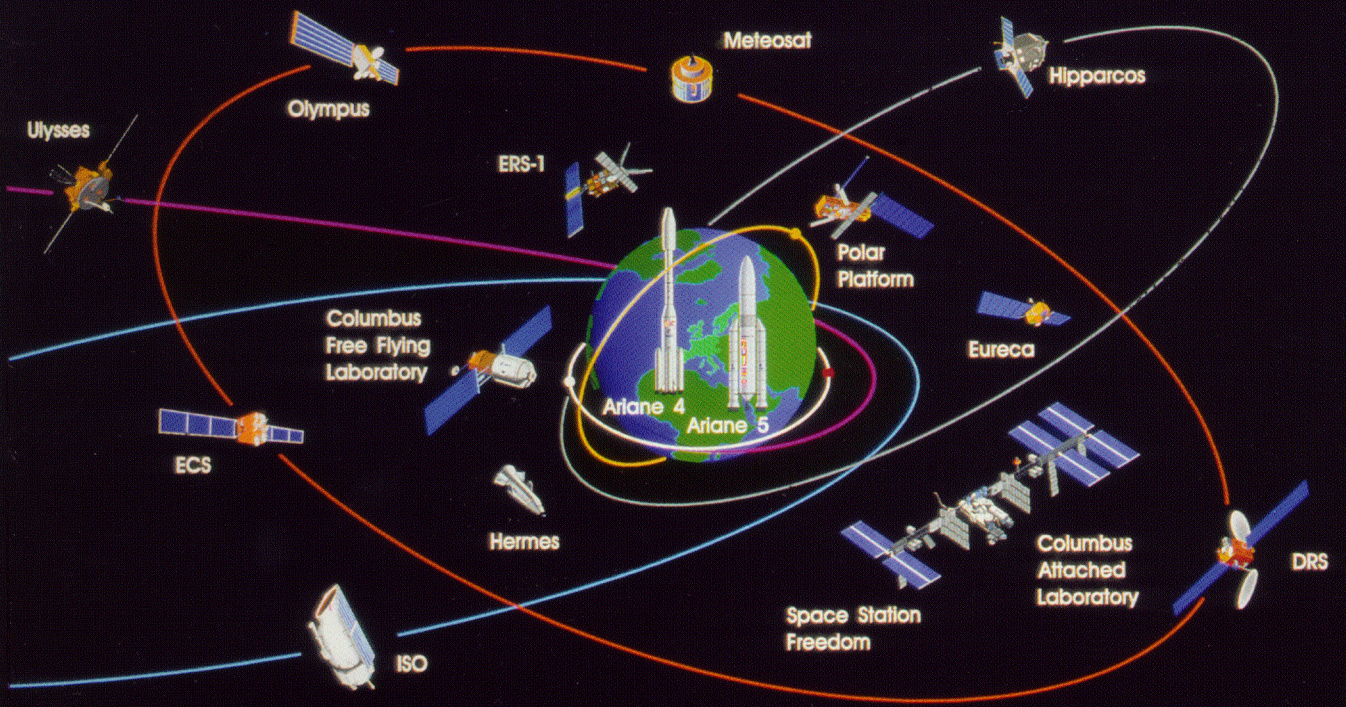




The early activities of the COPERS and the drafting of the ESRO Convention (1961/62)

by John Krige



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The ESA History Study Reports are preliminary reports of studies carried out within the framework of an ESA contract. As such they will form the basis of a comprehensive study of European Space activities covering the period 1959-87. The authors would welcome comments and criticism which should be sent to them at the appropriate address below.

The opinions and comments expressed and the conclusions reached are those of the authors, and do not necessarily reflect the policy of the Agency.

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The early activities of the COPERS and the drafting of the ESRO Convention (1961/62)[1]

John Krige

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In a previous report in this series[2] we described the steps taken by a small group of European scientists in 1959 and 1960 to set up a collaborative space effort. We explained how, having initially thought to create a single organisation dedicated both to launcher development and to space research, they quickly limited their ambitions to formulating a satellite and sounding rocket programme. In parallel with their activities there were intense high-level political discussions between Britain and France over the joint development of a launcher based on the use of the UK's *Blue Streak* rocket as the first stage. This was not the kind of project that lent itself to freewheeling international collaboration. Participating governments were determined to maintain control over the shape of the project and to define a form of collaboration which protected their national interests. The scientist, for their part, feared that the launcher would be funded at the expense of their research, were confident that they could acquire American launchers "off the shelf" if they needed them, and realized that the political and military implications of rocket/missile development might impede collaboration with some of their colleagues from neutral countries. They thus easily accepted that Europe should in fact enter space with two very different organisations. One was to be similar to CERN, the European Organization for Nuclear Research, and would be devoted to basic research in space science. The other, essentially the business of engineers and industry, would aim to build a

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1 This account makes extensive use of the files of Jean Mussard, Auger's right hand man in the setting up of both CERN and of ESRO, and number two (after Auger) in the COPERS Secretariat in the period covered here. This collection of papers is in the ESA Archives, Villa Il Poggiolo. European University Institute, Florence. It is supplemented by official ESA documents of which there is a master set available for consultation in the same archive.

2 Krige (1992b).

European launcher. At a large meeting with high-level government officials held at CERN at the end of November 1960 an agreement was signed by representatives from ten European states, and later an eleventh, for setting up a Preparatory Commission to explore the possibilities for "pure" space research (abbreviated COPERS). This agreement entered into force on 27 February 1961.

The COPERS held its first session in Paris on 13 and 14 March 1961.[3] Its first task was to create the organs needed to define the scientific programme and necessary infrastructural facilities of the envisaged organisation, to draw up its budget, and to prepare a convention for signature by those member state governments who wished to join it. To this end the meeting first elected its "bureau" — chairman Sir H. Massey (UK), vice-chairmen, L. Broglio (I) and H. Van de Hulst (NL), and executive secretary P. Auger (F) — all men who had played an important role in the debates in 1960 and, Auger apart, still active and eminent European space scientists or engineers. It then established two working groups. Firstly there was the Interim Scientific and Technical Working Group (STWG). Its task was to prepare both a short- and long-term scientific programme for the COPERS, paying particular attention to the technological implications of its proposals, as well as the time, personnel and cost of the projects put forward. Prof. L. Hulthén, from the Royal Institute of Technology in Stockholm, was nominated chairman of this group; Dr. R. Lüst from the Max-Planck Institut für Physik und Astrophysik near Munich was appointed its coordinating secretary.

The COPERS also created a Legal, Administrative and Financial Working Group (LAFWG). Its chairman was initially left open, though it was recommended that he be someone from the German Federal Republic. In the event Dr Alexander Hocker, a senior bureaucrat from Bad-Godesberg who was also the chairman of the CERN Finance Committee at the time, took on this task. All member states were to be represented on both working groups, which were empowered to set up subgroups to facilitate their work.

The aim of this report is to describe the main activities of these two groups, particularly in so far as they bore on the drafting of the convention of the new European Space Research Organisation (ESRO). This convention was laid before an intergovernmental conference in Paris on 14 and 15 June 1962. By restricting our

[3] The minutes of this meeting are COPERS/Min/1 (undated).

time span and our subject matter in this way we do not, of course, deal with all matters handled by the working groups in this period, and not by the LAFWG in particular (staff policy and internal structure, privileges and immunities, etc.). We do however throw into relief the most significant issues which were "settled" in the run up to the signature of the convention, so exploring in depth the history of some key clauses in that important legal document.

The debates that we are about to describe have two striking features. Firstly there was the determination of the member states delegates to keep the development of ESRO under tight control. This was so regarding the scope of its scientific programme, the extent of its facilities, and above all its budget, which was fixed for no less than eight years with difficult-to-dislodge ceilings on expenditure at regular intervals. Secondly, and more surprisingly, there was the willingness of scientists to accept these constraints. In fact we even find scientists arguing *against* administrators who wanted to increase ESRO's budget during the first eight-year period, and who thought it prudent to introduce a large margin of flexibility into its funding profile. The attitudes of both governments and scientists were, we believe, informed by their wish to develop robust national programmes in parallel with their European commitments. This inevitably meant that the scope of ESRO's activities and its cost had to be contained so as to stop the international initiative swamping the national efforts. It was yet another difference between ESRO and the CERN on which it was "modelled", a difference reflecting the very different perceptions which government's had of space — seen as a strategic activity directly affecting the national interest — and high-energy physics in the 1960s.

1 The Scientific Programme [4]

The most pressing task facing the Preparatory Commission was the definition of the scientific programme of the new organization. This was not simply because this programme formed the backbone, the raison d'être of the envisaged body. It was also for practical reasons: it determined the necessary infrastructural facilities and, of course, the budget of the European Space Research Organisation (ESRO).

To this end Hulthén and Lüst rapidly convened the first meeting of the Interim STWG in Stockholm on 4 and 5 April 1961. It was attended by about two dozen

[4] This has also been discussed at length in Russo (1992).

delegates from the eleven member states of the COPERS, the bulk of them scientists, though there were also a few engineers. The meeting was necessarily preparatory. Not only had it been called in great haste. There was also limited overlap in participation with the GEERS working group which had met the previous October. Ten of the delegates to Stockholm had not been at the earlier meeting, and many influential European space scientists were not present in Sweden.[5]

The main purpose of the Stockholm meeting was to make a preliminary survey of suitable scientific and technical projects, and to set up working groups to elaborate them further. After lengthy discussion, the projects were divided into three categories according to their duration: short-term (i.e. projects which could be started immediately), medium-term and long-term (i.e projects which could only come to fruition after five or six years).

The most significant short-term project put forward was the fully documented proposal by Dr. Bengt Hultqvist, the Director of the Kiruna Geophysical Laboratory in Sweden, for sounding rocket measurements of the upper atmosphere in the auroral zone.[6] (Sounding rockets are ballistic devices used primarily for upper atmosphere studies.[7]) As for medium-term projects there were well-received suggestions from the French delegation (Kovalevsky and Blassel) for a radioastronomical satellite and from the German delegate (Lüst) that satellites and sounding rockets be used to create artificial comets.[8] It was the British who stole the limelight with long-term projects.

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5 We have two versions of the minutes of this meeting, one in French one in English. Both are unsigned. In addition there are twelve Appendices to the minutes which include a list of those present and the details of the various offers and scientific proposals made at the meeting — Mussard files (cf. note 1), folder *GTST intérimaire*. See Krige (1992b) for the GEERS.

6 Hultqvist's proposal is Appendix 9 to the minutes (cf note 5).

7 The workhorse of high altitude astronomers in the U.S.A. was the *Aerobee* sounding rocket, which was designed by James A. Van Allen, a cosmic ray physicist at the University of Iowa (cf. Hirsh (1983), p. 23). An *Aerobee* could lift 70 kgs to 115 kms, and later versions could reach 275 kms. *Aerobees* had a success rate of 90% between 1948 and 1976, and cost about $30,000 in the 1960s. There were also important national sounding rocket programmes in Europe. France had, for example, the *Centaure* which could lift 32kg to 140k, and Britain the *Skylark* (68kg to 230km). Italy (*Quirra* series) and Sweden (*HR*- series) also had their own sounding rockets under development. See the *Note Preliminaire* drafted after the meeting of the Vehicles subgroup on 24 and 25 April 1961, Mussard files (cf note 1), folder *GTST Vehicules*.

8 The British and French proposals are Appendices 3, 5 and 6 to the minutes of the meeting, cf note 5.

Dr. Robert Boyd from University College, London proposed that the new organization concern itself with satellite astronomical observatories i.e. "flying telescopes" for ultraviolet and X-ray stellar spectroscopy, and with lunar satellites.

Obviously not all of the ideas put forward in Stockholm were deemed suitable — there was even some dissension over Hultqvist's proposal as we shall see. Some ideas were received coolly and ultimately given a very low priority by the STWG e.g. a proposal by Bolin (S) for a major programme of sounding rocket research in meteorology and a Spanish offer to establish a launching range as soon as possible on the Iberian peninsula or in the Canaries.[9] Other proposals were stifled at birth, notably a Dutch suggestion that ESRO conduct research into means of guidance and control for sounding rockets such that they could be safely launched from small sites (e.g. 5km x 5km) in built-up areas.[10] The meeting felt that the safety questions raised by this proposal should first be settled by international agreement before ESRO considered such activities. Another important proposal made in Stockholm was not simply marginalised but actually subsequently excluded by the STWG. It was a Belgian suggestion that the working group "leave open" the possibility of having European telecommunication satellites for telephone and television linkages. The STWG did just the opposite. In an early draft of the convention the Group, after its meeting on 27 and 28 July 1961, specifically excluded work of a commercial nature from the activities of ESRO.[11] Indeed the only technically-oriented proposal which survived this first meeting of the STWG was Italian delegate Broglio's idea that ESRO's activities should include research into advanced systems of propulsion.

Two main points of principle emerged at various points in the discussions in Stockholm. The delegates tried to draw a distinction between programmes which were best pursued nationally and those that were suitable for a collaborative effort at the European level. They also debated the use of American launchers in the European programme. Both issues were connected in a proposal made by Italian delegate Broglio, who came at the problems under discussion from a quite different angle to the majority of those present.

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9 Appendices 10 and 11 to the minutes of the meeting - cf note 5.

10 Appendix 7 to the minutes of the meeting - cf note 5.

11 The Belgian proposal is prominent in the French version of the minutes of the meeting - cf note 5. The change in the convention is to be found in COPERS/AWG/18 (add.1, rev. 3) 28/7/61.

Broglio began from the idea that sounding rocket programmes were best conducted at the national level. To get a genuine European programme started quickly he proposed that contact be made with NASA to establish what kind of launchers and what technical assistance the American agency would be prepared to give to the Europeans. ESRO's short term (satellite) programme would then be "subordinated to the vehicles which might be available." The medium-term programme would be based on Boyd's proposal which, by virtue of its size, cost, and complexity, was an ideal candidate for a European collaborative effort — though, Broglio insisted, the UK project had to be "handled on a truly European basis, both in the 'study' and 'construction' phases." Finally, there was a need "to start and to coordinate nuclear and special systems for space propulsion research and development" which could provide the foundations for a "real, original and advanced long term programme."

Broglio won little support for his idea that sounding rocket work be left at the national level. "The geographical dependency of such projects," it was argued in 1961, required a collaborative European effort, and there was also scope for the joint provision of range equipment. His suggestion that American launchers be used immediately created considerable controversy. Some delegates, obviously not wishing to have a European satellite programme defined simply by the availability of American launchers, feared that his proposal "would lead to extensive dependency upon American organizations." More generally, though, there was a "thorough discussion" of whether or not American launchers should be used *at all* in the European programme. According to one version of the meeting, there were "tense exchanges between representatives from the United Kingdom, Belgium, Holland, Italy, Germany and France" on this question and, after " a show of hands the Working Group rejected the British request to take immediately a position for or against the possible use of American satellite launchers."[12]

There were probably two reasons why delegates to the Stockholm meeting baulked at the idea of using American rockets to get started quickly with a European satellite programme. Firstly, in April 1961 negotiations in government circles over ELDO membership were in a particularly delicate phase. Britain and France had proposed to their European partners a joint launcher development programme based

[12] The first two quotes are from the English, and the last from the French version of the minutes - cf note 5.

on *Blue Streak* as a first stage, but the initial reactions in Germany and Italy, in particular, were cool. It would be politically foolish to draft an ESRO programme now in which the scientists seemed committed to using American launchers.[13] Secondly, there might also have been some suspicion about Broglio's motives. Around this time the US offered the Italians the plans of a *Scout*-type rocket to be built on Italian soil.[14] If this was known to other delegates at Stockholm, they might have seen Broglio's proposal as being inspired less by the requirements of European collaboration than by the need to curry favour with the United States and to secure benefits for Italian industry. In the event the interim STWG decided that a decision on the question of the launcher "was not appropriate under the present circumstances and that a subgroup would be a more suitable forum to discuss this question."

Concluding its business, the Stockholm meeting nominated Norwegian delegate Odd Dahl as Vice-Chairman of the Interim STWG and set up four subgroups to continue its business. These were Scientific Programmes (chairman B. Hultqvist), Technology (A.W. Lines, from the Royal Aircraft Establishment at Farnborough), Tracking and Data Handling (J. C . Pecker, from the Observatoire de Meudon, Paris) and Vehicles and Ranges (J. A. Vandenkerckhove, from the Institute of Aeronautics at the University of Brussels). It fixed the coordinates of its next meeting as the 8 and 9 May in London.

The meeting in London was very different to that held the month before in Stockholm. Not only were far more people present — 37 as opposed to 23 in Sweden. There were also more engineers, there were bureaucrats (e.g. Guenod from the Department "Engines", Ministère des Armees, Paris, Page from the Office of the UK Minister of Science, and Shapcott from the Guided Weapons Division of the UK Ministry of Aviation), and there were representatives from industry (e.g. Dorleac, Chief Engineer at SEREB, the French "Société pour l'étude et la réalisation d'engins ballistiques"). The goals of the meeting were also very different. They were to

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[13] A report on the launch of ELDO is in preparation and will be in circulation shortly.

[14] This information is based on interviews made by L. Sebesta in Rome with L. Broglio (22/6/92) and C. Buongiorno (23/6/92). It is hoped to be able to check these claims against written documents.

define in broad outline the launching programme, the facilities and, most fundamentally, the cost of ESRO over the first eight years of its existence.[15]

The proposals made at this meeting regarding the facilities and the eight-year budget of ESRO will be treated in detail in sections 2 and 4 below. For the present we simply want to focus on the launching programme. The details, as laid out in the paper drafted at the end of the meeting, are given in Table 1.[16] Here we find the now-

Table 1. Launching programme for ESRO's first eight years, as proposed by the Interim STWG at its meeting in London on 8 and 9 May 1961.

DEVICE/YEAR	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Sounding rockets	20	50	50	50	50	50	50	50
Small satellites in near-earth orbits				2	3	2	4*	
Space probes						1	3*	
Large satellites						1	1*	

* These figures are for years 7 and 8 together.

familiar scheme embracing a short-, medium- and long-term programme Work would get under way with sounding rockets. This would continue in parallel with the development of small (weight about 100kg) and large (weight about 1000kg) satellites and space probes. Eleven of the former would be put in orbit from year four onwards at the rate of about two per year. Two large satellites and four probes would start producing data from about year six. The average cost of the first five years of this programme was estimated to be 130 MFF (million New French francs), climbing to about 230 MFF per annum from year five onwards as the larger satellites and probes were launched. The overall eight-year estimate of ESRO's cost at this stage was thus some 1340 MFF. This figure did not include the costs for the development and construction of the scientific instruments to be borne in the sounding rockets, space probes and satellites.[17]

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15 We do not have the minutes of this meeting. For a list of those present and a draft of the report which emerged from it see folder *GTST intérimaire*, Mussard files (cf note 1).

16 The document is COPERS/20, 11/5/61.

17 More on this in section 2 below.

The figures given in Table 1 did not undergo major revisions during the following six months. The weights of the small satellites were increased to cover the range from 100-200kg, while those of possible large satellites were increased to 1000-3000kg. The number of sounding rocket firings was increased.[18] Most important of all there was a change in the way the figures were presented. While the data in Table 1 gave the number of *successful* launchings, the budget figures calculated at the same time assumed that, on average, two launchings would be needed to put one satellite or space probe successfully in orbit. Financial considerations subsequently overruled scientific ones. The "definitive" launching programme proposed by the STWG to the third session of the COPERS which met in Munich on 24-25 October 1961, and widely circulated in the so-called *Blue Book*, is presented in Table 2. To take account of failures, and to add a margin of contingency, it increased the number of sounding rocket firings from 370 (cf Table I) to 430-440 and simply doubled the number small satellites, space probes and large satellites for astronomical and lunar studies.

Table 2. Launching programme for ESRO's first eight years, as proposed by the Interim STWG to the third session of the COPERS, Munich, 24-25 October 1961. It assumes that two launches are required for each successful satellite or space probe placed in orbit.[19]

DEVICE/YEAR	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
sounding rockets	<10	40	65	65	65	65	65	65
small satellites in near-earth orbits				4	6	4	4	4
space probes						2	3	3
stabilised astronomical satellites								
and lunar satellites						2	1	1

[18] After a meeting of the STWG in July the launching programme was revised to 500 (370 in May) "standard" sounding rockets, defined in terms of a reference rocket capable of carrying a 50kg payload to 150km, while the figures for the satellites and probes were mostly just doubled — for this information see document COPERS/AWG/18 (add.1, rev. 1), 10/7/61, a revised version of the then Article II of the convention.

[19] From the *Report of Scientific and Technical Working Group to the European Preparatory Commission for Space Research*, COPERS, 3rd session (24-25/10/61) — the *Blue Book*, December 1961 — p. 75.

In addition to describing the "hardware" that would be required, the *Blue Book* spelt out the kind of experiments that a European scientific effort might cover.[20] The interest of Hultqvist's proposal to use sounding rockets in the auroral zone was stressed. Auroral phenomena studied at latitudes above roughly 65 degrees were particularly important, said the *Blue Book*, for a better understanding of the relationship between the sun and the earth, and there was a traditional and continuing interest in this research by European space scientists. The *Blue Book* also proposed that sounding rockets be used to do upper atmosphere physics at lower latitudes, where it would be particularly interesting to study phenomena which depended on latitude, and to use these tools for astronomical studies, notably the moon and planets. Studies of parts of the spectrum of celestial bodies which could not be observed from the ground would not only be important in their own right but would also provide information valuable for work with satellites.

Boyd's experiments for the long-term programme proposed in May were taken over almost unchanged in the *Blue Book*. The large astronomical observatories could be used for various studies in the UV and X-ray regions, as well as for cometary studies, cosmic ray studies, etc. The lunar satellites could typically be used to study the properties of lunar gases, the lunar surface, and the measurement of gravitational, magnetic and electric fields at the moon.

Finally a wide range of experiments was proposed for small satellites, each assumed to contain five experiments. In particular the *Blue Book* mentioned ionospheric and radio astronomical investigations of different kinds, the measurement of atmospheric temperature, pressure, density and composition, the studies of flux, energy distribution and angular distribution of different types of corpuscular and quantum radiations, and magnetic and geodetic measurements and investigations of the biological effects of cosmic radiations. Concerning deep space probes, questionnaires circulated inside the community indicated an interest in measuring interplanetary magnetic fields, studying cometary evolution and the effects of the "solar wind" and solar radiation pressure on comet tails, and studies of interplanetary plasma and of cosmic dust.[21]

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[20] A preliminary and somewhat similar list of experiments had been prepared by the GEERS at its meeting in October 1960 — see Krige (1992), section 4 — and expanded at the Interim STWG meeting the previous May, of course.

[21] For this information see the *Blue Book* (cf note 19) p. 14 and chapter 2. For the long term projects see also Boyd's proposals to the first meeting of the Interim STWG (cf note 5).

The launching programme and its scientific content proposed by the Interim STWG to the Munich session of the COPERS was warmly received. The British delegation thought that it "was a valuable study because it gave the broad framework of a programme of space research [...]".[22] Six months later the schedule defined in Table 2 was accepted more or less unchanged by the Conference of Plenipotentiaries which signed the ESRO convention in June 1962. They resolved that during the initial eight year period the organisation should aim to achieve the sounding rocket programme building up to a steady level of about 65 medium sized vehicles per year by the third year of its existence, as well as the *successful* launch of two small satellites in near-earth orbits per year from year four onwards (so ten in all), and two space probes or major satellites from year six onwards (so six in all).[23] It was an aspiration which was to prove wildly optimistic in the light of the available resources.

* * *

This first scientific programme calls for a number of comments. Firstly, there is the important role played in it by sounding rockets. Whatever doubts some may have had about their value, the fact remains that there was a strong demand for them in Europe. According to the *Blue Book*, a survey undertaken early in 1960 revealed that there were about 55 groups comprising some 300 qualified scientists interested in doing space research. They proposed about 150 groups of experiments for ESRO's initial programme, no less than half of them with sounding rockets (and the remainder with satellites or probes).

Several factors accounted for this strong interest. Firstly, there was the inhomogeneity of the "discipline" of space science. As Hulthén, the chairman of the STWG, pointed out to the second session of the COPERS, "space research was not a well-defined discipline, like nuclear physics or organic chemistry. [...] In terms of well established sciences, it covered practically all astronomy and branches of physics and chemistry, e.g. geophysics, upper atmosphere physics and chemistry, cosmic radiation physics."[24] By launching a large number of sounding rockets one could hope to cover large sections of the field at relatively low cost.

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[22] See COPERS, 3rd session (24-5/10/61), COPERS/Min/3, 16/11/61, p. 3.

[23] For the conference resolution see ESRO/Conference/3, 17/5/62.

[24] COPERS, 2nd session (17-18/5/61), COPERS/Min/2, 25/5/61, p. 2.

Then there was the fact that the rockets provided a hedge against disappointments in the satellite programme, a programme in which competition was intense and lead times were long. Individual researchers, small groups or graduate students might have to wait years before actually getting a scientific experiment flown on a satellite. They were more or less assured results within one or a few years on a sounding rocket.[25]

The relative inexperience of the European space science community was another argument in favour of sounding rockets. No less than 40 of the 55 groups surveyed had no flight experience, and were either already planning experiments or simply hoping to enter the field. Sounding rockets provided a useful means for novices to cut their teeth in the new, challenging domain.

Finally, sounding rockets were of particular interest to groups in some of the smaller countries with relatively low budgets for space research. They enabled scientists in those countries to participate alongside their colleagues from Britain and France who had well developed national space programmes, and who had the experience and the resources required to fly also the (technically) more sophisticated and expensive satellite experiments.[26]

A word should also be said about the significance of the large satellite projects in this programme. In a context in which major European countries, notably Britain and France, were willing to build up strong national space programmes, these "long-term" projects provided an important rationale for them to collaborate in a joint European effort. "The real raison d'être of Organisation" said Alexander Hocker, ESRO's second Council chairman, was "to carry out projects of a scale and technical complexity beyond what the European countries could achieve within the framework of their individual national programmes." And, he added, "this was the reason why, right at the outset, consideration was given to the project for a Large Astronomical Satellite".[27] In other words the large projects were a way of cementing Britain in

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[25] This point has been stressed in Hultqvist (1967).

[26] Massey and Robins (1986), p.121 have stressed the importance of sounding rockets for "small" countries at this stage of the negotiations.

[27] Forward by A. Hocker to *ESRO General Report 1966.*

particular, with her important human and material resources, in a European programme. They also incidentally provided the rationale for a clause in the ESRO convention stipulating that no member state could withdraw before the eighth year, and for establishing an eight-year budget for the body. This was seen in 1962 as a way of ensuring that funds would be available for a long-term project.[28]

Finally, it must be stressed that when the scientific programme was initially put forward in May 1961 it was defined as the minimum programme,[29] and a special provision was made in the convention for its extension. In particular, taking CERN's convention as a model, a distinction was drawn between a basic or initial programme, and a supplementary programme which could later extend the basic programme if two-thirds of the member states agreed to it.[30] The whole idea was soon dropped on the insistence of the British. They claimed that no clear distinction could be made between a basic and a subsequent programme. They also refused to have the former defined in a formal document like a convention in terms of a number of devices to be launched.[31] As a result there was no provision made in the ESRO convention for the organic growth of the agreed programme. Article VII dealing with launchings stipulated simply that the organisation would launch sounding rockets, and small and large satellites and space probes, the number of launchings to be decided by the Council "with a view to providing reasonable opportunities for scientifically valuable experiments [...] to be carried out." This is not to say that no provision was made for new projects in the ESRO convention. However these were not seen as extensions of some basic programme, and so necessarily springing from within the framework of the organisation. Rather they were treated as additional initiatives coming from within the Member States who sought certain forms of support from ESRO.[32] In short

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28 See the report of the Budget Subgroup COPERS/AWG/II/2 (rev. 1), 19/3/62.

29 See COPERS/20, 11/5/61.

30 Hermann et al (1987), section 8.2.1.

31 See COPERS/AWG/18 (add. 2), 5/9/61, a note by the British delegation on the article of the convention dealing with the scientific programme *inter alia*.

32 Thus Article VIII of the ESRO convention reads "If, outside the agreed programme but within the scope of the Organisation, one or more Member States engage in a project in connection with which the Council decides, by a two-thirds majority of all Member States, to make available the assistance of the Organisation or the use of its facilities, the resulting cost to the Organisation shall be refunded to the Organisation by the State or States concerned". A typical application of this clause would be a request by a member state to use the ESRO launching range at Kiruna for its national sounding rocket programme.

there was no legally-enshrined opportunity for expansion and increased expenditure inside the ESRO programme as there was in CERN's.

2 *The Facilities*

ESTEC and ESLAB

From the outset it was assumed by the scientists planning ESRO that its core facility would be an establishment responsible, either itself or through contracts with industries and national institutes, for the engineering and testing of satellites and their payloads, the integration of scientific instruments in these payloads, and for making arrangements for launching. These activities were to be undertaken by what was initially called a Payload Engineering Unit and, later, the European Space Technology Centre (ESTEC).

At the same time some people felt that it was a mistake to restrict European scientific and technological collaboration in this sphere to what were essentially engineering tasks. In particular they felt that ESRO should also have a scientific research role of its own. This complicated question was to bedevil the debates inside the planning groups for much of 1961, and was never really satisfactorily resolved.

The debate was triggered by the first report of the Interim STWG prepared after its meeting in London on 8 and 9 May 1961 (COPERS/20). The report began by drawing a sharp distinction between scientific research and technological development, restricting ESRO's activities to the latter. ESRO, it said, was to be responsible for the engineering development of space technology which universities and other research institutes in the participating countries needed in order to do their research. It was not to compete with such institutions "in carrying out purely scientific research."[33] Apparently then scientific research as such — and the terms were yet to be defined — were not to be an intrinsic part of ESRO's activity. Instead, the Interim STWG proposed that ESRO provide scientific fellowships for training and research tenable at the "Payload Engineering Unit" or, where appropriate, at any of the national laboratories.

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[33] See the introduction to COPERS/20, 11/5/61.

This restriction on ESRO's activities was immediately contested by the Belgian, French and Swiss delegations, supported by Council chairman Massey, at the COPERS session a few days later in the Hague. Their objections were developed in two papers prepared in June for the meetings of the Interim STWG. The first was written by Golay (the director of the Observatoire de Genève), Pecker and Vandenkerckhove. The second, written after one of the STWG meetings, was by Pecker alone.[34]

The heart of the matter was whether or not ESRO should have a "scientific function in its own right" or whether it should be reduced to "nothing but a European service at the disposal of Member States."[35] The critics of COPERS/20 felt that it was essential that ESRO develop its own scientific identity. In practice this could mean two things which were never clearly distinguished from each other. Firstly, ESRO could engage in basic research. For example, Pecker suggested that ESRO could do research "on photochemistry of molecules and atoms in the high atmosphere, on the methods for measuring magnetic fields, on high dispersion spectrography, etc." These views were strongly supported by Massey at the Hague meeting. "The organisation should have its own research laboratories in certain well-defined fields," said the chairman of the session. He later identified the kind of activities such laboratories could engage in: theoretical and experimental work on "reaction rates and processes occurring in the upper atmosphere, in stars and elsewhere in the Universe [...]" and "plasma flow in the interplanetary field [...]." [36]

The second way in which ESRO could establish its own scientific identity was by building scientific instruments to be flown on ESRO satellites. This point was specifically referred to by the French delegation, supported by their Swiss colleagues,

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[34] For the objections raised by the Belgian, French and Swiss delegations see the minutes of the second session of the COPERS held in the Hague on 17-18/5/1961, COPERS/Min/2, 25/5/61. The paper by Golay et al is document COPERS/GTST/6, 12/6/61, that by Pecker alone is COPERS/GTST/I/8, 20/6/61. It should be noted that both Golay and Vandenkerckhove were members of the Swiss and Belgian delegations which raised the objections made at the Hague.

[35] The first phrase is from the intervention made by the French delegation to the second session of the COPERS in the Hague (cf. note 34), p. 4, the second from the paper by Golay et al (cf note 34). It is to be noted that the head of the French delegation, Francois de Rose, was an ardent champion of CERN, which had a very strong inhouse staff.

[36] For the material in this paragraph see the documents cited in note 34 and Annex 12 to Massey and Robins (1986).

at the Hague meeting. It was contrary to the Meyrin agreement, said the French, to limit ESRO to the provision of technical facilities, leaving the initiation and execution of scientific experiments entirely to national institutions. France, its delegate pointed out, had the infrastructure and money to undertake its own programme of space research but this was not so for all European countries, notably the smaller ones. To protect their interests ESRO should build scientific instruments to be used for space research.

While on the face of it these demands appeared quite reasonable, their institutional implications created considerable concern. The problem was this. Everyone seemed to agree that ESRO should supplement, not compete with, national space activities. However, it was feared that this was precisely what would happen if the proposals made by the Belgian, French and Swiss delegations were carried out. In particular, if ESRO was to build scientific instruments of its own to be flown on satellites it would need to have a strong in-house scientific staff. And this was seen as a danger to research in universities and national institutions by the Dutch delegation at the Hague and, eloquently and explicitly by the chairman of the Scientific Programmes subgroup and Director of Kiruna, B. Hultqvist.

Hultqvist had four reasons for not wanting to set up scientific groups inside ESRO carrying out their own research. Firstly, he feared that there would be a braindrain from national scientific activities to the central scientific laboratory. Secondly, he feared that ESRO scientific groups would rapidly become privileged groups with the best staff, the best facilities and the best experience and so might come to monopolise the most sophisticated and challenging satellite experiments. Thirdly, he believed that if there were no such scientific groups set up the scientific activity would be more readily distributed among the participating countries, to the overall benefit of ESRO and of the European space effort in general. And finally, he was concerned that the in-house staff would have privileged access to satellites. Proposals for space experiments from such groups, Hultqvist stressed, would have to pass through exactly the same channels as those coming from national teams.[37]

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[37] Hultqvist expressed his fears in a letter to Lines extracts from which were published as document COPERS/GTST/I/1, 15/6/61.
It is to be noted that friction between in-house staff and "outside users," and the tendency for the former to dominate the latter, is a common feature of high-energy physics research laboratories. This matter has been discussed extensively in Pestre (1990a) and in Krige (1990b).

Golay, Pecker and Vandenkerckhove were aware of the weight and the appeal of Hultqvist's objections. To meet them, they insisted that, while it would be necessary to build up research groups having the critical mass needed to do useful work, the permanent membership of these groups should be restricted to a minimum, and a majority of their members should be on temporary fellowships. They also left the precise location of any such group open to discussion. For example, there might be such a group attached to ESRO itself, but there might also be groups in various national institutes. In this way advanced scientific research would be decentralised, so putting a check on the size of ESRO's inhouse staff while also distributing ESRO's research activities among several member states.

The debates around this issue were to dominate the Interim STWG throughout June 1961. Towards the end of July it was finally accepted that a scientific research laboratory be established. A new set of budget estimates prepared on the 19th of that month specifically made allowance for buildings and equipment as well as for the salaries of an ESRO research group which was to be supplemented by research workers on ESRO fellowships.[38] As for its tasks, in a text "arrived at as a result of a long and difficult discussion," (Hulthén) they were defined as "to undertake theoretical studies and fundamental theoretical research of importance to space science," and "to provide experimental facilities to enable individuals and small institutions to undertake research in space science."[39] At the same time the Interim STWG spelt out a way of organizing the scientific work which effectively precluded the ESRO inhouse scientific group having its own sounding rocket or satellite-based experimental programme.

The organization of the scientific work foreseen by the STWG in the *Blue Book* divided experimental projects into three categories by source of funding. Firstly, there were pure ESRO experiments, i.e. experiments paid for entirely by ESRO (typically, the large satellite projects). Such projects would be engineered at ESTEC though the scientific payloads, even if paid for by ESRO, would be contracted out to a large extent to European industries and scientific groups in universities and national institutions. Secondly, there were combined national and ESRO experiments, in

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[38] For the new budget estimates see COPERS/GTST/14, 19/7/61. See also the new version of the convention which made allowance for the laboratory, COPERS/AWG/18 (add 1, rev. 2), 20/7/61.

[39] For the quote by the chairman of the STWG, see COPERS, 3rd session (24-5/10/61), COPERS/Min/3, 16/11/61, p. 3. For the role of the scientific laboratory see *Blue Book* (cf. note 19), p. 24.

which the scientific instrumentation would be built in the member states and paid for exclusively from national funds, ESRO's task being to engineer the satellites. This would be the case with most experiments. Thirdly, there were what were called national experiments undertaken with ESRO help, in which once again the scientific payload would be paid for from national budgets, but ESRO facilities, e.g. launching ranges, would be used and perhaps even paid for by the national group. In all cases then it was assumed that the construction of scientific instruments flown on ESRO satellites would normally be under the control of national groups, even when all the costs were being borne by ESRO. The STWG, as we have mentioned, stressed that an additional 16 MFF annually would be needed for such activities over and above the money required for the ESRO budget.[40]

The size of the ESRO inhouse scientific staff allowed for by the Interim STWG reflected this determination to deny them space on satellite payloads. The laboratory was provided with a building and equipment for about 50 research workers and technicians as well as a permanent staff. A typical permanent staff, it was said, would comprise one scientific head with two scientific assistants along with administrative officers, technicians and a maintenance staff. This was in fact smaller than the so-called standard scientific group which the STWG estimated to be necessary for preparing experiments to fly on satellites, and which comprised four scientists, four technicians and three auxiliary staff.[41]

The limitations imposed by the Interim STWG (supported by the British, Dutch and Norwegian delegations) on ESRO's scientific laboratory, ESLAB, were reflected in the convention. According to Article VIb, ESLAB was to be situated "near" ESTEC and its task was "to undertake joint research programmes on the minimum scale deemed necessary by the Council [...] to complete or complement the scientific studies carried out in Member States." These formulations were not simply a victory for those who wanted to ensure that a strong inhouse staff did not come to dominate the scientific programme. They were also a symptom of the determination of space scientists to protect their national efforts. And an index of their perception of the role of ESRO in European space science: for many of them it was, indeed, to be a service organization.

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[40] For this information see COPERS/GTST/I, 15/6/61 and the *Blue Book* (cf. note 19), pp. 12/13.

[41] See the *Blue Book* (cf. note 19), pp. 24-25, 30 and 34.

To conclude let us simply note that the debate over ESLAB was far from settled by these "agreements." Its site was unexpectedly contested a few months later by the Italians just before the convention was due to be signed. Notwithstanding the specification in Article VIb that it should be near ESTEC, the Italians wanted a facility on their soil. And the conviction in some quarters that the laboratory should have a highly competent inhouse scientific staff, capable of flying their own experiments, was to lead to a bruising conflict throughout the early 1960s over who should control the scientific payload for ESRO's first major scientific project, the large astronomical satellite (LAS).[42]

ESRANGE, ESDAC and ESTRACK

Three other facilities were required in addition to the Payload Engineering Unit, or ESTEC, and the scientific laboratories of ESRO, ESLAB. These were launching ranges, a data analysis centre, and a network of tracking and telemetry stations.

The first, labelled ESRANGE, caused little difficulty. It was generally agreed that it was important to carry out a sounding rocket programme in the auroral zone, and for this reason it was essential that ESRO equip itself with a suitable range in the northern latitudes. Apart from that, there seemed to be no need for ESRO to have any additional ranges of its own. Its sounding rocket programme in medium latitudes could, it was felt, be adequately supported by using existing national ranges. And although there were certainly some advantages to be had from creating a special satellite launching range under ESRO control, the STWG concluded that "up to the present the creation of such a new range does not appear to offer any scientific advantage."[43]

Data handling had two aspects. Firstly, it required the setting up of a network of tracking and telemetry stations which could receive signals from spacecraft (ESTRACK). Secondly, it required a central laboratory which would edit and process the information from the tracking network. This data centre would have scientists and engineers on its staff who would not only concern themselves with the technological problems of data recovery, processing and analysis, but also with

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[42] See Krige (1992a).

[43] See the *Blue Book* (cf. note 19), p. 18.

fundamental questions associated with the prediction and analysis of satellite orbits. The facilities at the centre (ESDAC), essentially a large mainframe computer or computers, would be available both to its inhouse staff and to visiting scientists and fellows who wished to use them to analyse and study the recovered data.

There only seemed to have been two points of ambiguity, and possibly of controversy, surrounding these several facilities. Firstly, there was the question of the relationship between ESDAC and ESTRACK. The first report prepared by the STWG in May 1961 explicitly stated that the data centre would, "in addition to data handling, also control a number of tracking and telemetry stations."[44] By October that year this seemed no longer necessarily to be the case. There is no explicit reference in the *Blue Book* to ESDAC actually controlling the telemetry and tracking stations and indeed when ESRO was born the control centre for managing tracking and data acquisition facilities was situated at ESTEC. It was an unhappy decision. Within a few years it was reversed, and satellite tracking reverted to ESDAC which was renamed ESOC, the European Space Operations Centre.[45]

The second possible point of friction concerned the nature and distribution of the ESTRACK facilities. In the *Blue Book* it was proposed that ESRO set up four new radio tracking and telemetry stations, and three optical tracking stations. Three of the radio stations were to be distributed roughly along longitude 135° East, and the fourth around longitude 15° East. They could be supplemented by stations on these longitudes which were part of the U.S.'s Minitrack network. In this way two new chains of stations, one running through Japan and Australia, and the other through Europe and the African continent, could be added to an American chain running roughly down longitude 75° West. As for the three optical stations, the *Blue Book* insisted that these were urgently needed to support a variety of studies, e.g. gravitational, geodetical and atmospheric structure studies as well as certain ionospheric investigations. There were far too few of these stations in existence in the world at the present time, claimed the report, and it seemed clear that ESRO should make as large a contribution as possible to their extension, in consultation with the COSPAR.

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[44] See COPERS/20, 11/5/61, p. 2.

[45] For information on the control centre at ESTEC see Fraysse (1966). The transfer of this centre to ESDAC was a consequence of the recommendations made by the Bannier report in 1967. This report and its implications will be discussed in another paper.

The STWG regarded this set-up of four radio tracking and telemetry stations and of three optical tracking stations to be an absolute minimum, a network "capable, if need be, of operating independently of existing networks, but capable also of being linked with them where possible."[46] Indeed the concept of having a network which could operate independently was built into one of the earliest drafts of the convention.[47] It did not survive for very long. The British delegation soon objected.[48] And at a meeting of the LAFWG in September 1961 it was decided to omit all reference to the coverage, and so location, of tracking and telemetry stations from the final convention.[49] Thus Article VId of the ESRO convention simply stated that to meet its initial requirements the organisation would establish and operate "a Data Centre and tracking, telemetry and telecommand stations [...]" suitably equipped. Once again the member states, apparently with little resistance from the scientists, had succeeded in pruning back the scope of the ESRO programme.

3 The Sites of the Establishments

The choices of the locations of ESRO's three main establishments, the headquarters, the payload engineering unit with its associated scientific laboratory, and the data centre, were essentially determined by political considerations: there were no overriding scientific arguments for any particular site. By contrast, scientific concerns were dominant as regards the siting of the sounding rocket launching range, which necessarily had to be placed in northerly latitudes so as to carry out geophysical studies in the auroral zone.[50]

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46 See the *Blue Book* (cf. note 19), pp. 54-56. COSPAR is an acronym for Committee on Space Research.

47 The system of tracking stations, it was said, should "complement the existing world network", but should also be "capable of giving reasonable coverage by itself." See COPERS/AWG/18 (add. 1, rev. 2), 20/7/61.

48 See the UK note COPERS/AWG/18 (add.2), 5/9/61.

49 LAFWG, 4th meeting (28-9/9/61), COPERS/AWG/38, 9/10/61.

50 Scientific as well as political considerations also played a role in the siting of the tracking stations of course. We do not discuss this here as the choices were made well outside our timeframe. Suffice it to say that in 1967 ESTRACK stations were being built in Belgium, Alaska, Spitzbergen and the Falkland Islands. See also Massey and Robins (1986), p. 132.

The STWG considered three possible places for this range. The first was in Greenland (Narssarssuaq), the second in Norway (Andoya), and the third in Sweden (Kiruna). Of these three the last was deemed the most suitable. Firings at the bases in Greenland and Norway would be respectively over the ice cap and over the sea, making payload recovery difficult. At Kiruna they were over the land. The first two were remote and accommodation was likely to be difficult. Access to Kiruna was good by air, road and rail and the launching range was close to a fairly large town of the same name. Finally and perhaps decisively, ESRANGE could be located near Hultqvist's Kiruna Geophysical Observatory. The only disadvantage with Kiruna appeared to be "the fact that one or two dozen Lapps may be in the area during certain periods." This safety problem, the STWG thought, was not a serious one and it strongly recommended that the Kiruna site be chosen as the location for the ESRO Northern sounding rocket range.[51]

By October 1961 several member states had expressed an interest in having one or more of the remaining ESRO facilities on their soil. France and the Netherlands had submitted bids for the headquarters in Paris and the Hague respectively. Six member states had proposed sites for ESTEC:[52] the Federal Republic of Germany near Munich; France at Bretigny, about 30 km from Paris and alongside the Centre d'Essais en Vol; the United Kingdom at Bracknell which was near the Royal Aircraft Establishment in Farnborough as well as other facilities engaged in space research; Switzerland, 15 kms from Geneva near the Observatoire de Genève, and also close to CERN and to several universities; Belgium, at Zaventem, near Brussels and close to several universities, aeronautical research centres, and research laboratories; and the Netherlands, adjacent to the Technische Hogeschool and the Central Organisation for Applied Scientific Research in Delft. At the third COPERS session in Munich at the end of October the Belgian and Dutch delegations said "that they wished their separate proposals for ESTEC to be viewed as variants of one proposal [...]."[53] As for ESDAC, by mid-October there had been just

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[51] *Blue Book* (note 19) , pp. 35, 64-67. See also COPERS/GTST/I/16, 6/7/61.

[52] For the information that follows see the folder *Emplacement des Etablissements* in Mussard files (cf note1).

[53] COPERS, 3rd session (Munich 24-25/10/61), COPERS/Min/3, 16/11/61. For more on the Bracknell site, and its advantages, see Massey and Robins (1986), p.127.

one offer of a site: from Germany, near Darmstadt.[54] In Munich the UK added the candidature of Bracknell.

The delegates to the Munich session instructed the COPERS bureau to continue to collect factual information relevant to the various sites proposed. They also authorized it to set up, if need be, a Working Group on Sites to facilitate the final choice which, it was hoped, could be made by the Council at its fourth session scheduled for 23-24 January 1962.[55] This session was, in fact, postponed by about a month. In the interim, on 25 January 1962, the bureau decided not to set up a site panel. Instead, "in view of the delicate nature of the matter", it invited Odd Dahl to study the proposals that had been received, "consulting with the appropriate authorities in the Member States as necessary, and [to] present a confidential report to the Bureau".[56]

Consistent with his brief, Dahl did not go on further fact-finding missions. Instead, he sounded out senior government officials and scientists in the several countries which had made proposals for sites. As he made his rounds, and explained the various offers and possible combinations, the number of candidate sites grew rapidly. Countries, wrote Dahl, tended to work "on the assumption that something is better than nothing," and it "became apparent that if a filed proposal were not to be upheld, a proposal for one or more of the other establishments would come forth." Thus when Dahl sat down to draft his report in March 1962 he found himself with a long "semi-official" list of proposals. France, Switzerland and the Benelux countries had all offered to host the Headquarters. Germany had effectively withdrawn its proposal for ESTEC, while Italy had added a site at the old airport just outside Rome and associated with Broglio's aeronautics experimental facilities. As for ESDAC, Switzerland had added its bid to those already on the table from Britain and Germany.[57]

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[54] LAFWG, 3rd meeting (14-15/9/61), COPERS/AWG/33, 27/9/61.

[55] COPERS, 3rd session (Munich 24-25/10/61), COPERS/Min/3, 16/11/61.

[56] This is the procedure outlined by Auger in a circular letter dated 7 February 1962 and sent to all delegations to the COPERS — see e.g. folder *Denmark* in Mussard files (cf. note 1).

[57] Dahl's report is reproduced as Annex 11 in Massey and Robins (1986). There is also a copy in the Mussard files (cf note 1), folder *Emplacement des Etablissements*.

In Dahl's report, and in the subsequent debate around the sites of the establishments, three considerations more or less explicitly informed the negotiations: whether the sites should be concentrated or dispersed, whether ESRO's headquarters should be close to ELDO's headquarters or remote from it, and whether or not it was desirable to put ESRO's headquarters near to ESTEC.[58] There were of course strong arguments on both sides as regards all three of these criteria.

Cost, efficiency, and the possibility of making a quick start to the European space effort weighed in favour of concentrating the establishments. As Dahl put it, "ESRO will cost relatively more, we will move slower and it will be more difficult to have control," if the establishments were dispersed. "There [would] be a tendency towards independent growth of establishments as administration and services must in certain ways be duplicated."[59] Against that there were obviously strong political considerations in favour of dispersing the establishments. Not only would it enable more member states to have a direct stake in the joint effort so making it more "truly European." It was also a means of stimulating space activities in those countries, particularly smaller ones, which were relatively backward in this regard. What is more, it was not obvious that dispersion necessarily meant a loss of efficiency. As the Belgian delegation and the LAFWG's budget subgroup pointed out, NASA's establishments were widely dispersed across the United States and this did not seem to create intolerable inefficiencies.[60]

Opinions were also divided over whether or not ESRO's and ELDO's headquarters should be in the same place. Massey, for example, was very much against the idea or even against any close cooperation. "His main argument [was] that ELDO [was] a 'commercial' set-up [...]", while ESRO was strictly scientific.[61] Some delegates, e.g. Austria, also feared that if ESRO and ELDO were tied too closely

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[58] These considerations were spelled out in Dahl's report (cf previous note), and in COPERS/87, 4/5/62, a summary report of meetings held between the bureau and the heads of delegates of the member states on 26 and 27 March and 4 April 1962.

[59] See Dahl's report cited in note 57.

[60] See COPERS/87, 4/5/62. It is to be noted that in a trip to NASA at the end of 1961 by some members from the budget subgroup NASA recommended that ESDAC and ESTEC be located in the same place — COPERS/AWG/II/2 (rev. 1), 19/3/62.

[61] *Memorandum for Prof. Auger from Odd Dahl, Meetings in London, February 12* — Mussard files (cf note 1), folder *Emplacement des Etablissements.*

together it would limit ESRO's freedom to purchase rockets from NASA.[62] Against that it was felt that there would obviously have to be very close contact between ESRO and ELDO, and that it was highly desirable that they share certain "neutral functions" (e.g. administrative services) in the interests of saving money and of efficiency.[63]

Finally, there were clearly advantages to having ESRO headquarters close to ESTEC, so facilitating the lines of communication between the administrative arm of the organisation and the most important ESRO establishment. This in fact was the combination preferred by the scientists on the STWG.[64] The picture was however blurred by the fact that some people, particularly the British, felt that there should also be very close technical collaboration between expert groups in the ELDO headquarters and the engineers in ESTEC. Thus the question of whether or not the ESRO headquarters should be near the payload engineering unit became intertwined with the question of whether or not it should also be close to the ELDO headquarters.

When Dahl came to frame his proposals it was already known that ELDO's headquarters would be in Paris. That granted he opted for moderate concentration, suggesting that ESRO's headquarters should be located together with ESTEC (and ESLAB) on the proposed site in Delft, while ESDAC and the tracking centre be located in Darmstadt. His report was laid before a joint meeting of the COPERS bureau and the heads of the delegations on 26 and 27 March 1962 — and his recommendations were summarily dismissed. A number of delegations, we read in one report of the proceedings, "while acknowledging the difficulty of Dr Dahl's mission and thanking him for the considerable amount of work which it had involved, considered that the report touched on matters of opinion as well as of fact and in this

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62 See COPERS/87, 4/5/62, p. 2. Austria also stated that it was against putting the headquarters of ESRO and ELDO close to one another for "political reasons" — by which it probably expressed a desire to distance itself from the military associations of the launcher development organisation.

63 From Dahl's report cited in note 57.

64 COPERS/36, 19/10/61. This document listed the STWG's criteria for the location of ESTEC which were: within some tens of miles of liquid oxygen and liquid nitrogen plants, near an international airport and central with respect to the member states, near small electronic and electric factories, near an industrial area, near a technical college, near a university, suitable accommodation available, and near ESRO headquarters. All the sites offered satisfied the first seven of these eight criteria.

regard was not an appropriate basis for discussion."[65] Whereupon the hard bargaining and political horsetrading began.

Three points emerged at this very tense and difficult meeting. Firstly, it was generally agreed that ESRO's headquarters would be in Paris along with ELDO's. The French were extremely keen to have them there, letting it be known that they would withdraw the bid for ESTEC at Bretigny if successful. There were also some advantages to having ELDO's and ESRO's administrative and policymaking centres close to one another, as we have said. Secondly, the choice of a site for ESTEC was more or less reduced to a two-cornered contest between Bracknell and the Belgian/Dutch proposals. The other remaining candidates, Italy and Switzerland, were poorly supported. Finally, Italy, finding itself marginalised, made a bid for ESLAB. There was apparently "strong support" for this idea, even though the draft of the convention, agreed after months of negotiations, specifically said that ESLAB should be near ESTEC, and there was "no suggestion at the meeting that ESTEC also should be in Italy."[66]

No definite decisions were taking at the meeting in March. Those present agreed to reconvene on 4 April. This time the climate was, apparently, more relaxed. The British, having found that only the Scandinavians were in favour of having ESTEC in the UK, had decided in the interim not to press their case for the central unit, even though they were convinced that the human and material resources in and around Bracknell provided the best way "to ensure quicker development of a subject in which Europe was already a long way behind the United States and the U.S.S.R." The Swiss too came to the meeting willing to withdraw their candidature for ESTEC "in order to facilitate a solution", they said, preferring to put up a fight for ESDAC.[67] A secret ballot was held on the location of the payload engineering unit, the vote being 6—4 in favour of Delft over Brussels (Belgium and The Netherlands did not participate). The voting for ESDAC, now a choice between the Swiss site in Commugny and the German site in Darmstadt, was 8—4 in favour of the latter, only

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[65] See COPERS/87, 4/5/62.

[66] For this paragraph see Dahl's report (cf note 57) on the French position, and Massey and Robins (1986), p. 129, and COPERS/74, 28/3/62 and COPERS/87, 4/5/62, which describe the proceedings at the meeting.

[67] For these elements see respectively Massey and Robins (1986), pp. 127, 129 on the UK, and COPERS/87, 4/5/62, pp. 6,7.

the two "neutrals" Austria and Sweden, along with Spain, joining the Swiss in preferring the site near Geneva. The headquarters, as expected went to Paris, by 10—2 (Norway and Sweden), the latter insisting that their objection was not "to be construed as anything other than the expression of their conviction that the Headquarters should be located at ESTeC". It was also unanimously agreed that the Nordic launching base of the ESRANGE complex should be at Kiruna. In fact so sure were the Swedes of their case, and so keen were the scientists to get started, that there was already a bill before the Swedish parliament, due to be passed in May, proposing that the existing site near Hultqvist's laboratory be made available to ESRO.[68]

This left the thorny question of Italy's offer to host ESLAB. The British were strongly opposed to this. The laboratory, they said, had been conceived as a small centre close to ESTEC, which would now be in Delft. Hulthén, speaking on behalf of the Interim STWG, backed up the UK delegation. The Italian proposal was contrary to the "carefully worded compromise" regarding this facility which had been arrived at by the Group after months of discussion. One could not now redefine the nature of the laboratory without referring the matter back to the STWG, so introducing additional delays. Broglio, however, was emphatic, though he did imply that the laboratory which the Italians wanted need not in fact be ESLAB, but an additional facility with a rather different focus. This broke the deadlock. The majority of the delegations felt that the Italian demands had to be met, and voted 9—3 (Norway, Sweden and the UK) to recommend to the COPERS "that a laboratory of a size and scope to be decided by the Council should be established in Italy".[69] The Council accepted these proposals with some misgivings at its fifth session, and they were confirmed by the Conference of Plenipotentiaries on 14 June 1962.[70] Thus was born ESLAR (later renamed ESRIN): a laboratory for advanced scientific research in Italy in addition to ESLAB. [71]

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[68] See COPERS/87, 4/5/62, pp. 6-8 and Massey and Robins (1986), pp. 129-30.

[69] See COPERS/87, 4/5/62, pp. 9-10, and Massey and Robins (1986), p. 130 et seq. The proposals for the sites are summed up in COPERS/82, 27/4/62.

[70] See COPERS, 5th session, (10-11/5/62), COPERS/Min/5, 12/6/62, and ESRO/Conference/3, 17/5/62.

[71] We shall discuss the debates over the precise role of ESRIN and its site in a later report. To get the flavour see Massey and Robins (1986), pp.130-2.

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It was only to be expected that the sites for ESRO's establishments would be hotly contested. The prestige associated with having an international organization on one's soil, and the spur to local education, and to local and national industry provided by the technically-oriented centres like ESTEC and ESDAC, were considerations that, for some delegations, weighed heavily in favour of making a bid. At the same time the procedure followed in this case has one striking feature: the lack of any serious attempt, or perhaps we should say of any pretence, to base the key choices on "non-political" criteria. It is not unusual in situations such as this for those who must ultimately take the decision to strive for at least a semblance of "objectivity", even if only to reject the relevance of scientific and technical criteria afterwards.[72] This was precisely the kind of task that the envisaged Working Group on Sites would presumably have performed: visiting the various proposed locations, assessing the suitability of the surrounding facilities, perhaps checking the nature of the ground, of the water supply etc, especially as regards the possible locations of ESTEC. This was never done systematically. Instead one man, Odd Dahl, was appointed to tackle the problem, which he construed, not as requiring a fact-finding mission, but as needing to forge a compromise behind closed doors between the different member states. This procedure indicated perhaps a healthy realism, the recognition that the defence of national interests in the choice of the sites was likely to be so dominant and so explicit that any attempt to place them on some kind of objective basis would be a waste of time and a charade. As matters turned out though this proved unfortunate, for the decision to locate ESTEC at Delft was a bad one. "I know now why the cows are always running on the land offered to us by the Dutch," Lines reputedly joked to Mussard soon after the choice of the site was made. "As soon as they stop they sink!"[73] Indeed it was found that the stability of the soil in the polder on which the Dutch government had proposed to build ESTEC was suspect. After a long and rather acrimonious debate, and a special plea from ESRO Council chairman Massey, it was agreed in October 1964 to construct the facility on a new Dutch site at Noordwijk.[74]

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[72] See for example Pestre (1992) on the procedure followed for the choice of the site of CERN's 300GeV Super Proton Synchrotron.

[73] From letter Mussard to Auger, 19/10/83. Copy kindly provided to the author by Mussard.

[74] See document ESRO/C/12 (rev. 1), 5/6/64 for the doubts over the site; ESRO Council, 4th session (22/10/64), ESRO/C/MIN/4, 4/11/64 for Massey's plea that the delegates stop competing for an alternative site for ESTEC on their national soil in the interests of European cooperation.

4. *The ESRO Budget and the Mechanisms Evolved for Keeping it Under Control*

The first estimates of the level of ESRO's budget were quickly made by the Interim STWG. Their figures were then gradually revised upwards, initially by the scientists themselves and later by the administrators in the budget subgroup of the LAFWG. In parallel with these developments, and partly spurring them on, some of the member states began to worry about how best to keep ESRO's budget under control. The British were particularly determined to install a set of mechanisms to ensure that governments retained the power to limit ESRO's expenditure. The solution that they came up with, after some difficulty, combined the imposition of financial ceilings with the right of any member state in the Council to veto a proposal to exceed these ceilings. The UK delegation's determination to fight for this kind of solution was directly linked to a recent painful experience it had just had at CERN. If they achieved their objectives with far less rancour in this case, it was because in ESRO, unlike in Geneva, the British had wider support among the member states and, indeed, were not strongly opposed by the European space science community.

ESRO's eight-year budget estimates as calculated by the STWG

The earliest estimates of the costs of ESRO were prepared by the interim STWG in time for the second session of the COPERS held at the Hague from 17 to 18 May 1961.[75] Their annual and overall eight-year figures are presented in column 2 of Table 3. It shows costs rising steadily during the first three years, when the construction of buildings and the acquisition of capital equipment dominate expenditure. As these fell off in years four and five, so their place was taken by the growing needs of the medium-term scientific programme based on the launching of small satellites. There was then a sharp jump in year six to a level of expenditure which remained constant in years seven and eight as the space probes and large satellites were launched. With this distribution of expenditure, over half the burden of financing ESRO fell in the last three years of the eight-year plan.

We will discuss the problems surrounding the Delft location for ESTEC in more detail in another report.

[75] They are presented in COPERS/20, 11/5/61.

A word is apposite on how costs were distributed between the different sectors of the organization's activity. Fifty per cent of the overall estimate of 1360 MFF was for the payload engineering unit. Of this about half again was for the three project groups whose task it was to engineer sounding rocket payloads and satellites.

Table 3. Estimates of the costs of ESRO (in millions of New French Francs) made in anticipation of the signature of the convention by the scientists in the interim STWG of the COPERS. The scientists did not include estimates of the cost of the headquarters in their figures; the figures arrived at by the LAFWG Budget Subgroup (83.7 MFF over the eight years) have been added to the STWG's January 1962 estimates for completeness (column 5).

Year	STWG May 1961	STWG Blue Book Oct '61	STWG Jan '62	STWG Jan '62 + Hdquarters
1	61.9	69.7	73.8	82.4
2	123.0	121.2	104.9	115.5
3	150.6	148.7	157.5	169.0
4	156.0	162.2	168.2	177.7
5	172.5	181.2	187.7	198.5
6	232.1	243.2	262.0	272.8
7	232.1	243.1	259.4	270.3
8	232.1	242.6	259.6	270.6
TOT	**1360.3**	**1411.9**	**1473.1**	**1556.8**

Sources. Column 2: COPERS/GTST/20, 11/5/61; Column 3: *Blue Book*, data laid before the third session of the COPERS in Munich on 24-25 October 1961, pp. 18-9; Column 4: COPERS/GTST/30, 22/1/62; Column 5: as for column 4, with LAFWG's data on headquarters taken from same source.

The costs of acquiring and launching light and heavy launchers counted for another third of the overall expenditure. No provision was made by the STWG for the costs of building and running ESRO's headquarters. Nor did the figures include the 16 MFF per year required to fund the construction of scientific instruments in the various member states.

In presenting this first budget the scientists insisted that the numbers that they had come up with were "to be a minimum below which it would not be worthwhile having such a programme at all."[76] Several "possible additions" to this programme were identified, including a new launching site for light and heavy satellite launchers (costing about 300 MFF) and an additional large satellite project (costing about 90 MFF).[77] The paper also stressed that the costs for vehicles had been calculated using figures provided for NASA's *Scout* launcher for the small satellites and the costs of *Blue Streak* as provided by the UK Ministry of Aviation for space probes and large satellites. The latter was "a marginal cost", and it assumed that ESRO effectively bought the rocket off the shelf. As we remarked earlier it was also assumed, for budgetary purposes, that two launchings would be required to put one satellite or space probe successfully into orbit. At the same time it was mentioned that if the *Atlas-Agena B* rocket was used instead of *Blue Streak* additional resources to the tune of 90 MFF per year during years six to eight would be required.

Despite its provisional nature, and these various qualifications, the scientists in the Interim STWG made relatively few additions to their first estimates. The main increases asked for in the classic *Blue Book* prepared for the Munich session of the COPERS in October 1961 (see column 3, Table 3) were some 35 MFF for expenditure in industry by ESTEC and an additional 12 MFF for ESLAB.[78] These estimates were further increased after a visit to NASA on 1 and 2 September 1961 by a small party headed by Dr C. de Jager. Their aim was to discuss satellite tracking and data acquisition facilities and to explore the possibilities of future collaboration with the USA in these fields. They came home convinced of the need to increase their earlier estimates of expenditure in these areas.[79] The cost of both was thus pushed up by a little over 30 MFF with respect to the *Blue Book* figures to give a final STWG

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[76] This is in fact the way in which the British delegation put it at the meeting in the Hague. See COPERS, 2nd session (17-18/5/61), COPERS/Min/2, 25/5/61, p. 8. Sir Harry Massey, who was the chairman of the session, replied to the British delegation that "there could be no doubt at all on this point."

[77] Other new projects envisaged were a pilot meteorological experiment costing some 4MFF per year and an additional project group to study advanced methods of propulsion (initially 2MFF/year).

[78] The arrival of ESLAB at this point has been explained in the previous section. For an anticipation of the figures given in the *Blue Book* see also document COPERS/GTST/14, 19/7/61.

[79] For their report see COPERS/GTST/III/9, 20/10/61 to which is attached document COPERS/GTST/III/8.

estimate of 1473 MFF in January 1962 (see column 4, Table 3). This was less than 10 per cent above the first estimate provided in May 1961. If the budget subgroup's costing of the headquarters is added we arrive at an estimate for the scientists' eight-year programme of a little over 1500 MFF (see column 5, Table 3).

The debate on financial control

These relatively minor and carefully calculated increases to the STWG's global budget estimates took place against the background of a debate in the LAFWG and in the COPERS Council about how best to control ESRO's finances. It was a debate which led some members of the budget subgroup to insist that the scientist's figures would have to be revised upwards if the programme was not to be seriously reduced.

The first steps towards defining a set of budgetary rules for ESRO were taken by the British, quickly supported by the French, in September 1961.[80] They rapidly proved to be controversial and the LAFWG decided that the issues were best left to the Munich session of the COPERS to be held the following month.

There were two aspects to the problem. Firstly, Britain and France wanted the major contributors to the budget to have a veto over the expenditure on particularly costly developments. "Experience with CERN," said the French delegation in Munich, "whose annual budget was now twice as much as originally planned, had caused the larger countries to ponder what they might be letting themselves in for in ESRO's case."[81] Budgets at CERN were voted by simple majority. The British and the French felt that this would not do for ESRO. They suggested that any modifications to ESRO's programme of work or to its facilities should be agreed by a qualified two-thirds majority, the qualification being that each member state paying more than 10% of the ESRO budget (i.e. F, FRG, I and UK) should be among the

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[80] See documents COPERS/AWG/18 (add. 3), 5/9/61; COPERS/AWG/18 (add. 4), 11/9/61; LAFWG, 3rd meeting (14-15/9/61), COPERS/AWG/33, 27/9/61; and LAFWG, 4th meeting (28-29/9/61), COPERS/AWG/38, 9/10/61.

[81] See COPERS, 3rd session (24-25/10/61), COPERS/Min/3, 16/11/61, p. 6. For French determination to have a veto over expenditure see letter V. Giscard d'Estaing to his Prime Minister, 14/12/61 (folder *France*, Mussard files (cf. note 1)). In his letter Giscard pointed out that France's contributions to international organizations had increased by a factor of 155 between 1955 and 1962. He was determined, he said, that his country should not be put before a *fait accompli* in terms of financial commitments at the international level, and that the only way to brake the growth in expenditures was by the means of a veto.

concurring majority. This effectively gave these states the power to veto the proposed expenditure.

The second way in which the British hoped to exercise some control over ESRO's expenditure was by establishing "a procedure for keeping the whole financial development of the organization under review."[82] For this purpose the British proposed having three-year budgetary periods introduced, with the Council determining the level of expenditure in each year of the first three-year period and, at the same time, giving an indication to member state governments of the annual level of expenditure during the successive three-year period.

The first of these proposals was vigorously opposed by the Dutch delegation. They did not object to there being a two-thirds majority vote in certain cases; what they disliked was a *qualified* two-thirds majority. It was unwise in practice — complicated voting procedures impaired the efficiency of the organization, they said. And it was offensive in principle — the low percentage contribution of a country like the Netherlands to ESRO's budget was, in absolute terms, a lot for it, and was not a reason to restrict its formal power to decide the level of the budget. In the event no decision was taken, the delegates being divided on the issue. The three Scandinavian delegations along with the Swiss supported the Dutch, while the German, Belgian and Spanish delegations favoured some kind of qualified majority.[83]

The UK's proposals for forward planning were also greeted with some scepticism. Most delegates apparently agreed in principle with the idea. However, the French for one felt that it was "impossible to give meaningful figures, at this distance in time for the fourth or fifth year onwards." Undeterred, the British "suggested that informal discussions should soon take place between the Member States through diplomatic channels on the actual figures [...]" to be inserted into the financial protocol to be attached to the ESRO Convention.[84]

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[82] See COPERS, 3rd session (24-25/10/61), COPERS/Min/3, 16/11/61, p. 8.

[83] For this debate see the minutes of the COPERS session cited in the previous note, pp. 5-6.

[84] For these quotations see the minutes of the COPERS session cited in note 81, p. 8, and document COPERS/AWG/18 (add. 8, rev. 2), 31/10/61.

In the month after the October session of the COPERS the UK refined its proposals to control ESRO's expenditure. Towards the end of November it suggested that, on further reflection and in the light of further informal discussions, there appeared to be a "strong desire [...] by many delegations" to have an overall eight-year ceiling imposed on ESRO's expenditure. This ceiling would need to be settled at an intergovernmental conference of the organization's member states to ensure that it was binding. The same meeting would also set a ceiling for the first three years of ESRO's expenditure. It would agree on the annual budget for each year within that first three-year envelope, and it would provide an indication of expenditure for years four to six. Two alternative procedures were proposed for subsequent triennial reviews. Either *the Council itself*, meeting at ministerial level, could agree on a ceiling for the next three years by a qualified two-thirds majority. Or the Council could simply propose a level of expenditure, and *leave it to governments* to agree among themselves on a final figure for the next three years. Governments could settle this matter either through diplomatic channels or by an intergovernmental conference especially convened for the purpose.[85]

As the British grew more determined to tighten the controls on ESRO's expenditure, so the LAFWG continued to search, without success, for a compromise on the UK's proposals. Serious doubts were again raised at its sixth meeting, early in December, by both scientists and the members of its budget subgroup on the feasibility and advisability of setting firm ceilings for the later periods of ESRO's life.[86] These doubts were reinforced after a visit paid by some members of the budget subgroup to NASA.

Three considerations in particular led the science administrators to conclude that it would be foolish to try to fix expenditure using firm and difficult-to-change ceilings for anything but the first three years. Firstly, there were the likely cost escalations in the large satellite projects. Europe, it was pointed out, had as yet no experience in any satellite project taken to completion and no-one anywhere in the

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[85] For the British memorandum see COPERS/AWG/19 (add. 9), 29/11/61. We have described the content of this note in some detail because a very similar debate was occurring at CERN at this time. We shall go into this debate in more detail later.

[86] See LAFWG, 6th meeting (7-8/12/61), COPERS/AWG/51, 2/1/62. See also letter F. Bath of the British DSIR to J.J. Beattie of the COPERS secretariat, 16/11/61 and letter F. Bath to C.E.I.M. Hoogeweegen, 17/11/61, both in folder *AWG Budget Subgroup. Correspondence*, Mussard files (cf. note 1).

world had experience of very large projects. Experience at NASA however showed that the initial cost would certainly rise as scientists and engineers modified their designs in the light of new information. Thus the cost of NASA's large astronomical satellite, due to be launched at the end of 1963, had risen from an initial estimate of $21 million to $75 million.[87] Secondly, echoing the earlier remarks made by the STWG, there was the question of the launcher. If instead of using *Blue Streak* ESRO was forced to rely on American *Thor* and *Atlas* rockets for its large projects the budget would have to be increased by almost 100 MFF annually from year six onwards.[88] Finally, as German delegate Frank pointed out, during the last few years of the eight-year period one needed to provide for an as yet undefined follow-on programme if the work of ESRO was not to be disrupted.[89] In sum the budget subgroup concluded, as an internal French document put it, that

> the imposition of a "ceiling" is altogether illusory. NASA has concluded that it cannot foresee its expenditures more than three years in advance, and even then, has to make allowance for unforeseen expenditures of 20 to 30 per cent. In these circumstances the STWG's estimates after the third year are uncertain and those after the fifth year are wholly illusory.[90]

Consistent with these convictions, the budget subgroup revised upwards the estimates of expenditure proposed by the GTST. They increased the global estimate of some 1550 MFF by 100 MFF, most of the additional expenditure being for ESTEC (column 3, Table 4). And they proposed that a 20 per cent contingency be added on the total amount of the budget and that a 15 per cent allowance be made for growth during the last two years of the organization's life. This brought the subgroup's proposal for ESRO's eight-year budget to a little over 2100 MFF (column 4, Table 4).

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87 This information is taken from a NASA trip report written by members of the budget subgroup which is Annex 3 to Document COPERS/AWG/II/2 (rev.1), 19/3/62.

88 For a detailed analysis of the financial implications of replacing *Blue Streak* with equivalent US launchers see the paper COPERS/GTST/IV/7, 10/11/61.

89 See letter Frank to Hoogeweegen, 22/12/61, folder *AWG Subgroup Budget. Correspondence*, Mussard files (cf. note 1)

90 We only have a section of this document which is initialled RR on notepaper headed "Finance Extérieur." It is available in folder *AWG Subgroup Budget. Correspondence*, Mussard files (cf note 1). The translation is of course ours.

The British meanwhile, having just suffered a major setback in their attempt to impose ceilings at CERN, decided that the same mistakes (as they saw them) were not going to be made at ESRO.[91] In January Her Majesty's Government again circulated a document to the governments of the other member states of the COPERS. In it they insisted on the need for "a system of really firm triennial ceilings [...]," to be

Table 4. Estimates of the costs of ESRO made by the LAFWG's budget subgroup, as compared to those made by the scientists in the STWG. The last column is the budget levels calculated by the administrators assuming a 20% contingency for unforeseen developments, and increases of 15% in years 7 and 8 to allow for growth in the organization.

Year	STWG Jan '62 + Hdquarters	LAFWG Jan '62	LAFWG Mar '62 +20% (con) +15%(7&8)
1	82.4	89.6	107.5
2	115.5	135.8	163.0
3	169.0	185.2	222.2
4	177.7	190.4	228.5
5	198.5	212.6	255.1
6	272.8	285.7	342.8
7	270.3	281.8	389.6
8	270.6	283.1	398.1
TOT	**1556.8**	**1664.2**	**2106.8**

Sources. Column 2: COPERS/GTST/30, 22/1/62, with budget subgroup's data on headquarters taken from same source; Column 3: COPERS/GTST/30, 22/1/62; Column 4: Report of the budget subgroup, COPERS/AWG/II/2/Rev.1, 19/3/62, Annex II, Summary Table S5.

fixed by a unanimous vote of the Council, preferably meeting at ministerial level. These ceilings, the communication went on, should be "coupled with the overall eight-year ceiling, reviewable every three years, but only in the light of major changes in scientific or economic circumstances [...]." If their requirements were met, the British went on, they would no longer press for a qualified majority on the pro-

[91] We shall return to the difficulties which the British were having at CERN in a few moments.

grammes, annual work plans and budgets of ESRO. A simple two-thirds majority would suffice. Nor would they seek to have financial ceilings determined by negotiations between governments outside the framework of the ESRO Council.[92]

This note was followed by another in February, this one concerned with the level of the eight-year ceiling and the shape of the expenditure curve. Here the UK objected to the upwards revision of the eight-year budget estimate from 1500 MFF to 2100 MFF, as well as to the provision for rising expenditure in the last three years of ESRO's life (see column 4, Table 4). This expenditure curve "puts Her Majesty's Government in the greatest difficulty," the note said. If implemented it would push British expenditure on scientific space research beyond what was deemed reasonable, and the field would "claim for itself too large a share of the total national effort in pure science." Elaborating, the British stressed that it was of "cardinal importance" for the UK that ESRO's costs during the first eight years of its life should remain at 1500 MFF and that its rate of expenditure in the last three years of this eight-year period should be stable and should not exceed 240 MFF per year. The government realised that it may not be possible for ESRO to carry out the envisaged programme within these limits, as indeed the budget subgroup had stressed. However, it believed that if this were not possible the programme would simply have to be pruned back in line with the money available.[93]

The British proposals were discussed in the COPERS by both scientists and science administrators during the first three months of 1962. As one might imagine there was considerable debate both on how ceilings ought to be set, i.e. by unanimity or by majority vote, and on what those ceilings should be. Regarding the former point, the members of the STWG were clear. A unanimous Council vote for a three-year ceiling, they said, "could paralyse the working of the organization." To reach a compromise on such a ceiling, the STWG said, delegates may find themselves setting a figure which was too low to allow for effective work. Member states representatives in the LAFWG, on the other hand, were more or less split on the question. Britain and France, along with Sweden and Austria made it absolutely clear that they wanted

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[92] For this material see COPERS/AWG/19 (add. 12), 19/2/62, Annex 2.

[93] For this material see COPERS/AWG/19 (add. 12), 19/2/62, and Annex 1 to the same document.

unanimity for fixing ceilings and, in particular, would not support a German proposal that ceilings be settled by a qualified two-thirds majority.[94]

As for the level of the eight-year ceiling itself, the striking point is that it was the scientists, rather than the administrators, who were persuaded to accept the figures proposed by the British government. In January 1961 the budget subgroup insisted that the overall figure for ESRO should not be less than 2000 MFF for the first eight years. The majority of the LAFWG also apparently supported this figure.[95] The scientists, by contrast, were less convinced. At an inconclusive meeting of the STWG in January 1962 both Boyd and Lines (UK) claimed that there was probably no need to provide for a contingency on the total ESRO budget "since certain items already included a safety margin and others did not need one." At the same meeting Hultqvist (Sweden) "expressed the opinion that Europe could make a substantial contribution in space research staying within a limit of 1650 MFF" (see column 3, Table 4).[96] This tendency to accept a lower level of expenditure than the administrators deemed advisable was confirmed once the British government had insisted that the overall ceiling be 1500 MFF. An ad hoc committee of experts chaired by Van de Hulst was asked to report on what the scientists felt. In a highly uncharacteristic statement — at least if one takes the behaviour of the CERN scientific staff vis-à-vis their fund givers as one's point of reference — the expert group effectively accepted the British restrictions. The *Blue Book*, Van de Hulst's committee claimed, did not represent a detailed scientific programme, and the budget figures presented therein and in its subsequent amendments were not to be regarded as highly precise. "It is considered improbable but not impossible that the approximate programme as outlined in the *Blue Book*, " the committee went on, "can actually be carried out within the adopted ceiling of 1500 MFF." If it could not it would be necessary simply to reduce the number of launchings. Despite these restrictions, the committee concluded, "the consensus of opinion was that a programme thus reduced would still yield valuable

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[94] For the scientists' position see COPERS/AWG/18 (add. 27), 25/1/62. For the debate inside the LAFWG see the summary report of its 7th meeting (23-25/1/62), COPERS/AWG/58, 15/1/62. (This document seems to have been incorrectly dated by the COPERS secretariat. The date should presumably be 15/2/62.)

[95] See LAFWG, 7th meeting (23-25/1/62), COPERS/AWG/58, 15/1/62 for the opinion of the subgroup and COPERS/45 (rev. 1), 14/2/62 for the opinion of the LAFWG as a whole.

[96] For these quotations see STWG, 5th meeting (22/1/62), COPERS/GTST/31 (undated).

scientific results [...]."[97] In other words the STWG was no longer going to fight for its proposed programme on the grounds that it was the minimum compatible with a viable European space science effort, as they had stated less than a year earlier.

There was one other financial point that needed to be settled before the convention could be signed. This concerned the ceiling for the first three years of ESRO expenditure. As we can see from column 4 of Table 4 the preferred figure of the budget subgroup was approximately 490 MFF. This was cut by removing the allowance for contingencies and by reducing the staff foreseen for headquarters.[98] It was reduced further at the fourth session of the COPERS in February. Here delegates from nine member states agreed, without opposition, to allocate 380 MFF to ESRO for its first three years and 600 MFF for the second three years — roughly the figures proposed by the STWG (see columns 4 and 5, Table 3). Only the Belgian government abstained, not on principle, but because it had no information on how the programme would be reduced to remain within these limits.[99]

It goes without saying that the British triumphed at the conference of plenipotentiaries held in June 1962. Their various demands were enshrined in the convention, in its associated financial protocol, and in an additional protocol concerning the financing of ESRO during the first eight years of its existence. Article X.4 of the convention stipulated that the Council would determine every third year, by unanimous decision of all the member states, the level of resources for ESRO for the succeeding three-year period. At the same time it would determine, on a provisional basis, and by unanimous decision of all the member states, the level of resources for the succeeding three-year period. The annual budget was to be adopted within these limits by a simple two-thirds majority of Council. One of the protocols also stipulated that the overall eight-year ceiling was to be fixed at 306 MAU (equal

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97 See document COPERS/64, 14/3/62.

98 See COPERS/45 (rev. 1), 14/2/62, and COPERS/AWG/II/2 (rev. 1), 19/3/62, summary table S3 in Annex 2. The 490MFF were cut to 450 MFF in January by shuffling the envisaged contingencies in the first three years of expenditure and by reducing headquarters staff by 30%. It was then further reduced to about 410 MFF by doing away with the allowance for unforeseen expenditure.

99 See COPERS, 4th session (21-23/2/62), COPERS/Min/4, 13/3/62, p. 3. See also letter Holvoet to Auger, 15/3/62 (folder *Belgique*, Mussard files (cf note 1)).

to 1500 MFF), at price levels ruling at the date of signature of the protocol.[100] Provision was also made for the Council unanimously to adjust this figure in the light of "major scientific or technological developments." As for the initial phases of ESRO's life, the budgets were set at 78 MAU (380 MFF) for the first three years and a provisional ceiling of 128 MAU (600 MFF) was agreed for the second three-year period after the entry into force of the convention.[101]

The factors at work in this debate

Two factors lay behind the British government's determination to impose a ceiling on ESRO's expenditure, and to ensure that it was binding on the member states. The first, based on their experience at CERN, was to restrict the power of the ESRO Council. The second was their estimate, made towards the end of 1961, of the acceptable levels of UK expenditure on space science, national and international, for the next six to eight years.

To appreciate the first point we need to digress for a moment and to explain the experience which the UK government had had at CERN. As early as 1957 it became clear that the costs of running CERN were going to be far greater than anyone had ever anticipated. As new and more powerful high-energy accelerators began to be commissioned in the United States in the mid-1950s, it emerged that sophisticated and complex detection equipment was required to exploit the machines properly. The CERN management were caught off their guard by these new developments and let it be known that they would need as much money to run CERN's new accelerators as it had cost to build them. Alarmed, the British government decided in 1957 that some sort of forward planning should be instituted

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[100] 1 MAU was defined as the value of 0.88867088 grammes of fine gold, and at the time was equivalent to one dollar — see Article 6 of the financial protocol annexed to the convention for the establishment of ESRO, document COPERS/AWG/19 (rev. 6), 23/5/62.

[101] The "Convention for the Establishment of a European Space Research Organization" can be found for example in Annex 1 to *ESRO General Report, 1964-1965*. Its financial protocol annexed to the convention is document COPERS/AWG/19 (rev.6), 23/5/62. The protocol concerning the financing of ESRO for its first eight years is document COPERS/AWG/19 (add. 13), 12/3/62. Alternative labels for these two protocols are ESRO Conference/5, 23/5/62, and ESRO Conference/6, 23/5/62.

at CERN, and that two or three-year ceilings should be imposed on expenditure.[102] These proposals were greeted with widespread hostility both by the high-energy physics community and by many of the other member state delegates on the grounds that it was impossible to predict in advance the costs of research and development, and that the policy of ceilings would stifle the growth of the laboratory. Matters came to a head in 1961. On the one hand the British Treasury had found its CERN Council delegates incapable of persuading their colleagues to accept a firm and binding ceiling policy. At the same time there was growing pressure coming from within the laboratory and from some of the member states, notably France, that forward planning should make allowance for an annual growth rate of about 8% in real terms. Frustrated by the power of the CERN Council to thwart the preferred policies of the major contributor to the CERN budget, the Foreign Office took the unprecedented step (for CERN) of circulating an aide mémoire to its homologues in the member states in November 1961, precisely at the time when it was suggesting that similar steps would be needed at ESRO. In this aide mémoire it was proposed that, instead of leaving the CERN Council to set the levels of CERN expenditure, the level should be set between governments themselves, leaving the Council simply to adjust its programme within the limits decided between ministers.

The British government's move was greeted with intense hostility by the CERN Council at its meeting in December 1961. By challenging the authority of the Council in this way, said Dutch delegate Bannier, the British were challenging the very foundations of CERN's success. The French delegate de Rose went even further. Referring to ongoing and extremely delicate negotiations between the British and the French over the use of *Blue Streak* as the first stage of a jointly built European launcher, de Rose said that he would advise de Gaulle not to agree to the British proposals if they were not willing to abandon their attempt to impose firm ceilings on CERN, and to impede the "automatic" growth of the laboratory. In the face of this threat the British had little choice but to back down. The power of the CERN "lobby", a small core of senior science administrators and scientists dedicated to defending the laboratory's interests before their national bureaucracies, and determined to put up a united front along with the laboratory management in the face of any "external" threat, had carried the day.[103]

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[102] For an extensive discussion of the debate described in this paragraph see Krige (1990a) and Krige (1991).

[103] See Pestre (1990b) for an elegant description of the activities of the CERN lobby.

The British manoeuvres inside ESRO were a direct consequence of these experiences. Her Majesty's Government had learned a lesson. That lesson was that in future, when setting up any new organization for scientific collaboration, strict limits should be imposed on the Council's power to decide budgets. The way they chose to do this was by insisting that appropriate safeguards be built into ESRO's constitution so as to ensure that financial control over the laboratory's expenditure was a legally enshrined principle. This is undoubtedly why the British were so emphatic about having ceilings written into ESRO's basic documents. It is also why they insisted that these ceilings would have to be set between ministers, and not by the ESRO Council, if their demands were not written into the convention and its accompanying protocols. They were determined never again to be at the mercy of a CERN-like "lobby" as had happened in Geneva in December 1961. Governments also learn!

The second reason for the UK's firmness was the constraints that the government, in consultation with the its space science community, had decided to impose on expenditure in the field during the years ahead. As early as July 1961 Massey submitted to the British National Committee for Space Research an estimate of the UK's contribution to the costs of ESRO using the first set of figures available from the STWG (column 2, Table 3). He added the estimated costs of the national programme, including a budget line for UK/NASA bilateral arrangements. His paper foresaw annual expenditure climbing steadily until, in ESRO's sixth year, Britain would be spending a total of £5.65 million on space science, £4.1 million of which (i.e. about 58 MFF) was the estimated UK share of ESRO (25% of 232 MFF). These figures were submitted to the minister for science. After discussion within the government it was agreed, by the end of 1961, that Britain should be prepared to spend up to £6 million for what was called the "steady state" of funding for space research. From then on, according to Massey and Robins, this limit was "sacrosanct." Correlatively it was implied that, "for the balance of the UK programme [...]" ESRO costs should be confined to about 250 MFF per year during the last three years of its first eight-year period. The British space science community, in other words, in consultation with their government, was quite satisfied not to see ESRO's budget go above an overall ceiling of 1500 MFF and to level off in years six to eight.[104]

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[104] For the material in this paragraph see Massey and Robins (1986), pp. 117-127. The adoption of these figures by the COPERS was judged by Massey and Robins to have been "a completely satisfactory outcome for the UK [...]." This quotation and the others are from pp. 124 and 126.

It was perhaps to be expected that the British space scientists would only be prepared to join COPERS "provided that the UK national space research programme was not prejudiced."[105] Yet it is significant that they apparently met little opposition from scientists from other member states. This was possibly due to the wish to keep the British involved in the scheme — after all they were the most experienced and advanced community at the time and would bear a substantial fraction of the costs —, and the realization that they would only participate on their terms. At the same time it is surely a symptom of a more deep-seated lukewarmness of the continental space science community vis-à-vis "their" organization. After an initial burst of enthusiasm, in fact, many members of the community seem to have been less than convinced of ESRO's merits and were not opposed to seeing its budgets severely restricted and brought under tight control.

Why should this be so? Part of reason lies surely in the fact that space science communities in both the larger and the smaller member states, and not just in Britain, were more or less convinced that their governments would support national programmes. From this perspective ESRO was a potential competitor — a situation which the national bodies were determined to avoid, as the debate over ESLAB has shown. The interest of building a strong national programme was further reinforced by a generous offer made in 1959 by NASA. At an international meeting of space scientists in the Hague in March that year, the American delegate announced that his government, through NASA, would be willing to launch suitable experiments proposed by scientists from other countries. The technical support of NASA's experienced engineers was guaranteed. European scientists could either go and work in an American laboratory on the construction, calibration and installation of their equipment in the research satellite. Or, if the intention was to launch an entire payload comprising various experiments, NASA would be prepared to advise on the feasibility of the package, and on its design and construction, as well as help with the pre-flight environmental testing. In discussion NASA made it clear that it was seeking bilateral agreements for joint programmes. It also let it be known, at least to the British, that it was prepared to launch at least some equipment free of charge.[106] That granted, why spend scarce resources on setting up an entirely new organization,

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[105] Massey and Robins (1986), 117.

[106] Massey and Robins (1986), Annex 11 describes the NASA offer.

particularly if that meant a reduction in the funds made available for nationally built experiments and a "national" programme?

ESRO struggled into life then a fragile and vulnerable creature. Governments, though not uninterested, were not prepared to invest heavily in it. Scientists, though not uninterested, were not prepared to see it develop at the expense of national programmes. It could not compete with the United States, as CERN aimed to do. It was not to replace national programmes, as CERN was expected to do in many member states. It is hardly surprising that it required a fundamental revision of ESRO's aims, to wit, a shift away from pure science to applications, to revitalize an organization that had all but lost its way in the mid-1960s.

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