

Sweden in Space

Jan Stiernstedt

Swedish Space Activities 1959-1972

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*Translated into English by
Harvey Jessop*

Jan Stiernstedt

**European Space Agency
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The cover photograph shows the launch of a Nike-Cajun rocket from Kronogård in the summer of 1963, for temperature and wind research at altitudes of 40 – 100 km, connected with the prediction of noctilucent clouds
Photo - RTG

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Foreword

I became aware of outer space at an early age. On starlit autumn evenings my parents would take an evening stroll. We lived twenty kilometres from Uppsala. The dark plain spread out ahead but, beyond it, the Milky Way stretched out its glittering arc. Its millions of sparkling stars cast a soft light over the ploughed fields of autumn.

My father was a keen amateur astronomer. He would point out the various constellations and nebulae and tell me about his picture of the world – a macrocosmos that was perhaps reflected in a microcosmos. He would love to linger on how the picture of the cosmos had changed during his lifetime. My mother contributed with literary associations and quotations from poetry.

Space became a reality which would never leave my life. For that I feel an immense gratitude to my parents – Gordon and Kate Stiernstedt – who both departed this life a long time ago.

I owe thanks to many others.

First and foremost, my fellow staff and colleagues at the Ministry of Education and Culture who displayed infinite patience when my involvement in space activities took over from the more commonplace ministry business. Even greater thanks go to my fellow staff and colleagues at the Swedish National Board for Space Activities and the Swedish Space Corporation, and at ESRO/ESA, who have all taught me so much about the environment and conditions for space, space research and space technology, and who have been an invaluable support through the years. In addition, all those who helped me to select from the archives documents which were important as information sources. Above all, I would like to name Eva Vermeer, ESA in Paris, and Gerardo Bonini of the *Archivi Storici delle Comunità Europeo* in Florence. Both were untiring in their efforts to filter out, from the mountains of paper resulting from European cooperation, the documents which cast light upon the relationship between Sweden and ESRO/ESA.

Ernst-Åke Brunberg, Kerstin Fredga, Bengt Hultqvist, Lennart Lübeck and Silja Strömberg were kind enough to check the manuscript and make constructive criticism and valuable suggestions.

Kerstin Fredga has followed my work with keen interest and worked actively towards its publication in connection with the 25th anniversary of the Swedish National Space Board this year. On her initiative the Swedish National Space Board financed my archival studies in Paris and Florence and my participation in ESA's historical symposia.

Magn. Bergvall's foundation has made a financial contribution to the cost of the printing of the book.

When I retired in 1989 and was clearing through my papers from more than 25 years in Swedish space research and space activities I was taken by the desire to recount the developments in which I had been involved. Swedish space activity was born in 1959. In that same year I took up a post at the Ministry of Education and Culture. During the first four years I was not actively involved in the space programme, but I had a ringside seat from which I was able to observe what happened. However, in 1963, I was drawn into the magic circle of space, from which I have never wanted or been able to escape since.

The developments which I have had the privilege to witness have been rapid and dramatic. The developments from Sputnik in 1957, the size of a beach ball, to the Moon landing in 1969 and the manned space stations of the 1980s and 1990s have resulted in the need for constant reappraisals and new ideas, both technical and political. In the 1960s and 1970s no one believed that Sweden would ever send up its own space vehicles. However, by the 1980s we were launching two scientifically and technically very advanced satellites.

At first, I thought that it would be possible to afford a very brief treatment to the account of the first years of Swedish space activities, until the Swedish National Space Board and the Swedish Space Corporation were formed in 1972. I soon discovered that this was far from the case. The more I immersed myself in the material, the more interesting these first few unknown years appeared – they were in fact a fight for survival.

I therefore chose to deal with that period relatively exhaustively. Furthermore, I have focussed on the first five years, up to 1964, when our participation in European space cooperation was formally confirmed with the entry into force of the ESRO Convention. I will deal with the period from 1972 to 1989 in a second part of the history.

Because I am not a scientist myself, I have naturally placed the emphasis on the political decision-making processes which I followed closely for many years.

The account contains many of my own recollections. In the text I appear sometimes as 'Stiernstedt' and sometimes as 'I'. The first person form has been employed mainly in recounting personal memories or reflections.

The book was originally written in Swedish, for a Swedish public. There may consequently be references which are difficult for a foreign reader to understand.

Uppsala, February 1997

Jan Stiernstedt

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The Space Dream

Man's dream to fly and rise above the Earth and towards the heavens is as old as the hills and has survived in myths and legends. Foremost among these dreams which have been preserved for posterity is the legend of Daedalus and Icarus.

The Athenian Daedalus was an artist and an engineer. He is said to have been the first sculptor to carve legs on statues – earlier sculptors had allowed the body to disappear into the plinth. Even this required an understanding of strength and balance. Apart from inventing the saw, the axe, the drill, the lever, the protractor and the water-level, he is said to have been the architect of the labyrinth on Crete. When he and his son Icarus had to flee from Crete, he designed the first aeroplane – a pair of wings made of feathers, fixed together with thread and wax. Daedalus completed the test flight but, as we know, Icarus fared worse. In a spirit of youthful recklessness he wanted to realise the dream of reaching the canopy of heaven so that he could answer the questions which had puzzled astronomers from time immemorial. He did not heed to his father's warning not to fly too high, the Sun's heat melted the wax in the wings and Icarus plunged into the sea.

Daedalus, it has been said, was the first engineer, representing technical balance and practical possibility, whilst Icarus is the eternal dreamer, the poet who wants to reach up to the unattainable space, even if it costs him his life. The legend does not tell us how high Icarus wanted to fly, but through the centuries the dream to explore the heavens and to burst through its boundaries has lived on.

In the middle of the second century AD, Lucien from Samos imagined voyages to the Moon using wings, and also with a vessel which was thrown up into space by a storm at the Pillars of Hercules (Gibraltar) to be sent on to the Moon. In the 17th century, Cyrano de Bergerac wrote of journeys to the Sun and the Moon both in rockets and in a craft which was driven by jet propulsion using heated air. Then Jules Verne's *From the Earth to the Moon* (1865) slowly but steadily opened the floodgates for what is now known as science fiction.

Daedalus's engineering and Icarus' dreaming have become reality in modern exploration and exploitation of space as one of our most important natural resources, even though, according to the laws of nature, new goals and new horizons have emerged. The road has been a difficult one. The list of pioneers could be a long one, but here we will dwell upon only a few of them. The story of those pioneers is a story of dreamers, visionaries and mystics obstinately clinging to their inner certainty that the impossible is possible and that they held the future in their hands. It is the story of how secondary school teachers with their heads buried in books – Konstantin Tsiolkovsky and Hermann Oberth – sat leaning over drawing boards and mathematical formulae, evening after evening, to prove for themselves – but seldom believed by others – that it was actually possible to leave the Earth and its atmosphere. It is a story of how a single-minded engineer, Robert Goddard, and – perhaps in a more modest way – a Swedish infantry captain, Wilhelm Unge, risked

their lives to carry out experiments in order to realise the dream with the help of rockets which usually fell to the ground after a great bang and a feeble flight through the air. It is a story of human endurance and imagination.

The Chinese invented gunpowder. They used rockets as fireworks for their celebrations but also as "fire lances" in their battles with the Mongols in the 13th century AD. During the Napoleonic Wars rockets were used as a weapon, for example during the English bombardment of Copenhagen in 1807. But it was not until the Russian Konstantin Tsiolkovsky (1857-1935) came along that anything really happened. Tsiolkovsky was a mathematics and physics teacher in Kaluga. In his work *A Rocket into Cosmos Space*, published in 1903, he believed that he could prove that space travel was possible with rockets. Among other things, he advocated liquid fuel – solid fuel rockets would not be sufficiently powerful to reach outer space. In addition, he described the multi-stage principle with several rockets attached together and put forward a fully correct design for a rocket combustion chamber for two types of liquid propellant.

At around the same time, the Swede Wilhelm Unge (1845-1915), an infantry officer and managing director of the appropriately named Mars company, developed an "air torpedo" with jet propulsion. Unge's torpedo, or missile as we would call it today, was a steel cylinder, divided in the middle by a partition. The front section was filled with a charge which would explode when the air torpedo reached its target. In the rear chamber was placed a slow burning powder charge. The bottom of the torpedo was designed as a turbine and when the powder gases streamed out under pressure the torpedo was set in motion whilst rotating around its own axis, thus creating a stable flight path. In order to give the missile the desired initial direction, a very simple stand was used, a "torpedo aiming device". Unge's air torpedo was able to send loads of around 100 kg as far as 8 km. A smaller portable model weighing 12-17 kg had a range of 5 km. Another variant was used to fire out a line to victims of shipwrecks.

Unge's air torpedo was initially intended for military use, but it is not thought to have come into any widespread use even though it was sold to Krupps in Germany in 1908. Tsiolkovsky was a dreamer who was recognised, certainly before his death, as one of the pioneers of space flight, but who himself had neither the capacity nor the opportunity to bring his ideas to fruition. It was only with the American engineer Robert Goddard (1882-1945) and the German teacher Hermann Oberth (1894-1989) that space flight left the realm of theory and speculation.

In 1914 Robert Goddard filed a patent for a solid-fuel, multi-stage rocket. A few years later, in 1918, he tested for the first time a new design for a nozzle, through which the gases streamed out. The new nozzle drastically improved the rocket's performance – in earlier experiments Goddard had found that only 3% of the total energy produced by the solid propellant was used for combustion. However, at the same time it was clear to Goddard that a rocket driven by liquid propellant would further improve performance. He was the first person to experiment with liquid fuel. In 1926 the first liquid fuel rocket was sent into the air using a mixture of petrol and liquid oxygen. Admittedly it crashed two and a half seconds later after a flight of 56 metres, but Goddard had proved that his

theories were correct and he was able to successfully continue in that direction. This also meant that the rockets changed – the liquid fuel required pumps, pipes, valves etc and they were now driven by a controllable engine.

It is likely that in Germany Hermann Oberth was keenly studying Goddard's experiments and in particular his work *A method of reaching extreme altitudes*, which was published in 1920. In 1923 Oberth published a paper, *Rakete zu den Planetenräumen*, in which he put forward two theories. First he claimed that it should be possible to build rockets which, by exploiting the Earth's gravitation, could be turned into artificial satellites or even be made to break free of the Earth's gravitation to continue their journey into outer space. Secondly, he thought that it should be possible to build those rockets so that people could travel in them without coming to harm. In 1929 he further developed his theories in *Wege zur Raumschiffahrt* and thus rocket travel had its canonical standard work and Oberth, whose theories are still fundamental to modern space travel, earned his future honorary title as "the father of space flight". His opportunities to realise his ideas were limited, however.

Nonetheless, the director Fritz Lang made use of his services in the production of the film *Die Frau im Mond* which had its Swedish premiere in 1930 at the "Moulin Rouge" in Stockholm under the title *The Moon Rocket*. Lang allowed Oberth to carry out practical experiments, but in one of those experiments the fuel exploded and Oberth went off with a burst eardrum and serious eye damage. In spite of this, he had enjoyed his interlude as a film consultant as it gave him the opportunity to experiment, which made possible the construction of a new effective nozzle, the "conical nozzle". In addition, the film became a great success throughout the world and perhaps indirectly helped to promote the cause of space flight and rocket propulsion. During the 1930s rocket factories were opened at a few places and tests were performed with rocket-driven cars (Opel), boats, sledges etc. The British Post Office even tried – though without success – to send post by rocket. I remember from that time that the young people's magazines contained news items almost every week about new rocket experiments which enjoyed varying degrees of success, and when the Jules Verne Magazine started in 1940 it became an overnight success.

Germany soon began to see successes in the field. An association for space travel was started there and its activities in the mid-1930s attracted the interest of the re-arming German military – it took over financing and in 1936 moved the technicians to Peenemünde where a "rocket airfield" was built. Wernher von Braun (1912-1977) became the senior director of activities. Oberth was pushed aside and had to be content with watching the experiments from a small office in Peenemünde and noting that his theories held.

During the Second World War, as is well-known, the United States put priority on the development of the atomic bomb – Robert Goddard certainly did work on rocket experiments for the navy, though on a modest scale. Hitler, on the other hand, concentrated on the secret V1 bombs and V2 rockets in Peenemünde. Following a few test flights, the first V2 rocket took off in 1944, developed entirely on the basis of Oberth's

theories. It was the prototype of future launchers. After the war, the Russians and Americans took most of the German technicians. Both von Braun and Oberth went to the USA, while some of the Peenemünde team went to France and England and helped there in the development of ballistic missiles and rockets for peaceful purposes.

Just a few years after the end of the war, rockets began to be used to explore the upper atmosphere. Otherwise, nothing much happened. The Americans conducted test launches with the remaining V2 rockets with the help of von Braun, but did not really concentrate on new developments. Only with the Korean War did both the navy and the army begin to develop rockets and satellites in fierce competition. The French and the British followed suit.

The Sputnik Psychosis

The International Geophysical Year (1 July 1957 to 31 December 1958) saw the definitive breakthrough in the use of rocket technology for civil purposes. Several tests with sounding rockets – including the French *Veronique* and the British *Skylark* – were included in the research programme. In the West it was clear that a stage had now been reached where, within a short period of time, it would be possible to launch satellites into space. According to reports, the US army offered to launch a satellite several times during 1957, but was rebuffed at the highest level; the navy was seen to have the right to make the first attempt since that was where Goddard had worked. However, it was not until December 1957, two months after the Russians, that the navy was able to carry out the first test with its Vanguard rocket. It was a catastrophic failure. If the army had been allowed earlier to continue with von Braun and the Jupiter rocket, it is possible that the USA would have won the first stage of the Cold War space race between the superpowers.

The space age began on 4 October 1957 when the Soviet *Sputnik 1* was launched. It was followed one month later by *Sputnik 2* with Laika the dog. Only in January 1958 did the Americans successfully put their *Explorer* into space with the help of Jupiter C.

With hindsight, one might wonder why Sputnik was such a great shock to the West. It was clear to ‘those-in-the-know’ that a satellite breakthrough was imminent. The answer is of course that it had not been expected that it would be the Soviets – the Russians had worked in secrecy without any advance publicity to give rise to the attendant eager expectations. Furthermore, the West did not have the slightest confidence in Soviet technology, but now it had succeeded in doing what the Americans had failed to do for so long. The Cold War raged on and in the West Sputnik was seen as a serious defeat. The USA took the consequences – the space race began and would last for more than 30 years. Another effect was a heavy concentration on technical training and research throughout the West. In Sweden too, Sputnik probably contributed to some degree – at least indirectly – to the strengthening of the institutes of technology which followed the proposal of the Royal Commission on the Planning of University Education in 1955 when, amongst other things, a new institute of technology was established in Lund.

For the international scientific community, Sputnik meant that a stage had now been reached where astronomers, astrophysicists, meteorologists and others could have access to a technology which opened a window to the cosmos without the obstacle of the Earth’s atmosphere. The possibilities offered by the technology were soon demonstrated when the instruments on board Explorer 1 were able to show the existence of previously unknown radiation belts around the Earth – which were named the Van Allen belts after the man responsible for carrying out the experiments.

The reaction throughout the world – “the Sputnik psychosis” – gave political impetus to scientists. Before long a space authority had been created in the United States, the National Aeronautics and Space Administration (NASA), which, on the initiative of

President Eisenhower and despite fierce resistance from the military, was not incorporated into the national defence, but was made a purely civil authority.

Scientists in Western Europe naturally also wanted to have access to the new technology. However, it was expensive and it was clear at an early stage that no individual country in Europe would be able to raise the resources that would be necessary. A European effort in space research would require cooperation between several countries. An example could be found in the Western European nuclear research organisation CERN, which was founded in 1954 and introduced its first particle accelerator in 1959. Cooperation within CERN had been highly successful and it was natural to contemplate similar cooperation in the field of space research.

Leading roles in the creation of CERN had been played by the Italian physicist Edoardo Amaldi and his French colleague Pierre Auger, the father of the "Auger effect" in physics. These two were to play a possibly even greater role in the creation of the *European Space Research Organisation (ESRO)*. In July 1958 Amaldi began to discuss with colleagues in Italy and elsewhere – mainly by correspondence – the possibility of creating a European space research organisation. Those he consulted included Luigi Crocco, a rocket expert and researcher at Princeton, Luigi Broglio, director of the Institute for Aeronautics at the University of Rome and the British scientist Sir Harrie Massey – both Broglio and Massey would later become active in ESRO.

The organisation conceived by Amaldi in his letters and discussions should in his opinion

- comprise ten member countries, the six EEC Member States plus Britain and the Scandinavian countries;
- have a completely open character and be entirely free of military influence;
- have access to shared laboratories from the outset.

Amaldi's ideas were met with criticism and pessimism. First, it was thought unrealistic to start an organisation without military participation; the military was responsible for rocket development after all. The European character of the organisation was also called into question. Would it not be better to embrace a global form of cooperation which included both the Soviet Union and the United States?

Amaldi stubbornly clung to his ideas, however, which he considered were entirely within the realm of possibility. In February 1959, he learnt from the French physicist Perrin that Auger, who was soon to become the chairman of the newly formed French Space Research Committee, had been thinking along the same lines. They began to exchange correspondence and in April Amaldi travelled to Paris. During a walk in the Jardin du Luxembourg the two discussed how the future organisation might look. Auger reported:

We considered various possibilities, notably affiliation to the EEC, though I myself preferred a constitution on the same lines as that of CERN, whose success was a great encouragement. So far as the purely scientific paternity of the new organisation was concerned, there could be no better guarantee

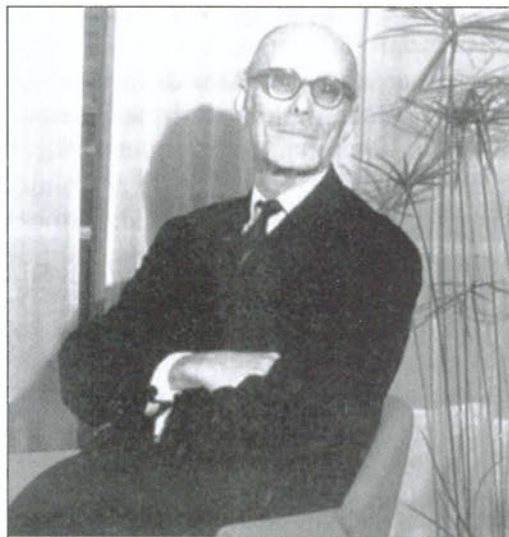
than the blessing, if I may so call it, given on behalf of the ICSU (International Council of Scientific Unions) by its special committee concerned with space physics, COSPAR (Committee on Space Research). It was at the Committee's first session, in January 1960 at Nice, that the first clear idea of a European Space Research Organisation was born.

Auger also explained that during the walk Amaldi suggested the name *Eurolune* for the new organisation – a parallel to *Euratom*. Some time later, however, Auger pointed out that the name could be misleading – Euratom was a problematical organisation and a bad example. Instead, the name should reflect the organisation's scientific purpose – so it became the *European Space Research Organisation (ESRO)*.

ESRO was thus born at the COSPAR meeting in Nice. However, the birth would probably have never taken place – at least not then – if Amaldi had not been so persistent. He had not been idle between April 1958 and January 1959. Just a few days after the walk in the Jardin du Luxembourg on 30 April he had completed the document which laid the foundations for European space cooperation. In that document – *Space Research in Europe* – he analysed the situation for European space research after Sputnik. He began by recalling the successful cooperation under the auspices of the Geophysical Year which, amongst other things, had led to the formation of COSPAR.

But, he continued, Europe was now running the risk of falling behind. If space research was not to be monopolised entirely by the United States and the Soviet Union, prompt action was needed. A joint European space research organisation should be formed using the example of CERN, with research as its sole purpose. Its activities should be run with complete openness and be fully independent of military space activity. It was proposed that the organisation, which should have access to its own laboratories and launch sites, should begin its activities with a minimal programme for an initial 3-4 year period during which the more simple problems should be resolved and personnel brought in. During the

Pierre Auger, who realised Amaldi's ideas for a European Space Research Organisation and was ESRO's first Director-General. Photo: ESRO



subsequent 6-7 years it should tackle problems at the same scientific level as in the United States and the Soviet Union. Lastly, it was suggested that a number of countries – for example Belgium, France, Italy, the Netherlands and West Germany – should set up national bodies with joint responsibility for setting the preparations in motion.

Amaldi sent his proposal to around 70 leading European researchers and scientific administrators. The reaction this time was overwhelmingly positive and optimistic. In December 1959 – one month before the important COSPAR meeting in Nice – a document was published under the title *Créons une organisation européenne pour la recherche spatiale* in the French journal *Expansion Scientifique*. The article was followed by positive comments from a number of influential scientists and scientific administrators, including Pierre Auger and the Dutchmen J.H. Bannier and H. Van de Hulst – all would later contribute to ESRO in various roles. In an additional note Amaldi underlined once again the importance of keeping the military at a distance. For that reason the organisation should develop its own launcher.

The principles laid down by Amaldi with the support of a number of influential scientists – an independent European programme, closing the technological gulf between Europe and the United States, its own facilities, peaceful activity, openness – would become the key foundations for ESRO and its successor the European Space Agency (ESA). However, there were also conflicts inherent in the programme. Amaldi warned time and again against military interference and repeatedly advocated CERN as the model to follow. The reason behind this was not only the simple desire to use CERN as an administrative model – the most important factor in the case of CERN was that its activities were not in reality devised by the governments of the member countries but by its scientists. The role of the governments was limited to ensuring that there were funds for the research programmes. At CERN an accelerator had been built for the scientists, but they had consciously refrained from building a reactor, since they would then run the risk of coming under the influence of non-scientific users. With a military involvement in space research, it would be likely that the government would control the organisation, politically and economically “contaminating” its *raison d’être*.

In the meantime, the question was lingering whether or not the organisation should have its own launcher. Amaldi believed that it should – that would keep it out of the hands of the military. However, it would soon transpire that the politicians had their own ideas. Throughout the 1960s the launcher issue would create endless difficulties within European space cooperation and, at times, threaten to undermine it.

It is important in this connection to recall that from 1957-60 there was a long-running and serious discussion concerning the possibility of creating a space organisation within NATO. One can hazard a guess that Amaldi was not unaware of that discussion. In any case, Auger was keenly aware of it, as we will soon see.

Kiruna put on the Space Map

One of those who learnt of Amaldi's initiative was Gösta W. Funke, the influential Secretary General of both the Swedish Natural Science Research Council (NFR) and the Swedish Atomic Research Council (AFR). Funke was part of the inner circle in CERN and everything would suggest that he was well informed of the discussion started by Amaldi.

In Sweden, as in the rest of the world, scientists had reacted positively to the news about Sputnik and Explorer. The technical possibilities within various areas of research were soon realised. Astronomers were perhaps at first somewhat reticent, but ionospheric, magnetospheric and atmospheric researchers who had their sights set on the Earth's immediate surroundings were more enthusiastic. Such research had a long history in Sweden. As early as the 18th century, Anders Celsius in Uppsala and his colleague and collaborator Olof Hiorter had been studying the aurora borealis. Celsius introduced methodical magnetic measurements and Hiorter pointed out the connection between the aurora borealis and magnetic declinations. In modern times, Hannes Alfvén's discovery of the principles of magnetohydrodynamics had held great importance for the understanding of cosmic phenomena.

However there was one further factor which would be of vital importance as far as Sweden and ESRO were concerned.

Scientific observations of various kinds had taken place in Lapland for a very long time — Celsius and his colleague, the mathematician Meldercreutz, also did pioneering work here. In the 19th century the idea of a scientific station at Torneträsk, not so far from the Norwegian border, had been discussed — it was thought to be of interest for meteorology,



Gösta Funke, the influential chief secretary of the Swedish Natural Science Research Council and the Swedish Atomic Research Council and the initiator of the Space Research Committee. For a time he was also chairman of CERN.

Photo: NFR

geology, physics, botany and zoology. The plans did not really take shape until 1902 when, with the help of contributions from the Swedish Royal Academy of Sciences among others, the Stockholm Natural Science Association purchased a house in Vassijaure in the same area and set up a station there, whose task would be – in language typical of the time – “to enable as far as possible a thorough, free and honourable exploration of nature within the Arctic region of the fatherland”.

The Vassijaure station burnt down a few years later and activities were transferred to Abisko where special buildings were constructed. Some of the meteorological observations were eventually moved to Riksgränsen. In 1935 the Royal Academy of Sciences took on responsibility for the stations. The meteorological activities in Abisko and Riksgränsen encompassed not only weather observations, but also geophysical recording of geomagnetism and seismological data and fundamentally important investigations of the aurora borealis and ozone.

During the Second World War, activities almost came to a standstill. When there was a wish to resume activities towards the end of the war, the question arose of a broader Swedish contribution to geophysics, taking advantage of the country's geographical position. It might be pointed out in this connection that the neighbouring Scandinavian countries had acted earlier. In Finland a geophysical observatory had been set up back in 1914 in Sodankylä in Finnish Lapland and in Norway an institute for cosmic physics was founded in Bergen in the 1920s, with a specific northern lights observatory located in Tromsø.

In 1946 a national committee chaired by the radiophysicist Professor Rolf Sievert delivered a report to the government in which it was proposed that a geophysical observatory should be set up in Kiruna – there was suitable crown land 8 km to the east of the municipality of Kiruna. The proposal did not give rise to any government action, but Sievert was not the sort to give in. As chairman of a committee for research activities in Upper Norrland appointed by the Royal Academy of Sciences he took the initiative to ensure that by 1948, with the support of the local authorities in Kiruna, barracks were built for a temporary observatory where Professor Olof Rydbeck of the Chalmers Institute of Technology in Gothenburg installed a panoramic ionosphere recorder for physical observations of the upper atmosphere. Activities commenced in October 1948 and after a short time Rydbeck also installed an auroral radar. Rydbeck's observations were successful but it later became necessary for him to concentrate his research on the space observatory at Råö on the Swedish west coast which was opened in 1955. The following year he ceased working at Kiruna.

The first step had been taken, however, and as a result in 1952 the government was persuaded to lay down regulations for the Royal Academy of Science's research stations in Upper Norrland, i.e. Abisko Natural Science Station, Kiruna Geophysical Observatory and the other stations. The county governor and former Minister for Foreign Affairs, Rickard Sandler, was appointed chairman of the board responsible for the now officially sanctioned activities. The new board almost immediately submitted a recommendation that the 1946 proposals be implemented, though on a reduced scale. This time things fared

3. KIRUNA PUT ON THE SPACE MAP

better and on the second day of the International Geophysical Year – 2 July 1957 – the Kiruna Geophysical Observatory (KGO) was opened.

One of Sievert's students, Bengt Hultqvist, had been appointed as the director of the institute. He realised that the new rocket technology would revolutionise the work of the institute. Hultqvist's services would be called on just a few years later in the preparatory work for ESRO. Thus started an involvement in ESRO and its successor the European Space Agency (ESA) that would be of great importance for both organisations' fundamental research and for the continuation of Swedish space research in Scandinavia, Europe and internationally.

The creation of the KGO meant that Sweden now had a research institute with a responsibility for areas such as observations and experimental research in upper atmospheric physics. As has already been stated, space physics was not something new in Sweden – research into various areas of space physics had been carried out at the institutes of technology, the universities and the National Defence Research Institute (FOA) – but the new and significant factor was that there was now a permanent research institute north of the Arctic Circle which made it possible *inter-alia* to carry out continuous observations of the hot plasma in the magnetosphere and its most spectacular expression, the aurora borealis.

The arguments put forward for the establishment of the KGO in the 1946 report make for interesting reading. There was heavy emphasis on the international interest in the observatory which could be expected. It was stated:

The importance of international research cooperation for a small country such as Sweden cannot be overestimated The most immediate reason for the international interest in a research institute in Northern Sweden is the geographical position of our country. Like its neighbouring countries, Norway and Finland, to a certain extent, Sweden occupies a unique position compared to other countries because the region to the north of the Arctic



Bengt Hultqvist, professor in space physics and for almost 40 years (1956-94) director of the Kiruna Geophysical Observatory, now the Institute for Space Physics. His contribution to science and research was of enormous importance to the Swedish space programme.

Circle has a relatively mild climate and is easily accessible. Similar regions in Asia and America have a particularly harsh climate and poor communications.

These are precisely the same arguments in favour of Northern Sweden which for years would be made both to the Swedish government and within ESRO/ESA by the Swedish national space bodies – arguments which are still relevant for the Swedish National Space Board and the Swedish Space Corporation and will probably always remain so.

In other words the Swedish space activity has good cause to feel gratitude to Rolf Sievert, who never gave up the idea of the Kiruna Geophysical Observatory. One can only speculate at the developments if he had failed. When ESRANGE was located in Sweden and in Kiruna it was certainly on account of its geographical position, but the most important secondary argument was that there already existed a research environment there.

A Swedish Space Research Committee

One person who realised what strong cards Sweden was holding both scientifically and geographically was Gösta W. Funke. As has already been stated, he had probably linked up with Amaldi's initiative at an early stage.

Gösta Funke liked to act quickly. He saw the importance of having a Swedish dialogue partner at international level – a collective body for Swedish space research. The need for such a body had been made more pressing since, by a resolution in December 1958, the UN had founded a Committee on the Peaceful Uses of Outer Space, in which Sweden was a member. In mid-March 1959, the head of the Political Department of the Ministry of Foreign Affairs, Sverker Åström, called a meeting to be held at the Ministry of Foreign Affairs on 8 April to consider the functions of the Committee and the role Sweden might play in it. Those who attended the meeting included himself, Funke, Bertil Lindblad, professor of astronomy and president of the Swedish Natural Science Research Council (NFR), Lamek Hulthén, professor in mathematical physics at the Swedish Royal Institute of Technology (KTH) in Stockholm, and representative for physics in the NFR, the space physicists Professor Hannes Alfvén and Nicolai Herlofson, also from KTH, and the director of the International Meteorological Institute in Stockholm, Bert Bolin.

The meeting at the Ministry of Foreign Affairs brought home the need to bring space research in Sweden under a single umbrella. Less than a week later – on 13 April 1959 – Lindblad and Funke sent out an invitation from the NFR to an inaugural meeting to be held on 6 May at KTH where a Swedish space research committee would be formed. It was sent to the Swedish Atomic Research Council (AFR), the Swedish Council for Technical Research (TFR) and to the Swedish Meteorological and Hydrological Institute (SMHI) as well as to the national scientific committees for geodesy and geophysics, for astronomy, for physics and for scientific radio. The Committee formed at that meeting assumed the formal status of a joint NFR, AFR and TFR space research committee – before long the National Defence Research Institute (FOA) joined the sponsors. Its name became the Space Research Committee of the Swedish Research Councils, later (February 1960) changed to the Swedish Space Research Committee.

When the composition of the committee was finalised at the beginning of autumn 1959 it consisted of 18 members, representing various fields of research and conceivable applications. KTH was well represented with no less than six members, including the institute's vice chancellor Ragnar Woxén, who however stepped down after a short time, and Hannes Alfvén, Nicolai Herlofson and Lamek Hulthén.

Lindblad became the chairman, but as early as the second meeting in October 1959 he handed over that post to Hulthén. Alfvén became vice-chairman and Ernst-Åke Brunberg from KTH became secretary.

Olof Rydbeck came from Chalmers University of Technology (CTH). Other members included Gösta Funke himself, Bert Bolin and representatives of the National Defence Research Institute (FOA) (Nils-Henrik Lundquist), the Telecommunications Administration (Håkan Sterky) and the scientific national committees. In addition, at the very first meeting, upon a proposal by Alfvén, Bengt Hultqvist from KGO was co-opted as a permanent additional member.

Nearly all of that core group of the Space Research Committee would participate in some way in the development of Swedish space activities over the next ten years. Hannes Alfvén played an active part within the Committee as a source of inspiration but also used his strong position nationally and internationally to lobby the government. Gösta Funke played a continuing supporting role of great economic importance in his capacity of secretary-general of the Natural Science Research Council (NFR). A few years later Bert Bolin would become director of the ESRO's scientific programme and later chairman of the Space Board of the Swedish Research Councils. Bengt Hultqvist's role in the development of KGO and of the Swedish and the European space research programmes cannot be overestimated – moreover it is not finished yet and there will be good reason to return to him many times in the course of this account. For many years important support would also be given by the authorities represented by Nils-Henrik Lundquist and Håkan Sterky – the FOA and the Telecommunications Administration respectively. Later Lundquist would also become chairman of the board of the Swedish Space Corporation.

There is particular reason to dwell upon Hulthén and Brunberg. As chairman and secretary of three successive space committees they would, under difficult circumstances but always with patience and amiability, plead the cause of Swedish space research for virtually the entire decade of the 1960s. As has already been mentioned, Brunberg was a professor at KTH, where he was a member of Alfvén's research team. The archives of the three space committees at NFR bear witness to the incredibly painstaking and committed work performed by him.

Lamek Hulthén was one of those few people who – without pretension or exaggeration – could be given the obituary "he was a genuinely good man". There was no trace of any ulterior motive with him. He exhibited a finely balanced kindness and amiability. I say finely balanced because he was certainly not ineffectual. He knew what he wanted and he did not hesitate to stand up for his opinions. He represented Sweden very even-handedly on the ESRO Council. When I saw and heard him for the first time there, I understood why the Swedish delegation – despite the more pretentious conduct of certain other Swedish delegates – was as respected as it was and why it played such a prominent role on the preparatory work within COPERS. The Latin phrase *fortiter in re, suaviter in modo*, resolute in deed, gentle in manner, can be applied to Lamek Hulthén. He was able to persistently hold firm in his position, but could also be flexible if it was necessary to achieve a solution. I learnt much from him.



Lamek Hulthén, professor of mathematical physics at KTH. From 1959 and for virtually the entire decade of the 1960s chairman of the various space research committees.

The press release from the first meeting of the Space Research Committee on 6 May stated that the Committee would be “a meeting point” for various affected interests in Sweden and “a contact point between Sweden and abroad” and that it would “assist official authorities in dealing with issues connected with space research”.

The activity of the Committee quickly became clear. It concentrated on three areas – developing a national programme of experiments, participating in international cooperation, in particular the formation of ESRO and dealing with the complicated issue of a launch site for sounding rockets in Sweden.

In the minutes of the inaugural meeting, there is a list of research which was considered to concern the Committee – direct satellite observations (mechanics, orbital theory), radio communications, rocket science, meteorology, space physics, astronomy, biology and medicine. Almost immediately experiments were proposed by Swedish researchers, including Hultqvist and Bolin.

The international background is also described – the offer by the US government to launch European research satellites free of charge, the formation of COSPAR and the UN space committee. There is no mention of Amaldi’s initiative, however. His letter of 30 April had probably not yet reached Sweden. But, at the second meeting of the Committee in October, the matter was raised. The minutes record that “the idea of future European cooperation in space research aroused interest” within the Committee which considered that the matter “should be monitored within UNESCO” and that “the Committee should be represented at any preparatory conferences”. The belief in UNESCO as a possible option in this connection was probably due to Funke’s membership of the Swedish UNESCO council.

By the beginning of November a request had been addressed to the Council of UNESCO, proposing that the Director General of the Organisation should include rocket experiments in the programme.

At the third meeting – on 26 November 1959 – Herlofson outlined Amaldi's proposal "concerning European coordination of space research" and the opinion was put forward once again that UNESCO should take the initiative "thereby putting a neutral stamp on the project". It was already apparent at this stage that there was a fear that Sweden's policy of non-alignment might in some way prevent the participation by Swedish researchers in any cooperation. Nevertheless Funke offered to "find out about the current status of the plan at a forthcoming meeting with Amaldi".

Following this discussion the enthusiasm for UNESCO appears to have cooled. A few days later, in a letter sent to Brunberg from Geneva, Funke reported that Amaldi had said that his initiative was meeting with greater interest and understanding than he had expected. In particular the French reaction had been positive and he would shortly be publishing an article on the need for coordinated European space research in a French scientific journal, instigated by Pierre Auger (see page 8 above). Amaldi himself did not want to head up the undertaking but he had doubts about the idea of involving UNESCO, partly because a French initiative could be expected. It is possible that he was perhaps also aware of the risk that his initiative would become caught up in the heavy-handed bureaucratic organisation. Instead, a dozen scientists and technicians should be brought over from the United States to train their European colleagues.

Funke closed the letter by referring to a meeting with some Yugoslav researchers who had called for global space research cooperation. "Personally I think that the Yugoslav ideas are a decade or two ahead of their time" was his realistic comment.

With the formation of the Swedish Space Research Committee, Sweden, like Belgium, France, Italy, Britain and others, had acquired a body which could represent the country in the imminent discussions and negotiations on a Western European space research organisation.

European Cooperation Takes Shape

As has already been mentioned, at the COSPAR meeting in Nice in January 1960 Auger presented his and Amaldi's ideas. Even at this early stage the idea of a launch site in the northern auroral zone was put forward. Brunberg included the following in his report of the conference.

Two informal meetings were chaired by Professor Auger. The first meeting was only attended by representatives from the United Kingdom (Professor Massey), France (Professor Auger, Dr. Blamont), Belgium (Professor Nicolet) and Sweden (Dr. Brunberg). It was pointed out that none of the representatives had the power to make official statements, but the meeting was to be regarded as one stage in the explorations which had to be initiated with a view to European cooperation.

Professor Auger first gave a brief summary of Professor Amaldi's plan and also mentioned that within NATO there were plans for some civil space research activity, but that general European support for that was probably not appropriate for political reasons. In that connection, I pointed out that as far as Sweden was concerned any cooperation was only conceivable in the context of an entirely non-political and non-aligned organisation.... I then gave a report on the Swedish rocket plans and stated that we were interested in participating in further discussions on European cooperation. Our position in the northern auroral zone was also alluded to. Both Professor Auger and Professor Massey were enthusiastic about the idea of the interesting measurements which were possible in the northern auroral zone and proposed the idea that a European launch base should be set up in northern Sweden.

A second meeting was also attended by representatives of West Germany and the Netherlands. At that meeting Auger called an informal meeting in Paris with the issue of a European space research organisation as the only item on the agenda.

At the beginning of February 1960, the Space Research Committee discussed Brunberg's report. It is interesting to note that the Committee did not regard participation in European cooperation as a *fait accompli*. It was stated that Sweden "should perhaps sooner or later take part in a European cooperation, but the most important condition at present is to set in motion a Swedish programme. That is an important precondition for obtaining the best results from European cooperation." Nonetheless, it would naturally be an advantage if some of the European activities were located in Sweden.

Here, for the first time, emerged a problem which would plague Swedish space activities through the years and which would regularly return to the discussions of the Committee and its successors. This was the need for a national programme as a basis for participation

in international cooperation together with the risk that the decision on international activity would be taken on the basis of criteria other than purely scientific ones and at the expense of the national programme. However, it had not properly been realised that international participation certainly had its own risks but that, correctly used, it could also be a gateway to a national programme.

One of the members – not surprisingly Bengt Hultqvist – did however appear to be clear about this. In any case, he understood the possibilities of international participation for research on the aurora borealis. He took up the idea put forward by Auger and Sir Harrie Massey concerning a launch range in the northern auroral zone. According to the minutes of the meeting, Hultqvist proposed exploring the possibility of setting up a launch range near Kiruna “with a view to possible future European cooperation”. The Committee took on board the proposal and instructed him to make informal enquiries and also to consider the possibility of cooperation with Norway.

One month later – in February 1960 – representatives of the West European space committees in Belgium, France, Italy, the Netherlands, Switzerland, the United Kingdom, Sweden and West Germany gathered at Auger’s home at 12, rue Emile Faguet in Paris. The location had been chosen to emphasise the informal nature of the meeting.

The Swedish representative was Brunberg. It is apparent from his report that all the delegates except for the Dutch and the Swedish had already privately informed their respective governments of the events that were transpiring. The Swedish plans for a national programme were outlined. These consisted of sounding rocket launchings from an existing launch range in Upper Norrland with the emission of artificial clouds together with measurements of protons, magnetic fields and electron density. The view held by the

Ernst-Åke Brunberg, Professor in thermophysics at KTH.

From 1959 to 1972 secretary of the various space research committees.



Space Research Committee that a national programme should be developed before Sweden could participate in European cooperation was expressed, as well as the fact that the Committee did not yet consider the time was right to contact the government regarding the plans for cooperation.

This caused Auger to ask, with some irritation, whether it was likely that Sweden would join a common European organisation and whether the Swedes were prepared to participate in the continuing discussions on the matter. Swedish participation was difficult to predict, said Brunberg, but "several members" of the Swedish Committee were favourably disposed and they intended to take part in the continuing preparations. His words indicated that there was not complete agreement within the Swedish Committee on the line that should be taken.

During the meeting it was agreed that UNESCO should not be involved in the preparations. It was also agreed that activities within a space research organisation did not need to be as centralised as the CERN model with its facility in Meyrin. The production of instruments for satellites and rockets could take place at various sites in Europe. Different launch sites were needed for different experiments – the northern auroral zone was of particular interest. Those present at the meeting reaffirmed their interest in working together, Sir Harrie Massey showing particular enthusiasm. This was important because Amaldi and Auger realised that without British support their project was likely to founder.

Now there was support and, at Massey's invitation, they met once again for an informal meeting on 29 April 1960 at the Royal Society in London. The group from the meeting at Auger's home had now expanded to include scientists from Denmark and Norway. With the exception of Norway, all the countries present, plus Spain, would be members of ESRO. Many of those present, such as Auger and Blamont from France, Amaldi and Broglio from Italy, Van de Hulst from the Netherlands, Boyd and Lines from the United Kingdom (Massey had been prevented from attending at the last minute) and Brunberg from Sweden would play an active role in the preparations for ESRO and in the work of the organisation once all the pieces had fallen into place. "The European space family" had been formed and Sweden was there from the very beginning.

The Swedish Committee lost no time between the meetings in Paris and London. At a meeting on 16 March, Hulthén, Alfvén, Lindblad and Brunberg were asked to inform the Ministry of Education and Culture and the Ministry of Foreign Affairs of recent developments. This was done in the form of a call on the Minister for Education and Culture, Ragnar Edenman, whilst the Ministry of Foreign Affairs was informed at a meeting with Sverker Åström. At the Committee meeting, Funke also reported that a few days earlier he had met with Auger in Paris.

With regard to space research, Auger reported that there had just been a meeting in NATO where the issue of space research under NATO auspices had been discussed. There was a consensus that NATO should not begin space research because countries such as Sweden and Switzerland would not be able to join in such cooperation. If NATO undertook space research

it would therefore be an obstacle to more widespread European cooperation in that field and it was found to be important for such cooperation to be developed on a broader scale. The view had been expressed by NASA that it would warmly welcome the creation of a common European organisation since it would be considerably easier for NASA to work with such an organisation than with a number of individual European countries.

"Everyone was free to put forward their own ideas on the interest shown by NATO in these matters and the form that interest took", comments Funke. He adds:

In any case, the observation probably has to be made that, as there is a desire to set in motion space research cooperation, the time is probably quite well-chosen, and if an entirely peaceful organisation does not come into being, perhaps fairly soon other forces will begin to push in another direction.

By keeping the government informed informally about the plans for West European space cooperation and, moreover, ensuring the peaceful nature of the cooperation, there was obviously nothing to prevent the Committee taking part in the European preparatory work – at least as long as the government was not committed to future participation. Brunberg was able to attend the London meeting with a clear conscience. It was opened with reports from the different countries on the progress they had made. Brunberg presented a written report which stated *inter-alia* that the Swedish Ministry of Education and Culture and the Ministry of Foreign Affairs were sympathetic to plans for a joint European space research programme. The Space Research Committee's own plans had now come a little closer to realisation and also had been scaled down since the Paris meeting. They primarily revolved around purchasing ARCAS sounding rockets from the USA and using them to begin experiments in meteorology and astrophysics. Bert Bolin from the International Meteorological Institute in Stockholm had proposed investigations of noctilucent cloud at altitudes between 75 and 90 km. Bengt Hultqvist at KGO had suggested proton measurements at altitudes between 30 and 70 km in conjunction with solar flares and Willi Stoffregen from the Uppsala Ionospheric Observatory had proposed measuring electron density in the atmosphere at the aurora borealis.

According to the report of the meeting, Brunberg also announced that a launch site for sounding rockets near the polar circle, with a radius of 40-50 km, would shortly be ready for use – he was alluding to the military field at Vidsel, which the Space Committee would use for launching sounding rockets the following year. He also reported that a launch site, 70 km in width and 140 km in length, in the far north of Sweden was being discussed – Hultqvist had quickly realised where launches should take place. Brunberg stressed that Swedish researchers would welcome proposals for launches of foreign experiments at the smaller base and hoped to be in a position to offer similar services at the larger base if and when it came into being.

Following his statement, the Norwegian, French and Italian delegates immediately rushed to ask to speak in order to underline that they too could offer launch sites in northern

Norway, Sahara and Salto di Quirra on Sardinia respectively. The Norwegian mentioned plans to build a base connected to military installations at Andöya in northern Norway. The French and the Italian delegates on the other hand were able to point out that their bases, unlike the Norwegian, actually existed – they had been built for military purposes but could be converted for civil use without any loss of time. After some discussion, it was agreed that it was still too early to set up a working group to examine the various options. In a conversation with Brunberg, Boyd reported that the British were extremely interested in launching rockets in the northern auroral zone and that both rockets and instruments could be organised at short notice.

At the end of the meeting in London, guidelines for the future were drawn up in a number of resolutions. They stated that the group was in favour of developing joint satellites. Priority in the scientific work should be given to ionospheric research and the study of arctic space phenomena near the geomagnetic pole – a position which obviously furthered the Swedish interest in building a launch site in northernmost Sweden. In another resolution it was stated that the organisation's satellites should be sent up using a jointly developed and funded launcher. The possibility of using the British Blue Streak was mentioned in the course of the discussions.

Lastly, Auger was invited to call another meeting within two months, at which the delegates should have full powers to set up a preparatory commission with an executive secretary as head of an executive secretariat. This issue was difficult – the meeting actually wanted to set up the committee immediately, but still no one had the mandate to do this. During the discussion Brunberg pointed out that, if a committee was to be set up, in view of Sweden's non-alignment, the Soviet Union should be officially notified. This demonstrated the Swedish fear that cooperation with a number of NATO countries in an area – rocket development – which bordered on military activity might be misinterpreted by the Soviet Union.

Brunberg followed up the matter on his return from London. In a letter to the chairman of COSPAR – Van de Hulst – he called attention to the fact that in London he had opposed the press release from the meeting on the ground that the Russians should first have been informed of current events. During the discussions on the matter, the view emerged that COSPAR should be responsible for notification and Brunberg now asked for this to be done as soon as possible. Van de Hulst was able to reassure him by sending a copy of a letter which had already been sent to the Soviet Academy of Sciences.

The London meeting pointed the way ahead in many respects. Previously, some countries had not been entirely out of sympathy with the idea that satellites should be developed bilaterally, while the role of the space organisation should be predominantly one of coordination. Now it was agreed that the organisation should build its own satellites and its own launcher. It had also been established that its function was to provide the scientific community with the technology required by space research. It is quite a different matter that it subsequently took more than thirteen years of negotiations, quarrels and failures before they were able to get as far as their own launcher.

Furthermore, as far as the Swedes were concerned, an important factor was the decision to prioritise ionospheric research and arctic-oriented studies – the Swedish dream of a launch site north of the polar circle began to become reality. Lastly, it can also be noted that the competition between the Norwegian base at Andöya and ESRANGE had now begun.

Auger immediately began to formulate a proposal for the terms of reference of the Preparatory Commission and called a constituent meeting – or so he thought – in Paris on 23-24 June 1960. In order to emphasise the fact that the preparations now had at least a semi-official character, the meeting was held at the French Ministry of Foreign Affairs. Some of the delegations now also included representatives from the ministries and research authorities concerned. In Sweden, the Space Research Committee had committed itself in earnest and on this occasion sent Hulthén, Funke and Brunberg.

As has already been mentioned, the purpose of the meeting was to form a Preparatory Commission to work out detailed plans which would then be put before a meeting of delegates holding full powers from their respective governments to sign a cooperation agreement. The Swedish delegation was prepared to agree to this course of action – it would initially be binding on only the Space Committee and not the government. However, not all the delegations had done their homework so well – several of the delegates believed that even at that stage the Preparatory Commission had to be formed at governmental level. Other delegates had not been given any powers by their governments.

Funke sought to bring order to the confusion. He stressed that it was time to get started and that would be possible by removing all references to the respective governments from the resolutions from the meeting. Rather than opening in the customary style of resolutions with “the Governments of France, the United Kingdom, Sweden etc, wishing to establish a Preparatory Commission ...” they would simply state that “France, the United Kingdom, Sweden, wishing to establish ...”. In this way the governments were not bound, pointed out Funke, who described his proposal as a “mixed or semi-official” decision for which in some cases governments, in other cases national research bodies could take responsibility.

There was also a Swedish domestic motive behind Funke’s proposal. While the Minister for Education and Culture, Ragnar Edenman, had been informed privately, within the Space Research Committee it was believed that the issue of Swedish participation was still not ready to be officially presented to the government back in Stockholm. It was thought that the “entire complex of problems” should be examined beforehand – there were probably fears of negative reactions from other scientists and from the government, bearing in mind the high costs for the current, fairly vague, plans. This might prevent the Space Research Committee from participating in the continuing preparatory work.

However, Funke’s cleverly presented – though formally dubious, not to say Machiavellian – proposal was defeated. This was partly because there were several difficult issues – for example, the British delegation did not want to rule out Australia as a member since it possessed a suitable launch site (Woomera) for the rockets – *Blue Streak* and *Black Knight* – which the British hoped would be used. Several delegations reacted against that

5. EUROPEAN COOPERATION TAKES SHAPE

suggestion – they did not want a non-European country as a member and it is very probable that they did not yet want to take a position on how the rocket question would be resolved. The final result was to form a study group for cooperation within space research, the *Groupe d'Etude Européen pour la Recherche Spatiale (GEERS)*, which, according to Auger, was to be regarded as the embryonic form of what was to come. According to the report from the Swedish delegation, the group would be named the study group for *international* cooperation in space research. The word “international” had been introduced in the place of “European”, thereby keeping the door open for participation by Australia. Some time after the conclusion of the meeting, the word appears to have been removed, however. The result nevertheless remained the same – Australian participation was still not ruled out.

The mandate for GEERS was to convene another conference in the course of 1960 – but this time at governmental level – with the task of finally establishing the Preparatory Commission. By that time, a proposal for an agreement had to be drawn up together with technical and scientific basic documents. No less than five working groups were set up, one for administrative and financial affairs, and the four others to draw up guidelines for scientific and technical development programmes and to define the requirement for technical facilities and for launchers and launch sites.

Sir Harrie Massey became the chairman of GEERS with Hulthén as one of three vice-chairman and Auger as executive secretary.

As far as the scientists were concerned, the Paris conference was a failure. What had at the beginning been a matter between them, which could be dealt with quickly and effectively had, as soon as it was an inter-governmental issue, become riddled with complications and delays. An entirely different, detailed document from the one presented by Auger was now necessary. The bureaucrats had made their entrance on the stage and behind them were the politicians. The scientists were not happy, they were in a hurry to move on and now their time plans had been wrecked; they did realise, however, that what was happening was unavoidable, since it was the politicians that held the purse strings.

Therefore, they quickly set about producing new guidelines for the prospective organisation. At a meeting in London in October attended by Bolin and Brunberg, that basic document was drawn up. The proposed broad-sweeping scientific programme would be centred on experiments on board sounding rockets and satellites.

The sounding rocket programme was primarily to be geared to atmospheric and solar activity studies (for example the aurora borealis). These would require launchings to both low (30-90 km) and medium (90-200 km) altitudes, and also to very high altitudes. For low-altitude launches it would perhaps be possible to manage with existing facilities, even though the possibility of the organisation building its own bases in the long run could not be ruled out. Medium-altitude launches on the other hand were expected to require no less than four bases, one in the northern auroral zone, i.e. in Sweden or Norway, one at a medium latitude, in Sardinia, one in the Sahara which could be used for experiments without rigorous safety restrictions being applied to the launches and, lastly, one in the

southern hemisphere, at Woomera in Australia. In addition, it was thought that some of the launches would probably have to be done from ships or aircraft and for certain experiments balloons would be required. It would be possible to conduct high-altitude experiments from satellite launch bases.

There was similar optimism surrounding the satellite programme. Three phases were envisaged. During the first three-year learning phase, a number of small satellites in the 100 kg class would be sent up for ionosphere studies and observations in the areas of astronomy, meteorology, geodesy and cosmic radiation. In a second five-year phase it was expected to have acquired the capacity to launch satellites weighing 500-1000 kg for more advanced studies and experiments in those areas. Here we see for the first time the eight-year development period which would eventually be established for ESRO. In parallel to those two phases, a third phase would run which would be directed at long-term, even more advanced targets, primarily in astronomy and astrobology; in that phase it should be possible to land scientific instruments on the Moon.

One important prerequisite for the various projects was access to the organisation's own technical facilities for the development of satellites, space probes, scientific instruments, rocket propulsion studies etc.

It appears that there was great optimism. However, costs began to raise concerns. Initially it had been said that the organisation's annual budget would be approximately as large as that of CERN, but now it became evident that it would be larger; pessimists spoke of an annual cost around ten times greater than the CERN budget. Massey remained unconcerned, however, and expressed the view that an annual expenditure twice as great as that of CERN was not unrealistic and stated that he was prepared to present such a budget to the British government.

It was proposed that all experiments would be scrutinised and selected by a research committee which was to issue recommendations for decisions to the organisation's supreme organ, its council, which would be responsible for policy and finances. It is notable that there was no thought to propose any special committee for administrative and budgetary scrutiny – the initiative was still in the hands of the scientists and the bureaucrat's arrival had not yet found its way into the documents.

It was obviously also necessary to acquire launchers and launch sites. Missiles mentioned as suitable as a first stage of a launcher included the British *Blue Streak* and the American *Thor* and *Atlas*. *Colomb-Béchar* in French Sahara (Algeria), *Woomera* in Australia and *Cape Canaveral* in the United States were put forward as possible bases. John Krige has pointed out that discussions no longer concerned the development of the organisation's own launchers and that *Blue Streak* was mentioned only as one alternative among other options. This was because the discussion on a European launcher now began to take an entirely different track.

Blue Streak was a medium-range missile, intended for rapid retaliation in a nuclear war, which Britain decided to develop in the mid-1950s. After a few years however it was clear

that technological development had outstripped the project. The rocket was liquid-propelled and had to be placed on a fixed platform which made it vulnerable to enemy attack. With the American *Polaris* and *Minuteman* and their Soviet counterparts at the beginning of the 1960s came the introduction of missiles which were propelled by solid fuel and could be fired very quickly from mobile platforms or from submarines. In April 1960 the British government decided to discontinue Blue Streak. However, a large amount of money had been invested in the project and therefore a civil use was being sought.

At the same time as the decision was taken to discontinue Blue Streak, the British therefore contacted the French government and proposed cooperation in developing a civil launcher in which Blue Streak would form the first stage and the scientific rocket Black Knight the second. The French reaction was positive – De Gaulle was attracted by the idea of a Europe which was independent in space technology and a launcher could play an important role in the aspiration to reduce the technological gulf which existed in relation to the superpowers. However, the French themselves wanted to take responsibility for the second stage. In their view Black Knight should be replaced by the military rocket *Veronique* (later renamed *Coralie*).

In autumn 1960, the British Minister for Aviation, Peter Thorneycroft, visited a number of European capitals to present the British proposal and recruit members to the inter-governmental organisation which was to be responsible for developing the European rocket. In Stockholm he met with a cold reception – the Swedish government invited him to dinner at the Foreign Ministry, but left the question of Swedish participation completely open – there were serious reservations over an undertaking with a military background which could possibly be intended for NATO purposes, even though Thorneycroft stressed the peaceful character of the launcher. In addition, there was deemed to be no risk that the prospective ESRO would not be able to send up its satellites, because as early as 1959 the US government had expressed its willingness to launch European research satellites at no cost.

Moreover, it was only now – in autumn 1960 – that the Swedish government was officially notified of the plans for ESRO. In September the Space Research Committee submitted its first appropriation proposal. This was a request for SEK 150,000 to fund national experiments but it also contained information regarding the European plans.

When GEERS, in accordance with its terms of reference – though with an official invitation from the Swiss government – called a governmental conference from 28 November to 1 December 1960 at the CERN headquarters in Meyrin near Geneva the Space Research Committee could no longer itself decide who would attend from Sweden. In a letter of 11 November, it was requested *inter-alia* that the government appoint delegates having the power to “sign an agreement concerning the establishment of a committee of inquiry to study the possibility of setting up European space research cooperation”.

Before the letter was sent, Funke appears to have privately contacted Hans Löwbeer, Undersecretary of State at the Ministry of Education and Culture, who had made clear that

the letter must be "firm". It therefore begins with general arguments regarding the importance of continuing with space research, particularly the proposed European cooperation. Among other things, the industrial aspects were highlighted, since "a European cooperation programme would be in line with the trend within Europe towards economic and industrial integration" and it should help to prevent the "brain drain" of scientists across the Atlantic – Funke was tactically aware that this was a sensitive issue to which the Swedish government was devoting great attention. There was also a reference to the proposal from the British government that the European satellite programme should be divided into a rocket technology component and a scientific component. The Committee considered that Sweden should participate only "in investigating the scientific component of the satellite project, i.e. the development of the satellites themselves, their instrumentation and their applications". This attitude probably reflects the view taken by the Swedish government on Thorneycroft's proposals.

The letter ended with a summary, which also constituted instructions for the delegates at the Meyrin conference. At the conference Sweden was to make clear that the role of the Preparatory Commission was to investigate the question of West European space research cooperation and that it was willing to give financial support to those investigations, but intended to reserve its position. The question of a possible launch range in Sweden is given surprisingly little treatment and obviously still did not play a major part in the Committee's thinking. It was pointed out that, at the conference, the Swedish interest in cooperation in high-altitude research, i.e. research using sounding rockets, should be underlined and that the organisation's activity should be distributed geographically between the participating States.

Examples are the rocket launch ranges at various locations which are necessary for the high-altitude research programme as well as the fact that researchers at the universities and institutes of various countries will have the opportunity to participate in the processing of the telemetry data which have been collected. Of course, some joint centres must be expected, but Sweden should adopt a reserved line vis-à-vis excessive centralisation.

The negotiations between the French and British governments over the launcher were still continuing in autumn 1960. This greatly affected the conference in Meyrin bringing together the representatives of eleven West European countries, the countries which attended the meeting at the Royal Society in April, together with Spain and Austria. As the Swedish delegates, the government had appointed Hulthén, the chairman of the delegation, Funke and Brunberg and, for the first time, a Foreign Ministry official, Bengt Rabaeus. Funke was chosen as chairman of the working group which, during the conference, would draw up the budget and the scale of contributions for the Preparatory Commission on which, it was hoped, agreement could finally be reached.

However, the discussions dealt with the budget and the scientific programme much less than had been expected. The basic document from GEERS (see above) was acceptable to most and instead the main focus was the question of the launcher.

The head of the British delegation, R.N. Quirk, Undersecretary of State at the Ministry of Science, began by pointing out that, while leaving the question of British participation open, the sole task of the Meyrin conference was to formulate a legal document which established the Preparatory Commission. The scientific and technical objectives and tasks should be briefly defined and should not include telecommunications satellites and launchers. He found immediate support from the head of the French delegation, De Rose. Hulthén stressed that his delegation was prepared to support a possible agreement, but that of course did not mean any commitment to the future programme. On the other hand he believed, unlike Quirk, that it was important to discuss at this early stage some of the scientific problems which it could be foreseen that ESRO would encounter.

As the discussions continued, both Quirk and De Rose emphasised that a scientific organisation could fulfil its function very well without developing its own launcher and that, for the time being, they were opposed to a single organisation for European space activity.

Several of the other delegations expressed doubts about the British and French statements. In particular, the Belgian delegate, Depasse, some years later administrative director of ESRO, made an enthusiastic appeal for a unified organisation responsible for developing both satellites and launchers. Only the Swedish delegation gave its unreserved support to the British and French. It was necessary to limit the mandate of the Preparatory Commission in view of the rocket project which was under discussion, according to Funke. Hulthén also pointed out that the role of the Preparatory Commission was scientific and not technical. The development of launchers was a matter for highly industrialised countries and must be kept separate from issues of space research.

The Anglo-French line won through. Opposition does not appear to have been very strong – the scientists in particular realised the risk that a costly new launcher would become a cuckoo in the nest, which would also upset the balance between international and national space programmes which most of them carefully guarded. They were therefore satisfied with a resolution in which it was noted that the negotiations regarding a launcher were proceeding and in which very close cooperation between ESRO and the rocket organisation was recommended, if such an organisation came into being. In the working committee meetings, three countries – West Germany, Italy and Sweden – abstained from voting. Their positions were dictated by entirely different motives. The Germans did not have any mandate to take a decision. It is not clear what lay behind the Italian attitude, but it can possibly be conjectured that it was related to the fact that Amaldi felt a deep scepticism at the proposed solution to the launcher issue. In the plenary discussions, however, the Italians and the Germans supported the resolution while Sweden insisted on abstention.

Even though it was not stated directly it can be assumed that the Swedish position was dictated by doubts over the Blue Streak project and its military emphasis resulting from the policy of non-alignment. It cannot have been difficult for Hulthén and Funke to support that line, as it was consistent with the position of the Space Research Committee; for them, as for many of the other scientific delegates, the most important thing was to

establish space research cooperation. As has already been mentioned, satellites could be sent up with American assistance.

In the end, agreement was reached to set up a Preparatory Commission to examine the possibilities of forming an organisation for cooperation within space research and space technology – the latter words were added only after a fierce debate where certain far-sighted delegates succeeded, not without difficulty, in persuading the conference that the task of the organisation would become completely impossible if it did not also pursue technical development based on the scientist's requirements and specifications. The result of the Commission's work would be presented at another inter-governmental conference which would formulate the convention, scientific and technical programmes, organisational structure etc. In the Commission each member country had one vote and the right to be represented by two delegates. The budget was set at FF 900.000, on a proposal from the subgroup chaired by Funke. The Swedish share was calculated at 4.27%.

Lamek Hulthén, as head of the Swedish delegation, signed the Meyrin agreement without any reservations. Some countries had however made reservations about signing the agreement, on procedural grounds. As a result, the agreement could not enter into force immediately. Only on 27 February 1961 had the requirement for entry into force – that at least six states whose total contribution amounted to 70% of the budget had committed themselves – been satisfied.

COPERS (European Preparatory Commission on Space Research) had finally been formed. The first internationally binding step had thus been taken on the road to a European space research organisation.

The Blue Book and the ESRO Convention

On 13-14 March 1961 – two weeks after the Meyrin agreement entered into force – COPERS held its constituent plenary meeting in Paris. Sweden was represented by Lamek Hulthén and Gösta Funke. Sir Harrie Massey was appointed as Chairman of the Commission, and not unexpectedly Pierre Auger became Executive Secretary. Two working groups were set up, one to draft guidelines for the scientific and technical activities, the other to draw up the convention, administrative and financial regulations, organisational structure etc. Hulthén became Chairman of the Scientific and Technical Working Group and the German astrophysicist Reimar Lüst, who, in various posts and positions, would play a very important and influential role in ESRO and ESA during the following 30 years, was appointed Secretary. The chairman of the Legal and Administrative Working Group was the German scientific administrator Alexander Hocker, who would also serve within ESRO in various roles for some considerable time.

All member states were required to participate in the working groups. Apart from Hulthén, Sweden was represented in the Scientific and Technical Working Group by Bert Bolin and Ernst-Åke Brunberg, together with two newcomers to the European arena, Carl-Gunne Fälthammar from KTH and a pupil of Hannes Alfvén, and Bengt Hultqvist from KGO. Hulthén, Funke and Bengt Rabaeus from the Ministry of Foreign Affairs took part in the work of the Legal and Administrative Working Group. Later in 1961, another new face arrived on the scene who within a couple of years would come to play a dominant role in the preparatory work, Rune Fremlin, head of a newly established international section in the Ministry of Education and Culture, to which he had been seconded by the Foreign Ministry.

Notable among the other countries' COPERS delegates were the Spanish general Luis de Azcarraga, who represented his country in ESRO/ESA for more than 25 years, and the Frenchman Bignier who would also be linked to ESRO/ESA for more than 25 years, first as a chief delegate and later as a senior official in the organisation.

The work of the two working groups will be dealt with together since the discussions and proposals of the Scientific and Technical Working Group would to a large extent direct the work of the Legal and Administrative Working Group – the dialogue between the working groups was conducted primarily at the COPERS plenary sessions.

The first meeting of the Scientific and Technical Working Group was called by Hulthén and held on 4-5 April 1961 at KTH in Stockholm. During the meeting there was a study visit to the Institute for Electronics at KTH, where various space projects were discussed with Professor Alfvén and Professor Herlofson. In the minutes there is also a vote of thanks to the Ministry of Education and Culture for its hospitality, which might have been a dinner funded from the Ministry's sundries budget.

The most important items on the agenda were the discussions of short-term and long-term projects. Dr Robert Boyd, from University College London, proposed that, in the long term, the organisation should focus on astronomical satellite observatories and satellites orbiting the Moon. The proposal met with a sympathetic reception, in particular the space observatories proposal. In reality, a commitment was being made to a project which the British had already begun to plan and which would later cause the organisation a serious crisis, the LAS project, the Large Astronomical Satellite. The proposals by the Frenchmen Kovalevsky and Blassel included radio-astronomical satellites and the Germans, through Lüst, proposed satellite and sounding rocket experiments with artificial comets. The Belgians wished to keep open the possibility of ESRO also developing telecommunications satellites, but their proposal was contemptuously rejected, since most countries took the view that ESRO should actually be prohibited from becoming involved with commercial projects.

The Dutch delegation proposed developing guidance mechanisms for sounding rockets which could then be launched from sites with dimensions of 5 km x 5 km, located close to built-up areas. This proposal was rejected for the time being – it was thought to be too expensive and, moreover, an international safety agreement would be required before development could be started. The scientists did not have time to wait around – far too much time had been lost already.

The Swedes presented two well-written and carefully considered proposals from Bengt Hultqvist and Bert Bolin.

Hultqvist presented a paper entitled *"Proposal for measurements in the auroral zone of the upper atmosphere by means of rocket borne instrumentations"*. It covered no less than 13 different sounding rocket experiments within the northern auroral zone, including geomagnetic measurements, investigations of the aurora borealis' ultra-violet radiation, flux and energy measurements for electrons and protons in the aurora borealis at different altitudes, and electron density measurements within the ionosphere.

Nine of the experiments were said to be of primary interest for KGO and other interested parties mentioned included Uppsala Ionospheric Institute within the Swedish National Defence Research Institute and some Norwegian and Danish institutions. Nike-Cajun was put forward as a suitable rocket at a cost of \$7-8000 each. Telemetry equipment could be obtained from SAAB at a cost of \$2-4000 per rocket. The average cost for each experiment was calculated at \$89.000, in addition to which there would be \$20.000 for the necessary investments at KGO together with an annual cost of \$45.000 which, at the value of money at that time, covered the salaries of four researchers, four technicians and three assistants.

The proposal was favourably received by the working group. It was also in keeping with the ideas which had been expressed earlier in the preparatory work. The minutes of the meeting do not deal with the matter of where rockets should be launched, but there can be no doubt that, by presenting a well-prepared proposal for experiments in the northern auroral zone at the very first meeting, Hultqvist had grasped the initiative for himself and

Sweden as far as a base for sounding rockets in the north was concerned. In the working group the Spanish delegate Sans-Aranguéz proposed a sounding rocket base on the Iberian Peninsula or on the Canary Islands without providing any further information. This was allowed to pass by in silent benevolence. In the years to come it was produced at regular intervals by the Spaniards as a sort of threat whenever they were dissatisfied with one thing or another within ESRO or when they wished to get their own way in some other matter.

Bolin's proposal was entitled "*Rocket Research in Meteorology*". The high-altitude experiments which were envisaged, using sounding rockets, included investigations of noctilucent cloud like those conducted by the Space Research Committee in the next few years. In the discussions, however, questions were raised whether research of that nature would not be better conducted in collaboration between the national meteorological services and the World Meteorological Organisation (WMO). The proposal therefore was given low priority, but it was agreed that ESRO should carry out a pilot study which might later form the basis of research cooperation between the national meteorological services.

It is interesting to note an annex to Bolin's paper in which the three Swedish institutions which had plans for "rocket research" at that time are set out, together with the personnel directly connected with that research. At the Institute for Meteorology at Stockholm University were, among others, Lennart Lübeck and Georg Witt, at KGO was the Austrian Dr Johannes Ortner and at Uppsala Ionosphere Institute Willi Stoffregen and Arne Pedersen. All of these would make major contributions to the Swedish and European space programmes in the subsequent years. Ortner later became director of the Austrian Space Agency and Lübeck head of the Swedish Space Corporation.

It is apparent that sounding rocket experiments played an important role at the Stockholm meeting. Only one delegate – the Italian Broglio – had objections. He considered that sounding rocket experiments belonged in national programmes and that it was most important for ESRO to ascertain from NASA at the earliest opportunity what type of launch assistance the Americans were prepared to provide – only when that was known could ESRO formulate a short-term satellite programme. As far as the long-term programme was concerned, Broglio suggested development studies of rocket propulsion.

Broglio did not find support for his ideas. Sounding rocket experiments were, simply for geographical reasons, dependent on cross-border cooperation, it was thought, and there was also much to be gained from joint funding of rockets and equipment. As regards the launching of satellites by the Americans, many had doubts over such assistance on principle – in any case, they did not wish ESRO's satellites to be determined by the rocket launchers which the Americans could make available.

One reason for the negative reaction to Broglio was of course that the negotiations on the creation of the *European Launcher Development Organisation (ELDO)*, which was to develop a European launcher with Blue Streak as its first stage, were in full motion. Sweden took part in these negotiations despite its reservations over the project. The

Swedish position, which at the same time sheds some interesting light on its attitude to space activity in general, will be examined in the next chapter.

The meeting of the Scientific and Technical Working Group in Stockholm concluded with the formation of four subgroups, one for research chaired by Bengt Hultqvist, one for technical development under the chairmanship of the Englishman Dr F Lines from the Royal Aircraft Establishment at Farnborough, one for data handling and ground stations chaired by the Frenchman Dr J C Pecker from the Meudon observatory and one for astronautics, that is to say satellites and sounding rockets including launch sites, with the Belgian Jean Vandekerckhove from the Aeronautical Institute at the University of Brussels in the chair. The fact that Hultqvist was chosen to chair the research group shows that his proposal was being taken seriously. Of the others, within a short time Lines would move over to COPERS/ESRO as technical director. Vandekerckhove would also shortly take up a position with COPERS and begin a career with ESRO and ESA which would last many years. Pecker was succeeded in the data group after some time by the Dutchman Professor C. De Jager from Utrecht Observatory. Lüst became the coordinator for the four groups.

The Stockholm meeting has been covered in exhaustive detail, since it set the direction for ESRO during the 1960s. It also contained the seed of the conflicts which would shake the organisation during its more than 10 years of existence – basic research versus applications, own launcher or separate launcher organisation, European or American launch vehicles, scientific programme with both sounding rockets and satellites or concentration on satellites alone. Ultimately these issues would lead to the dissolution of ESRO, or at least a radical overhaul.

The working groups quickly set to work – Hultqvist's group had met by the end of April in Kiruna. The frequency of meetings up to the third COPERS plenary meeting in Munich on 24-25 October 1961 was intensive. At that meeting the "Blue Book", named after the colour of its cover, was approved. It contained the results of the work of the Scientific and Technical Working Group and its four subgroups and came to act as a kind of canonical text for ESRO even though it was stressed time and again that the Blue Book was only to be regarded as a collection of examples to act as a guide for activities.

In its introduction, the Blue Book identifies a total of 55 Western European research groups involved in space research and interested in cooperation with ESRO. In total, almost 500 people were working in the groups, 130 of them at PhD level.

The proposed research projects displayed strong similarities with the proposals made in the preparations for the Meyrin conference and at the meeting in Stockholm, though now in a more detailed form. The programme was divided into projects with short, medium and long-term planning. Projects with short-term planning consisted of sounding rocket tests centred within the northern auroral zone – the list of possible experiments included, not unexpectedly, those proposed by Hultqvist. Projects involving medium-term planning covered small satellites and space probes for ionospheric and magnetospheric measurements, radio-astronomical measurements, studies of comets etc. The long-term

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projects were composed of astronomical observatory platforms and satellites for Moon studies.

It was intended that the programme would be carried out at a number of installations, the European Space Technology Centre (ESTEC), the European Space Data Acquisition Centre (ESDAC), the ESRANGE launch site and a network of observation stations.

During a period of eight years and within a margin of expenditure of slightly more than FF 1400 million, which also covered the cost of investments and operations of the installations, ESRO was expected to execute space projects on the following basis:

Year	Sounding rockets	Small satellites	Space probes	Large satellites
1	10 max	-	-	-
2	40	-	-	-
3	65	-	-	-
4	65	4	-	-
5	65	6	-	-
6	65	4	2	2
7	65	4	3	2
8	65	4	3	2
Approx. total	440	22	8	6

The quantitative targets were laid down in a specific resolution which was adopted in conjunction with the signature of the ESRO Convention a little more than six months after the COPERS meeting in Munich. In that resolution it was expected that, as set out in the Blue Book, an average of 440 sounding rockets would be launched in the eight-year period, but the number of satellites and space probes was reduced to 16 rather than the 36 proposed in the Blue Book. In actual fact, the reality was entirely different – 152 sounding rockets and seven small satellites in the period from 1964-72 within the scope of the budget and staffing envisaged in the Blue Book. That lack of realism may be surprising. The statement made by Bengt Hultqvist in a paper, *Space Research in Sweden*, delivered at an ESRO historical symposium in Palermo in 1992, is certainly wholly accurate.

We, who planned the programme, were, of course, quite unexperienced of space research, but that may not be the main explanation. The plans were based upon the limited experience that there was in the World. In the period October 1957 to early 1958 the Soviet Union launched Sputnik I, II, and III. A single university institute in USA, Van Allen's Institute at the University of Iowa, launched one satellite per month in the early part of 1958. ... It was this kind of experience that was behind the figures presented in the Blue Book. It did not seem unrealistic to us that the whole of Europe should be able to compete with Van Allen's group in terms of number of satellites

per year. What we, and most likely all others in Europe were unaware of was the enormously fast rise in sophistication and complexity of the new satellites that were required to carry the science further. The situation in which even the simplest instrument launched into a satellite orbit would produce interesting new scientific results was very short lived. It was essentially explored by Van Allen and the Russians. Also in USA and USSR the frequency of launches of satellites providing exciting new results decreased very much in the sixties. But we who planned the programme in the Blue Book were not yet aware of that in 1961.

The following comments can be added to that statement. During the 1960s, a permanent feature of ESRO's committees and its Council was the reports of changes to the design of the satellite projects on account of new scientific requirements and the related new technical developments. The result was often great escalations in cost. It was pointed out many times in ESRO and ESA – in particular by the administrative delegates – that it would have been better if the project had been frozen at an early stage in the development work. Personally, I now take a different view, at least as far as ESRO is concerned. In the light of the scientific and technical successes which ESRO had been able to achieve after all with its seven satellites and more than 150 sounding rocket launches when the activities were evaluated at the end of the first eight years, that period is best seen as a learning phase, necessary to take a lead position in research and also necessary for the continuing technical development of both research and applications satellites. In practice, although it was not stated directly, ESRO also to some extent took responsibility for joint technical development, the results of which could then be used in the member countries' national programmes.

At the same time as the Blue Book, the Legal and Administrative Working Group was working on the proposal for the ESRO Convention and its annexes. This proved to be a more difficult task and the final result was not available until spring 1962. The objective of ESRO was stated in the proposal as being to provide and promote collaboration among European states in space research and technology, exclusively for peaceful purposes. The scientific findings would always be published or made available in some other way, as would the technical findings, though subject to the restrictions to which any patent rights might give rise. The organisation would be controlled by a Council consisting of two representatives from each member state, with a scientific committee and an administration and finance committee as preparatory bodies. A director-general would head the executive secretariat. Subordinate to him would be a scientific and a technical director. Even during the COPERS period, the decision was taken which in practice appointed Auger as Director General of ESRO, Lüst as part-time Scientific Director and Lines as Technical Director.

The Swedish delegates had worked actively on the formulation of the Blue Book and the Convention. Of course they had guarded the peaceful character of the organisation and scientific openness – these requirements were not controversial in themselves but for Sweden they were absolute conditions, compared to certain member states which probably did not regard them as particularly important, at least the peaceful purpose. Sweden also

stressed the importance of the northern launch site as soon as the opportunity arose – ESRANGE was no doubt regarded by Swedish scientists as an entry ticket to future membership.

But above all the Swedish delegation, on the instruction of the government, pushed for the requirement of unanimity on certain budgetary decisions and on decisions concerning cooperation with member countries or international organisations. The latter requirement was important to the Swedes because they realised that collaboration between ESRO and ELDO was inevitable. However, it was important domestically to be able to show that there was a veto right if ELDO, with its military background, wished to cooperate with NATO and seek to bring ESRO along with it.

But unfortunately, long discussions were needed before agreement was reached on the budget structure and the rules for budget decisions. The UK delegation – having been burnt by experiences in CERN – proposed the introduction of a number of control mechanisms to prevent unpleasant surprises. It was asserted *inter-alia* that decisions to modify ESRO's programme and activities should require a two-thirds qualified majority. For the qualification requirement to be met, those countries which contributed more than 10% of the budget (France, Italy, the United Kingdom and West Germany) would have to be part of the deciding majority. This was fiercely opposed by the Dutch delegation which received strong support from the Danish, Norwegian, Swedish and Swiss delegations. The qualified majority requirement was unfair, in their view, since it gave the "big four" a veto right which the rest did not enjoy. There were no grounds for such a right, because the contribution made by a small state was, in proportional terms, of the same value as that of a large country. The Swedes insisted on the need for budgetary decisions to be taken unanimously and even went so far as to make calls on the other countries' foreign ministries to that end.

The British also proposed that a ceiling should be set for the funding of the eight-year development period envisaged in the Blue Book. ESRO's budget should, in their view, be decided three years at a time, using the proposed qualified majority rules. This was opposed by scientists in the various delegations who claimed that a ceiling was being set which could not then be changed if necessary without a complicated and time-consuming legal procedure and pointed out the difficulties of putting price labels on the various satellite projects without more detailed studies. But the British were seeking precisely this kind of fixed ceiling. They therefore abandoned the controversial qualified majority demand and instead took the line that the three-year budget should be fixed by a unanimous decision. Within the scope of that decision, one-year budgets could then be decided by a two-thirds majority. The scientists also warned against that approach; they pointed out that the unanimity requirement could paralyse the work of the organisation – a prediction which would, at least partially, come true. For the administrators in the Legal and Administrative Working Group, however, the new proposal was more attractive, since it would give each country a coveted right of veto. The Swedish delegation quickly fell in line with the new British proposal and made it a condition that it should be implemented. That line was successful.

But then, when the financial ceiling had to be determined, the delegations reached loggerheads. In the Blue Book, scientists had predicted an eight-year expenditure – not a ceiling – of around FF 1400 million. However in the Legal and Administrative Finance subgroup, chaired by Funke, they were sceptical. The lack of knowledge of the costs of space research, combined with the experience of research costs tending to escalate once a project was underway, suggested that a large amount should be included for contingencies. Eventually, they settled on a total expenditure of FF 2100 million, i.e. approximately 600 million for contingencies.

Then, remarkably, the scientists hit out. Boyd and Lines said that a contingency margin had already been built into the Blue Book and Hultqvist stated that Europe ought to be able to make “a substantial contribution to space research within a limit of 1650 million francs”. A special group chaired by the Dutchman Van de Hulst was set up to study the matter and it reached the conclusion that it should be possible to carry out the programme set out in the Blue Book within a margin of 1500 million francs. Thus the matter was settled and it was impossible for the administrators to return to their governments and persuade them of the need for a margin of an extra 600 million. In that position, where the scientists had guaranteed the realism of their calculations, it was not difficult either for the British delegation to gain a hearing for the proposal to change the eight-year margin into a ceiling.

The fact that the administrators sought a high sum and the scientists a lower amount is not as surprising as it might seem. As far as the administrators were concerned, we can conjecture that it resulted from the experience that it is always an almost impossible task to address supplementary requests for funding to the finance ministries after the event; it is better, to be safe, to seek a decent amount. For the scientists, the reason related to the balance between international and national space research. ESRO could not become too strong and, above all, could not be developed at the expense of national programmes. This question had concerned the Swedish delegation when the Blue Book was drafted. There it had arisen in the discussions of ESRO's scientific and technical identity. Several delegations – in particular the French, the Belgians and the Swiss – took the view that ESRO should conduct its own research in specially constructed laboratories which would build their own experiments on board satellites.

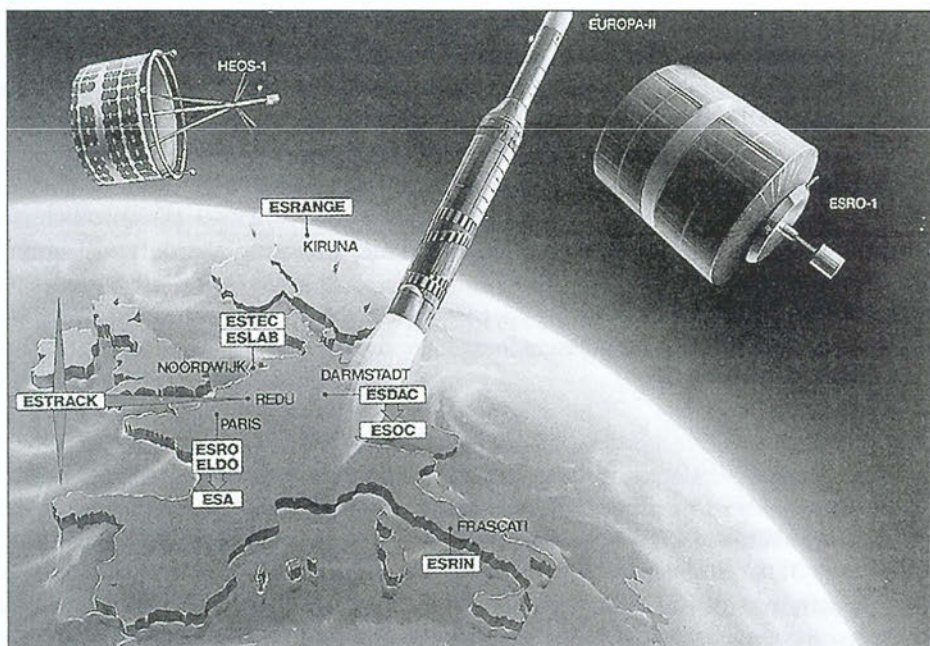
The Swedes and the Dutch raised objections. Hulthén pointed out at the second COPERS meeting in The Hague in May 1961 that space research, by definition, could not be delimited in the same way as, for example, nuclear physics or organic chemistry. Space research is research which uses sounding rockets, space probes or satellites and would therefore be better defined by its technology than by its object. He stressed that in practice it encompassed all astronomy and parts of physics and chemistry and also geology and biology. Such an enormous scientific field could not be handed over to a small group of scientists at a central institute. Ideas and initiatives had to come from scientists throughout Europe.

Two weeks later, Hultqvist expressed his fears in a letter to Lines. There was a risk that the ESRO groups, with their good salaries and good supply of resources, would attract the

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national groups' best people he pointed out. The likely consequence would be that ESRO would also appropriate the most interesting satellite experiments. Therefore, ESRO scientists should not automatically have access to satellites, but their proposals for experiments should be assessed in the same way and on the same conditions as national proposals. From the perspective of European cooperation it would be best if the ESRO groups were dispensed with and they instead concentrated on a reasonably equitable distribution of national research groups between the member countries.

The result was a compromise where the Swedes largely gained a hearing for their views. In accordance with the Blue Book, research would be conducted *in general* within the national groups and the various experiments would be funded by them, whilst ESRO would be responsible for coordination, testing, launching etc. Only the largest projects – the astronomical observatories and Moon satellites – would be purely ESRO projects. Within the organisation, however, there would be a kind of supplement to the national groups, a laboratory called ESLAB with premises connected to ESTEC and a modest permanent staff. In the Convention, the supportive nature of the activity is underlined – under Article VI(b) the research laboratory would “undertake joint research programmes on the minimum scale deemed necessary by the Council to complete or complement the scientific studies carried out in the Member States”.



ESRO as it eventually became after years of negotiations over installations – from ESRANGE in the north to ESRIN in the south – spread throughout Europe.

On board the satellite ESRO 1 was a Kiruna experiment. The ELDO launcher in the picture – Europa 2 – was never launched, as all test shots were unsuccessful. ESA 1984.

Hultqvist's view of ESRO as primarily a technical service organ within the European space research community had found general acceptance.

An even more difficult problem than budget management and scientific identity proved to be the locations for the organisation's various installations. Discussions dragged on and were not concluded until spring 1962.

Only on the subject of ESRANGE was there early agreement. Sounding rocket tests in the northern auroral zone had of course been a priority from the very beginning and now other interested parties – in particular the Spanish – were appeased by the fact that the proposed text of the Convention referred to "sounding rocket launching facilities" in the plural. Auger even boldly stated that the name ESRANGE was a plural form which would further mark future Spanish options. The rival which might have created difficulties – Norway – was slipping out of ESRO. In June 1962 the Norwegian government gave notification that it did not intend to participate in the cooperation.

As far as the other installations were concerned – the headquarters, ESTEC and ESDAC – all the countries except for the Scandinavian states and Spain put in bids. ESTEC was particularly attractive. It took almost a year to solve the complicated equation. The French gradually succeeded in securing a majority in favour of having the headquarters in Paris – a contributory cause appears to have been ELDO's decision to locate its headquarters there. During the increasingly confused discussions, Sweden's position fluctuated; originally Sweden supported the British candidature for ESTEC in Bracknell near Farnborough and the French candidature for the headquarters in Paris. When it transpired that the British were not able to secure a majority for its proposal, the Swedish delegation voted for both ESTEC and the headquarters to be located at Delft in the Netherlands. Although there had earlier been a wish for maximum possible decentralisation within the organisation, it was now believed that ESRO could achieve synergies by placing the headquarters and the technical laboratory under one roof. It was also declared that it was not seen as necessary for such close cooperation between the scientific ESRO and the commercial ELDO that both must be in Paris.

Following a dramatic vote in which the Swedish delegation succeeded – as a result of much work behind the scenes – in averting ESTEC having its home in Brussels, the final result was that the headquarters were located in Paris (only Sweden and Norway voted against on grounds of principle), ESTEC in Delft and ESDAC, later renamed ESOC – over which the battle was not as fierce – in Darmstadt in West Germany.

Italy originally wanted ESLAB. When this did not transpire, it made a proposal at the last minute for another scientific laboratory whose functions would be defined at a later date. On account of weariness, and for fear of the Italian threat to withdraw from the cooperation, most of the other Member States agreed to this – only Sweden, Norway and the United Kingdom obstinately voted against, Sweden stating that a bill concerning ESRO had already been brought before the Parliament in which there was no mention of any further research institute. This did not help and ESRO had another facility, ESLAR,

later called ESRIN, in Frascati. For want of anything else, it was eventually decided that its role would be to undertake certain theoretical plasma physics studies.

The changes in the Swedish position on the complicated location issues can probably be explained by the fact that Rune Fremlin from the Ministry of Education and Culture had now taken charge of the delegation. He always maintained a clear distance from the scientists, above all Hulthén and Hultqvist, and tended to take positions which did not coincide with theirs. He drew up his instructions himself, naturally after ensuring that they had been cleared by the Ministry.

In addition, the Ministry of Foreign Affairs contributed to the negotiations, particularly through Bengt Rabaeus, First Secretary at the embassy in Paris, and Axel Edelstam from the Political Section in Stockholm.

A number of annexes and proposals for resolutions were added to the proposed Convention text which could be agreed on only in June 1962. The financial protocol laid down the contribution shares of the participants based on each country's average net national income at production cost over the previous three years. Sweden's share was 4.92%, which, for the entire first three-year period, amounted to approximately SEK 19 million. The eight-year ceiling was set at 306 million AU. The value of each unit was calculated in gold and for most of the 1960s was roughly equivalent to one US dollar. The ceiling thus corresponded to 1500 million French francs or around SEK 1570 million. In accordance with the rules, the three-year budget would be laid down by unanimous decision and the one-year budget by 2/3 majority within that framework. The British budgetary approach had won.

There had been only half-hearted discussion of the organisation's industrial and contract policy in COPERS. In a hastily knocked-together proposal for a resolution it was recommended that ESRO place purchase orders for equipment and industrial contracts as equitably as possible in the member states after taking account of scientific, technological, economic and geographical considerations. The interpretation of this resolution would be the cause of many troubles and crises.

As soon as the preparations had been completed, the committees and working groups were disbanded, their work done. They were replaced *inter-alia* by a budget group and a scientific priorities committee which was responsible for selecting experiments following a proposal from a number of scientific working groups. Lüst became chairman of the priorities committee, the *Launching Programme Advisory Committee (LPAC)*, and Bengt Hultqvist became chairman of the working group on *Ionosphere and Auroral Phenomenae (ION group)*. LPAC became powerful, and it was there that decisions on scientific programmes were taken in practice.

Bengt Hultqvist has described how the young generation of researchers of the 1950s and 1960s made their entrance in COPERS and ESRO.

It was certainly a privilege to start a scientific career when a new research field was born, and it was another privilege to be allowed, as a very young man, to play a role in the birth process for European collaboration in space. The main reason for the low age of many of the members of the COPERS planning teams was ... that the field of space research was new and there existed very little experience of that field in Europe. There were, of course, some very senior persons involved at the top level of the preparatory work (e.g. Amaldi, Auger, Massey, de Jager, Hulthén) but they were there not because they had very much experience of space research but rather as leaders of the community in general. The young scientists, who wanted to participate themselves in space experiments, presented most of the views on what should be done and later on they came to dominate also the advisory and deciding bodies of COPERS, ESRO and the ESA scientific programmes.

His description provides a glimpse of the environment in which the work took place. A new experience, he reports, was the difference between northern and southern Europeans in their manner of communication. Where the northern Europeans expressed themselves briefly and concisely, the southern European replied with a sophisticated stream of words which were not always very easy to understand. In particular, discussions with Professor Auger left the impression that you had not entirely understood what he had been saying.

The comments about Auger are entirely accurate. I was also able to experience his presentations both in COPERS and in the ESRO Council; they were long, wordy and probably logically structured, but the problem was that when he finally came to the conclusion, you no longer had any idea what he actually thought or wanted; all that remained was the feeling that a great layer of fog had descended over the room. It was even worse when it was necessary to negotiate with him – I had the dubious pleasure of doing so on many matters regarding ESRANGE, where he was always charming and always equally unintelligible. Fortunately he had colleagues at his side who thought they understood him, at least they supplied interpretations at which he did not protest.

Another experience for Hultqvist was the suspicion which was introduced as soon as the bureaucrats became involved.

The work progressed fast and with few difficulties. After a year or two diplomats were added to our groups and I remember quite vividly how with them suspicion was introduced. They started to ask us what representatives of other national delegations *really* meant with what they said. And when I said that I thought the members of the delegations meant what they said, my colleagues from the Ministry of Foreign Affairs did not believe me. I learnt from them that the most serious mistake you can make in international negotiations is to be fooled. One reason for the differences in attitudes mentioned is probably that scientists have fewer possibilities of fooling each other than the participants in most other branches of human activities.

That scientists do not fool each other does certainly not mean that they always agree. Differences of opinions became stronger when the work proceeded from planning to executing space research programmes.

My own experiences also concur with those of Hultqvist in this respect. When I eventually succeeded Fremlin, I inherited a good deal of mistrust directed at both the Swedish scientists and the other delegations. I quickly got on well with the scientists; it was not all that difficult – who could believe that Hulthén, Hultqvist and Brunberg were constantly concocting conspiracies against the Swedish Chancery. However, it took longer to become free of the widespread view of the other delegations which I heard on my arrival. It was a bad starting point for the work, in particular because mistrust became reciprocal. Only when I began to judge the delegations by their delegates and adjusted my own conduct accordingly could trustful cooperation be established.

Auger had thought that it would take one year to launch ESRO. It had taken two and a half years from the COSPAR meeting in Nice to negotiate a proposed text for the Convention.

Rocket Technology Interlude – ELDO is Born

As has already been mentioned, at the same time as COPERS set its planning work in motion, negotiations were in progress over ELDO, the European Launcher Development Organisation. In January and February 1961, delegates from the same countries which participated at Meyrin had met in Strasbourg and drawn up guidelines for the development of a three-stage rocket, in which the British would be responsible for the first stage and the French for the second. However, it was still left open who would develop the third stage, test satellites, ground equipment etc.

In Sweden the government had not yet made a decision regarding participation in either ESRO or the Anglo-French rocket project. It is interesting to examine the way the Swedes handled the Anglo-French “Strasbourg Project”, since it is the first time that the possibility of Swedish contributions to space activity in the broader sense – not just space research – is discussed and analysed.

In the invitation to Strasbourg from the British and French governments, it was stressed that the project would have absolutely no military connection, but should be seen as a complement to the Meyrin agreement. At an informal session of cabinet in January 1961, the Swedish government appears to have come to the conclusion that, despite the doubts experienced during the visit by Thorneycroft, it did not want to display a lack of interest in a future, possibly important form of European industrial cooperation. Consequently, an official delegation was sent, chaired by Sverker Åström, with Funke, Brunberg, Rabaeus and Lars Brising, head of SAAB’s aeronautical division, as the other members. The choice of Åström and Brising shows that attention was now beginning to be paid to the importance of space activity from the point of view of general and industrial policy. Already at the beginning of January – three weeks before the conference – experts from the most closely affected sectors of Swedish industry had visited England to familiarise themselves with the project. This group comprised Tore Gullstrand, from SAAB’s aeronautical division, and Gunnar Broman and Gillis Huss, both from the company Flygmotor in Trollhättan. Gullstrand and Broman delivered a detailed technical report.

In the course of the general debate in Strasbourg, Sverker Åström made a lengthy statement which included an account of the Space Research Committee’s plans for a national research programme. In doing so, he took the opportunity to advertise the possibilities offered by Upper Norrland.

Present plans include some relatively simple meteorological investigations, with the help of small rockets, and also studies of special phenomena connected with auroral and magnetic storms. In carrying out this work we are favoured by our geographical position, the Northern part of Sweden being situated in the auroral zone, and we can make full use of our already existing fully equipped geophysical observatory in Kiruna in Northern

Sweden Such facilities as we already have or shall soon acquire will no doubt be of value within the framework of the European Scientific Space Research programme, if and when this programme is initiated pursuant to the Meyrin decision of last year.

Åström also underlined that Swedish industry was in a good position to make a contribution to European space cooperation.

Engineers and industrialists in very many fields – in the important Swedish aircraft industry with subsidiary branches, in the Swedish electronics industry, machine-tool industry, metallurgical industry, and so on – follow with greatest attention the developments in space technology and are fully aware of the direct and indirect beneficial influence of these developments on an advanced and advancing Swedish industry. There is also a great interest in the possible commercial application of space technology, for instance for telecommunications. We have much to gain from international cooperation in this field, indeed we recognise that such cooperation is essential for progress, and we also feel that we would have important contributions to make to a possible programme of the kind now under discussion, both as regards research and construction of space vehicles.

He went on to point out that a prerequisite for the Anglo-French project had to be that the participants could also involve their industry in the development work and that the results would be freely available to all. He assumed that there would be close cooperation between the new organisation and the prospective ESRO – the Swedish reservation at Meyrin on precisely this issue had now been completely forgotten. The traditional Swedish caution about the UN is reflected – under no circumstances must the activities conflict with the work within the UN's space committee. He concluded by drawing attention to the fact that Sweden had not yet decided whether or not to participate in the cooperation.

The conference did not result in any decisions – the main purpose had been to provide information regarding the proposed organisation of the project and so forth. It had originally been envisaged that the costs, which had been estimated at around £70 million, would be distributed on the basis of the same formula as used in CERN. For Sweden, that would mean approximately SEK 50 million over five years. The British and French were keen to secure the broadest possible support, but many delegations expressed doubts – the project was too expensive. Just as it was all appearing to founder, the British proposed a new distribution formula which gave small states a substantial rebate. Now the Swedish contribution fell to around SEK 30 million, or SEK 6 million a year for five years.

There are three interesting reports from the Strasbourg conference; they are interesting in that, together, they shed light on how space activity and the opportunities it offered Sweden, were seen from various perspectives at that time. The official report, delivered to the foreign minister (at that time still Östen Undén), was written by Sverker Åström. However, reports were also drafted by Brunberg and Brising.

Åström adhered to formal matters and described inter-alia the discussions on finances. Since no binding decision had been taken in Strasbourg, the initiative still remained with the British and French. The next stage for them would therefore be "an inquiry made through normal diplomatic channels ... to the governments in question" as to whether they were prepared to participate in the planned cooperation.

Brunberg analysed the project from a scientific, industrial, technical and political perspective. He described how far COPERS' planning had progressed and took the view that the Anglo-French project would be of "exceptional value" to the satellite plans. However, he pointed out, cooperation with the USA in the form of "purchases of satellite-bearing rockets" was perhaps also possible and could represent "a less expensive ... solution to the problem of putting European scientific satellites into orbit". In that case, it should be realised that "Europe would be for ever more dependent on the USA and the USSR in this new field".

Here there is a glimpse of a view to which previously only Brising had given voice – Europe had to create its own independence in space. Even though it is not apparent from the documents, it is more than likely that this argument had surfaced in Strasbourg.

Brunberg then pointed out the value of the project for future applications satellites in the fields of communications, meteorology and navigation. Swedish industry would benefit from the technical development work.

Lastly, from the political point of view "it may be obvious that any organisation within Europe which entails cooperative action, albeit within a relatively limited field, is important in the evolution towards an increasingly united Europe". One of the probable reasons behind this comment is the fact that discussions on possible Swedish membership of the EU, or the EEC as it was still called, were making progress that spring.

Brunberg expressed a very serious reservation, however, in relation to costs.

The high cost of the project means that the scientific aspects *alone* do not give adequate justification for Swedish participation. Equivalent sums made available to Swedish space research domestically would yield more valuable results for Swedish science.

This statement probably reflected opinion within the Space Research Committee at that time.

In the report by Brising, he assessed the technical requirements for the project, to which he did not have any major objections, and the technical facilities of the larger participating countries, which he found to be good. Britain was said to "hold a leading position in the development of advanced and large-scale technical systems as are required for the launch of satellites". This statement is interesting against the background of the position which the British would later adopt in ESRO – that Europe should not develop launchers, but instead purchase them in the United States.

According to Brising, France had great ambitions to "stay right at the top for as long as finances permit" in rocket and missile technology. West Germany held a unique position on account of its large industrial potential as well as "a less rational claim to have led the way in rocket technology until the end of the last world war – a factor which should not be permitted to have any significance for the division of labour in future European cooperation".

As far as Sweden was concerned:

On account of its aero-engine and telecommunications industries, which are well-developed for a country of its size, and the general concentration on quality materials and hardware, Sweden has favourable possibilities compared to Europe's other smaller countries to contribute to space cooperation and thereby secure a proportionately high dividend in the long term. If Sweden's contribution to the costs for 1961-65 was 2.9% according to the proposal, that would be equivalent to roughly SEK 30 million. It is reasonable to think that at least half of that sum will come back to the country in the form of orders for those subsystems where Swedish industry is particularly competitive. ... European space cooperation with a purely civil, commercial focus like the Strasbourg project is perhaps the only way for Swedish industry to supply the growing space hardware market. Even by the middle of the decade, this is likely to have reached a substantial size internationally, several billion SEK per year.

He went on to examine the areas which would be most suitable for Swedish industry. Certainly, the units of production in Sweden were small compared to the large-scale industry elsewhere in Europe, but because standardised mass production within this field was not to be expected in the foreseeable future, Swedish quality industry, with its emphasis on highly refined products, should be able to make its mark. One particularly important factor is the way in which space development shares technology with neighbouring areas. For example, he referred to "airborne mathematical devices working at high speed and having small dimensions", anticipating the on-board computers which would, in the course of time, become a speciality for SAAB in particular.

In mid-February 1961 came the Anglo-French inquiry, as Åström had foreseen. Was Sweden interested in participating in the rocket project? The Ministry of Foreign Affairs referred the matter to the relevant ministries and, through them, to any authorities and organisations which might be affected.

Among those who replied were the Federation of Swedish Industries, the Association of Swedish Chemical Industries and the Swedish Association for Metalworking. They made a joint statement in which they recommended Swedish participation, though with the customary additional proviso that it must not affect the state's other measures to promote technical and scientific research and industrial development work.

Within the Space Research Committee, Brunberg had drawn up a proposal which followed on from earlier discussions. As already mentioned, the Committee had expressed doubts on the eve of the Meyrin conference and also during the session of cabinet in January over cooperation in "rocket technology", which recurred again in the delegates' statement at Meyrin where a reservation was even made with regard to future cooperation between ESRO and ELDO. Brunberg had also expressed concerns over costs in his report from Strasbourg.

In the draft reply, he adopted the same attitude, albeit with a certain caution. It was pointed out that it was "difficult" for the Committee to take any position at all on "Blue Streak" since, in spite of reminders, absolutely no guidance had been received from the government as regards future Swedish space activity nationally and internationally. However, from a scientific perspective, Swedish involvement in the project was justified "only on the condition that resources for its own national research and for European cooperation in other respects are granted on at least equivalent scales". That would mean a review of the total amount of research funding in the national budget and a shift in the balance between space research funding and other research funding.

Enthusiasm did not appear to be high. However, it was at the meeting where the draft letter was discussed that the Committee shifted position. It is probable that industry had made clear its views and – as will be seen below – Funke had analysed the situation from national and international perspectives and it is highly likely that it is his ideas that appear in the statement.

In the statement, the Space Research Committee stressed that it did not wish to judge the "Blue Streak" project only on the basis of strictly scientific criteria, without placing it in a larger and wider context. The situation was not unique, it was stated, and many areas were now being entered where it was necessary to pool resources with a view to increasing cooperation between European states. "Blue Streak" should be seen as an introduction to a future collaboration within space research. The Committee therefore wished to "strongly recommend" Swedish participation in the project whilst at the same time underlining that "in order to derive benefit from any cooperation it is necessary that an equivalent national programme be provided with sufficient funds". Nevertheless, within European cooperation ESRO was still the first priority – this was emphasised by Hulthén at a Nordic meeting at the beginning of March.

However, the Swedish Natural Science Research Council (NFR) was responsible for the most interesting statement. It was signed by Lindblad and Funke but was quite clearly the work of Funke, his manner of expression is apparent and, on reading it, one can almost hear his slightly cheerless and sometimes monotone voice. It is clear that he had begun to believe that the situation both in Europe and at home had started to become confused and that it was time for a comprehensive analysis. Funke had many years of experience of international research cooperation. His analysis is characterised by a great, and refreshing, clarity of vision.

When one reads documents from that period, one is struck by a certain terminological confusion. The term space research could cover just about anything – rockets, applications and pure fundamental research. Funke appears to have thought the same and he began by explaining the notion. The purpose of Blue Streak was to:

create a vehicle which can be used to launch satellites, but it is not aimed at the construction of research satellites. The construction of satellites for technical purposes, for example for telecommunications, as navigational aids or for meteorological measurements and observations, is however conceivable within the framework of the envisaged organisation. For space exploration itself, negotiations are in progress on the creation of another European cooperation organisation, the European Space Research Organisation (ESRO).

After that clarification, he went on to place space research in a wider social context. He said that it was now a time which was “unprecedented in the history of human culture’s discoveries within science and their applications”, which had a “profound effect on human society”. A multitude of “findings, discoveries and improvements” resulted collectively in a “constant increase in the cultural and material standard of living in society”. Of this multitude, however, certain discoveries stood out in such a way as to characterise the current age.

Thus one talks of the “atomic age” because of the radical effect of nuclear physics on human society – at present primarily in the sphere of global politics – and it is equally possible to talk of the “chemotherapy or antibiotics age”, because chemotherapy and antibiotics revolutionised our health and also profoundly affected the structure of society, for example within social welfare and geriatric care. The third characteristic feature of science in our time has emerged only during the latter part of the 1950s and has already, and with every reason, given rise to such a notion as the “space age”. The results which have been achieved with American and Russian satellites and with other rocket-borne research apparatus are not only fascinating to the imagination, they also represent discoveries of the utmost scientific and technical importance.

After having outlined the results which had already been achieved with the aid of space technology within, *inter-alia*, astrophysics and meteorology, he described the applications of satellite technology which lay within close reach in the fields of telecommunications, navigation and meteorology. His conclusion was that developments had reached a stage where “regional or international cooperation” was a necessity. This made it necessary to discuss not only the Anglo-French rocket proposal, but Sweden’s position *vis-à-vis* space activity in general.

European cooperation had to be built on the United Kingdom “as the cornerstone” and “to a certain extent” also France, since those were the only two countries with experience in rocket technology. The contribution rebate which had been proposed for the small

countries in the Anglo-French project was questionable in the long run, because “the allocation of orders, contracts and supplies” should be made on the basis of the same principles as used in CERN and as envisaged for ESRO.

This means that large parts of the forthcoming project will be reserved for certain states, without the work being allocated according to the principle that each order should be placed with the supplier who can make the best offer, economically and qualitatively. As it stands, there are barely sufficient guarantees that work which, under the envisaged measures, goes for example to a French company could not be done better or more cheaply in another country. If such an idea is accepted it must nevertheless be clear that the allocation of contributions must be on the basis of economic strength, i.e. preferably as in CERN on the basis of gross national product.

The statement was clear-sighted – it was not possible to enter into cooperation without also expecting an industrial return. However, the key principles had to be, first, that membership contributions were paid according to capacity and, second, that normal purchasing principles – “best and cheapest” – applied. This had been successful within CERN. What Funke failed to foresee was that it would prove difficult to translate CERN's industrial policy to space activities without modifying the principles, at least as regards the “cheapest”.

In conclusion, there was discussion of whether European space cooperation was affordable. Was it worth the cost?

The position on this issue depends primarily on the other expenditure with which a comparison is drawn. If the matter is regarded purely as a scientific project and compared with what the state considers it can afford to make available to the research councils for all research from natural science to humanities and social science, the question can only really be answered in the negative. In the government budget proposals for the 1961/62 financial year, it was proposed that the research councils for natural science, technical research, medicine, agriculture, atomic research, social sciences and humanities would together be allocated less than SEK 30 million. To grant SEK 15 million per year for a single purpose, however important, could not be seen to give an accurate picture of the importance of the various fields.

The amount quoted – SEK 15 million – is probably an estimate of the combined annual costs of participation in both research and rocket cooperation. However, Funke underlined, if that amount was compared to the country's expenditure on tobacco, alcohol consumption and advertising, the costs for space cooperation could be borne “with equanimity”.

Consequently, the Natural Science Research Council (NFR) did not hesitate to support Swedish participation in European space cooperation, both in the prospective ESRO and

in the prospective ELDO. However, this meant that appropriations for research had to be generally increased to a completely different level than "exists at present" It was, for example, absurd that the Agricultural Research Council enjoyed only 1.7 million, that the National Council on Road Safety had to be satisfied with just half a million and that natural sciences "across their entire spectrum" had to make do with 6 million per year.

The conclusion was clear. Participation in European space cooperation "will highlight the overall Swedish policy on government contributions to research".

In the Ministry of Education and Culture, to which the NFR's letter was addressed, Funke was not entirely popular. Flexibility was not one of his characteristics, but he was respected, his words carried weight and they listened to him. In the discussions on Sweden's position with regard to space activity his letter undoubtedly came to play a key role – it was the first attempt at an objective analysis of the issue.

The NFR had certainly – formally – supported participation in Blue Streak, but at the same time it pointed out the cost repercussions, which must have alarmed the government and had an impact on its position. There also remained a certain suspicion over the military past of the rocket project.

The attitude of other countries also contributed to the negative outlook. It can be seen from a Foreign Ministry memorandum from September 1961 that Norway had already declined participation and Denmark and Switzerland had adopted a wait-and-see policy. The Swiss did not, however, take the view that participation conflicted with the country's policy of non-alignment. In Vienna, on the other hand, the Soviet ambassador had expressed his surprise that Austria was participating in the space research conference – he claimed that it ran counter to the country's non-alignment obligations. The United States was also sceptical, declaring with a little hypocrisy that the project was an "unfortunate waste of European resources" – in reality the statement was obviously dictated by reasons of economic competition.

The Soviet attitude probably did not fail to affect the Swedish government. In late autumn 1961, a government decision was taken. Sweden would not take part.

The decision prompted disappointment, particularly within industry where it was pointed out that Sweden would as a result be excluded from the parts of space cooperation which were of most interest from an industrial point of view. ELDO's plans were to develop not only launchers but also application satellites, primarily for communications, while ESRO's role was limited purely to research. LM Ericsson had actually been awarded the contract for a transponder in the F9 test satellite which would measure transmission conditions for the transfer of telephone channels between the Italian ground station at Fucino and the Swedish station at the Råö observatory. Like the other ELDO experiments, the transponders ended up at the bottom of the sea.

LM Ericsson applied to the National Board for Technical Development (STU) for funding for the project and Håkan Sterky gave his view on the application. His opinion is

interesting because it sheds light on how a senior government official, who was himself clearly interested in space activities and who believed in their future, viewed the situation in Sweden in 1961. He was quite pessimistic. Certainly, LM Ericsson's participation in F9 would increase the company's chances of becoming involved in international satellite projects, he pointed out, but nevertheless it was doubtful whether there were any future prospects for supplying satellite equipment in a "divided Europe, where ideas of national prestige or state subsidies to industry seem to dominate over sound business purchasing principles". However, his pessimism "could be changed to a quiet optimism if the government, for example through the STU, set objectives for Swedish space activity in a long-term plan and the annual amounts that were prepared to be invested in national and international projects".

However, the scientists had also seen the possibilities offered by ELDO. Perhaps its test satellites could hold scientific experiments. At the meetings of Scandinavian space researchers in Kiruna and Copenhagen in spring 1961, it was decided to examine the possibility of Norway, Denmark and Sweden taking on responsibility for ELDO's test satellites. A delegation of experts, which included members for the universities of technology, was sent to Farnborough where they met with Lines and his colleagues at the Royal Aircraft Establishment. The British were favourably disposed to the idea of a Scandinavian organisation taking responsibility for developing and producing three test satellites. The project could possibly be coordinated with a proposal being discussed within ESRO to set up a separate entity for the development of payloads, which could then be located in one of the Scandinavian countries.

Because the Scandinavian countries did not join ELDO, the plans came to nothing. Within ESRO the Swedish delegation maintained a clearly reserved position when cooperation with ELDO was under discussion. In February 1962, for example, Hultqvist stated that, as a representative of a country which would, as far as could be judged, join ESRO but not ELDO, he felt serious doubts over the increasingly common view that the development of the two organisations inevitably had to go hand-in-hand and be intertwined. Naturally, they should cooperate, but that should not prevent ESRO from working together with others, such as NASA. This statement is highly characteristic of the attitude which Sweden would take throughout the 1960s.

At the meeting in London in autumn 1961 where the crucial decisions were taken, Swedish observers were still present, but at the conference in March 1962 where the ELDO Convention was signed by Belgium, France, Italy, the Netherlands, the United Kingdom, West Germany and Australia, Sweden was not represented. The COPERS secretariat worked hard to persuade as many countries as possible to join ELDO. In a document from autumn 1961, Vandenkerckhove succeeded, with the help of wild logic, to prove that it would be cheaper for ESRO to use ELDO rockets than to purchase launchings in the USA. But this was to no avail – the ELDO group was smaller than the ESRO group; apart from Sweden, other absentees were Denmark, Spain, Switzerland and Austria, a factor which would leave its mark on European space cooperation for more than a decade.

It can be seen how the Swedish absence from ELDO was seen in a Ministry of Foreign Affairs report by Bengt Rabaeus at the Paris embassy, which describes a visit to see Auger in January 1962. The work on the establishment of ELDO was progressing, Auger explained. Everything indicated that the agreed timetable would be observed. He considered that it was now beyond any doubt that the Netherlands and Belgium would sign at the same time as the big four. "The customary sigh of disappointment over Sweden's absence was heard yet again".

The Germans and the Italians had been doubtful right to the end. Only at the beginning of 1962 did it become clear that West Germany would take on the third stage, Italy the satellites and that launches would be from Woomera in Australia. It had been particularly difficult to persuade Italy. Broglio wanted Italy to pursue its own rocket development and for that reason he did not wish to focus on sounding rockets in the COPERS discussions, but on development studies for launchers. The Italian views on ELDO were set out by Amaldi in the following prophetic words:

Any responsible person sees the difficulty of matching three stages and the satellite made in four different countries and can easily foresee the disputes that will arise if these do not fit together.

His predictions would prove to be more than true.

ESRANGE – The Entry Ticket to Europe

The story of the creation of ESRO is a textbook example of how an idea which is presented by the right person at the right time, and is carried forward by other “right” people, begins to take on a life of its own and assume a sense of inevitability – it becomes more difficult to say no than to say yes. Only two states in the original group, Norway and Austria, dared to resist the pressure and, after much agonising and internal conflict, decided not to join. Both began to regret their decision almost immediately.

The position of the Swedish Space Research Committee on ESRO is likewise a textbook example of a not uncommon course of events – from cool civility (February 1960) to participation as something absolutely self-evident, whilst at the same time underlining that a national space research programme was a prerequisite (January 1961). It was thought that it was necessary for Sweden to bring its own baggage when entering the international arena. This reasoning was based on the interest of research, but suddenly – almost without having asked – it transpired that the Swedes were holding a political card, the international scientific community’s interest in sounding rocket experiments north of the polar circle. The man who, perhaps better than any other, recognised the value of this card and understood how to exploit it was Bengt Hultqvist – a sounding rocket base in Kiruna would be important not only for his own observatory and research there, but also for the entire Kiruna region. He did not find it difficult to get his colleagues in the Space Research Committee on board. Hulthén, Funke and Brunberg took the lead and behind them, to inspire and instigate, stood Hannes Alfvén.

Possible Swedish participation in the planned Western European space cooperation had taken on a new and exciting dimension which must have appealed particularly to the internationalist Funke – one can recall his intensive work some years later in getting CERN’s 300 GeV accelerator located in Sweden. The wait-and-see policy towards ESRO slowly changed, even though no formal decision was taken, as the Swedes slipped almost unnoticed into a position of enthusiastic commitment; soon the Swedish COPERS delegation was one of the most active in the work on the programme and the Convention.

However, the fact that the Swedes were holding a political card in their hand did not mean that the politicians were on board, at least not the national politicians.

“It should not be believed that it was an easy task to bring the Swedish authorities and decision-makers to agree to the proposal to set up a rocket base in the Kiruna area, or to join ESRO at all”, wrote Lamek Hulthén, when he delivered his papers from the negotiations on accession to ESRO and the creation of ESRANGE to the archives of the Institute for Space Physics in Kiruna (IRF, formerly KGO) in the 1980s.

In the late 1950s and the early 1960s, research and technical development prospered in Sweden, as in the West as a whole. This was partly due to Sputnik, but that did not mean

that space technology and space research were the desired focus. Sweden never caught the "space bug" in the sense that it wanted to launch its own Sputnik. A relatively small group of researchers, technicians and industrialists realised the possibilities offered by space technology and, in addition, there was a slightly sensationalist interest from the mass media. A typical example was when 70 housewives were asked whether they could imagine their husbands becoming astronauts. Their enthusiasm seems to have been great, but in the ministries and the Chancery the position was quite clear – it was not a high priority for the Swedes, but a matter for the superpowers, with their need for visible prestige. When President Kennedy surprised the world in 1961 with his commitment – "that this nation should commit itself to achieving the goal, before this decade is out, of landing a man on the Moon and returning him safely to Earth" – his initiative was viewed with some scepticism by the Chancery. It was not seen to be dictated by scientific interests or solely by the need to outdo the Russians, but almost as much by the boy's own dreams and Jules Verne romanticism that could be sold to the media.

I myself remember a budget discussion in the Ministry of Education and Culture in autumn 1961 at which the Under-Secretary of State, Hans Löwbeer, urged us to reserve an amount for space research in the budget work. Sven Moberg, head of department, was vehemently opposed to this and gave voice to the negative attitude mentioned above which was highly representative of the general opinion within the Chancery. The discussion ended with Löwbeer getting his way.

If things had been otherwise, there is much to suggest that the negative opinion would have won through and Sweden, like Norway, would not have joined ESRO. The situation in the case of Sweden was governed by two important factors, Sweden's European policy at the beginning of the 1960s and the proposal to build a launch site in Lapland. It has already been described how, at one of the very first meetings of the Space Research Committee – in February 1960 – Hultqvist took up the idea floated by Massey and Auger at the COSPAR meeting in Nice one month earlier (see page 17). For Hultqvist, it stood to reason that a launch range should be located as close to KGO as possible, and it was the first time that Kiruna was mentioned in this connection. The Space Research Committee responded positively and, as has already been stated, instructed him to take the matter further informally.

The snowball effect began.

Hultqvist first contacted the municipal authorities in Kiruna, as well as the officer responsible for Lapp affairs in the county of Norrbotten and the district forest officer. They appeared to take "a relatively positive view". An initial estimate of costs suggested that SEK 3.2 million needed to be invested.

Now that possible Swedish membership of ESRO was linked in with a proposal for a rocket base on Swedish soil, it became necessary to inform the government. As has already been mentioned, calls were made on Ragnar Edenman and Sverker Åström in spring 1960. They evidently did not object to the matter being taken further, but could not make any promises for the future either. The position was one of caution, but was

nevertheless sufficiently positive for Brunberg to be able, a short time later at a meeting at the Royal Society in 1961, to float for the first time the idea of a sounding rocket base in Sweden.

In August 1960, the Space Research Committee submitted its first appropriation proposal. It included a description of the plans to utilise the Vidsel military range for research. It was pointed out, however, that Vidsel could not be used in the long term, since it was too small and military secrecy prevented the necessary scientific openness. A civil range north of Kiruna would be more suitable in all respects. There was interest from Europe and the town of Kiruna had also expressed a favourable attitude.

With this appropriation proposal, the plans became public knowledge and the media began to take an interest. The Lapps and other affected groups made contact and raised questions. In order to calm feeling, Hultqvist appeared on a local Lapp radio programme and explained that the plans were still at an extremely early stage, no official contacts had yet been made, and it would in any case be several years before rocket launches could take place.

At this juncture there is good reason to examine a minor incidental episode. Even earlier there had been rumours in the press of plans to launch rockets in northern Sweden. In February 1960, the Swedish daily newspaper Svenska Dagbladet interviewed Carl Reuterswärd at the FOA about "Swedish rocket plans", during which the idea of a "rocket station" in Upper Norrland was mentioned. The interview was read by the municipal council chairman in Frostviken in Jämtland. He was an active man who immediately sat down at his typewriter and typed a letter to Reuterswärd. In the letter he wrote that "in case the location has not been decided", he wished to draw attention to the northern part of the county of Jämtland and, more specifically, the parish of Frostviken, "a sparsely populated wilderness, whose roads reach up to the timber line on the mountain ridge between Blåsjön and Jormsjön and which is only a short distance from the Atlantic; I imagine it may be of interest". He closed by stating that "it is important for us to cover all possibilities of creating employment".

The name of the municipal council chairman was Per Olof Sundman. Fifteen years later he would become one of the most fervent supporters of Swedish space activity in the Parliament and the press. His letter ended up being passed back and forth between various authorities, until it eventually reached the Space Research Committee, where Brunberg wrote a polite reply explaining that the Frostviken area was unfortunately too small for rocket launches.

To return to the Committee's appropriation proposal, it left no traces in the national budget proposals presented in January 1961. However, the government could not remain passive. The Meyrin conference had taken place one month earlier and an official delegation had been sent there. At the end of January a conference on the subject of Blue Streak was to be held in Strasbourg. There had still been no commitment to participation in either ESRO or Blue Streak, but a decision nevertheless had to be made on the line to be taken in future. A notice was sent out for an informal session of cabinet on 20 January

1961. A large delegation representing the space contingent was present in what was then the Cabinet Office conference room, which overlooked the Mynttorget. For the first time there were now representatives of future areas of application and industry – Håkan Sterky, from the Telecommunications Administration, and Brising. The representatives of the Space Research Committee were the vice-chairman Hannes Alfvén – Hulthén was abroad – and Funke and Brunberg. The session was also attended by Åström and Rabaeus from the Ministry of Foreign Affairs. For safety's sake, there had been a dress rehearsal a few days earlier at a meeting in Löwbeer's office at the Ministry of Education and Culture.

Informal sessions of cabinet in the 1960s and 1970s were usually characterised by very short and concise presentations of reports. However, that was not the case on this occasion. The government gave over a surprising amount of time to listening. On the other hand, the combination of Alfvén, Sterky, Funke and Brising was an imposing quartet, whose contributions could not be cut off at will. Furthermore, wide-ranging and comprehensive information was required in order to be able to understand the space question. That information was supplied.

Alfvén began with a presentation of the Space Research Committee's three areas of operation – national research, European cooperation and the question of a rocket range in Kiruna. He stated that he was delighted to have the opportunity to explain "why it is also necessary in our own country to take an interest in this new and extremely fascinating field of research".

I will begin by drawing a parallel with the events at the turn of the century. At that time, there were some visionaries who believed that it should be possible to fly. Of course this was met with great scepticism; least of all was it possible to conceive that a small country like ours would have an interest in such adventurousness. To go back even further, the first stone-age man who began to sail the sea must have met the same scepticism. Nowadays, however, it is obvious that, because our country borders the sea, we must be able to sail the sea and build boats in our own country, and we must also fly – and invest a considerable amount of money in aviation – because we have air above our country in which it has been technically possible to fly since the arrival of the aviation age. Within the Space Committee we consider that, now that the "space age" has begun, it is necessary that we seriously look into this new, similar opportunity which is opening up in our own country.

After reassuring the members of the government, or at least the finance minister, giving assurances that "of course we do not have any plans to use Swedish funds to attempt to finance trips to the Moon or satellite launches", he gave a report on the Committee's plans for atmospheric research at altitudes of 70-100 km above the Earth's surface. The investigations were not only of great scientific interest, but were also important in order to "gain our first direct experience of the many technical problems associated with space research". For the first investigations, American Arcas rockets would be used.

To avoid any misunderstanding, I would like to make absolutely clear that they cannot be used for military purposes, but are developed solely to carry small instruments and radio transmitters to these modest altitudes. For technical reasons the launches can only take place from the military launching range at Jokkmokk, but we would like to look into the possibility of establishing a civil rocket range connected to the Geophysical Observatory at Kiruna.

He went on to speak about European cooperation, beginning with CERN, which was "dedicated to nuclear physics, but even though it is nuclear physics which had led to the atomic and hydrogen bombs, CERN is wholly devoted to peaceful purposes".

In CERN, Europe has a nuclear research institute of the same quality as the best in the United States and the Soviet Union. It was considered impossible for Sweden not to participate in that joint European, purely scientific research effort which is, as we know, dedicated entirely to peaceful purposes. The planned European space research cooperation is of the same nature. Although rockets are important weapons, it is possible, in this field as in nuclear physics, to clearly define an entirely peaceful research programme. Like nuclear physics, full-scale space research is so expensive that no country other than the United States and the Soviet Union considers itself in a position to finance it. The same reasons which lay behind CERN also apply to European cooperation in space research. We believe that Sweden can no more remain on the outside in this case

He added that countries such as Switzerland, France and Italy were able to reap greater benefits from CERN than Sweden, on account of their proximity to the facilities. However, in the case of space research, the situation could be different.

As a result of Scandinavia's northern location (within the northern auroral zone) there is a special interest in locating a considerable proportion of the space research here and the Kiruna observatory is also attracting great interest. It is conceivable that we could have a European research centre connected to the Kiruna observatory and, in our view, that would bring great benefits for Sweden and, in particular, for Upper Norrland.

Alfvén's contribution was well judged from a tactical point of view and in terms of the information it provided. He focussed on precisely the points which could be presumed to interest or concern the government. Space activity had come to stay, in the same way as air travel had once done. It was peaceful, it being understood that the policy of non-alignment was not compromised. The Swedish research programme was modest – they were not intending to launch satellites of their own, less still to travel to the Moon. However, they could remain outside European cooperation no more than they could remain outside CERN. In addition, if they joined, they would also have a strong chance of having a rocket base with a research centre located in Upper Norrland, which would provide a constant flow of job openings.

Following Alfvén, it was Sterky's turn to speak on the various applications of space technology. He began by pointing out how the meteorological service would be revolutionised by satellite technology. However, the application which was closer at hand was telecommunication by satellite. The American company AT&T (American Telephone and Telegraph Company) had put forward a plan for a communications system consisting of fifty satellites in arbitrary polar orbits for communications between the United States and practically the whole world. The cost of the entire system was estimated to be \$170 million, which compared to AT&T's annual investment in telephone systems of around \$2500 million.

The Board of Telecommunications was interested in communications satellites, according to Sterky, for its international connections and had therefore begun technical research and development in that area in order to be prepared when the time came to embark upon an international satellite project. At a meeting between European postal and telecommunications authorities, Sterky had proposed joint transmitting and receiving stations for telecommunications. The proposal had met with a positive reception and was being investigated. Swedish industry should be able to make a valuable contribution to the development work.

It would not surprise me if, before my retirement, I myself am able to participate in a decision which would result in Swedish subscribers having the opportunity to hold conversations with subscribers in North America by satellite. Such a project will probably be financially viable at the current rates ... Many doubts can however be raised on the question of transmission of television. It can barely be conceived that telephone channels in operation be interrupted to give way to a television broadcast. And to set up a specific television channel for the relatively infrequent television broadcasts which can probably be expected would be very expensive. In addition, there are the time differences which mean that live broadcasts can take place only rarely. Instead, a more suitable option would be tape-recorded programmes, where the tape is sent by jet or by rocket.

Sterky, who retired in 1965, was indeed able to take part before then in the decision regarding Swedish participation in a global commercial communications satellite system (INTELSAT) – in that respect his predictions were accurate, even if the system was not developed on the basis of the formula advocated by AT&T. On the other hand, his predictions on the transmission of television programmes proved incorrect, and his statement foreboded the highly negative position which the Telecommunications Administration would adopt during the NORDSAT discussions of the 1970s.

Sterky was followed by Funke, who described the outcome of the Meyrin conference. Lastly, Rabaeus and Brising outlined the Anglo-French Blue Streak proposal, Brising stressing industry's great interest in the project.

The presentations resulted in a recommendation to the government to make "a substantial national effort" to "keep Sweden reasonably up-to-date with developments". A national

effort was “*an absolute precondition*” (my italics) for participation in any European cooperation, since only then would it be possible “to reap the fruits of cooperation” and exploit “advances made within the large countries”. There would also be the possibility to have “part of the European activity located at a Swedish launching range in the Kiruna area, which would be of benefit to Upper Norrland, economically, socially and culturally”.

With regard to Blue Streak, a wait-and-see policy was advised.

Lastly, a commission of inquiry into the future of Swedish space research was proposed, in which “an officially recognised body, a space research board or space research commission”, should be considered.

No minutes were taken during informal sessions of cabinet, at most we have a few memoranda, sometimes in the form of correspondence between the affected ministry and the Ministry of Finance, but just as often decisions were communicated in the form of verbal instructions to the officials concerned. Only later was the decision-making formalised in the cabinet.

The results of the informal session of cabinet in January 1961 can be seen chiefly in the developments in the subsequent months. The government’s position was still one of caution. It was saying neither yes nor no – it simply wished to know more before a decision was finally taken on the future of space activity in Sweden. Of course, the government’s interest should not be overstated. There were certainly bigger, more important issues than space activity, but – and this is important – it was now recognised in the government as something to be taken seriously and no longer a matter of the dreams of scientists.

The Space Research Committee could continue along the path embarked upon provided it did not commit Sweden to future expenditure. The government sent a delegation to Strasbourg and the Space Research Committee became active within COPERS. In addition, the Committee widened its informal brief to Hultqvist to look into the possibilities of a launch range at Kiruna by setting up a working group to “investigate the technical possibilities of setting up a test area in the wilderness between the centre of Kiruna to the south and the point to the north where the borders of Sweden, Norway and Finland met”. Brunberg was appointed secretary of the working group and the members included Hultqvist, Lübeck and Örtner.

In March 1961, the working group had organised an information meeting for the national and municipal bodies concerned, including Lapp representatives. After the meeting, Hultqvist wrote a memorandum which was evidently to be used as the basis for future discussions. He began by vividly describing the scientific technology and pointed out that the use of rockets for sending up measuring instruments to high altitudes had already broadened knowledge of the density and temperature of the upper atmosphere. The technology was currently being developed into a routine technology. It was not expensive, at least no more expensive than the technologies in many other strands of modern science.

If the European cooperation which is under discussion at present comes into being, it is likely that part of the joint activity using smaller rockets will be located at a test area in or near the northern auroral zone ... For the Kiruna observatory, it is naturally of utmost importance that any high-altitude research centre in northern Scandinavia is co-located with the observatory – and not, for example, in northern Norway – particularly since this would, in all likelihood, open up alternative means of funding for the majority of the observatory's activity, which is at present paid for by the US Air Force.

Hultqvist went on to explain the reasons why they were particularly interested in the area north of Kiruna. One of the reasons was that its size – around 140 km long and around 80 km wide – permitted rocket measurements up to an altitude of a few hundred kilometres. The area consisted of crown land and it was therefore not necessary to compensate land owners. It comprised mainly low mountains, bogs and tundra-like areas and was rarely used by tourists. There was no forestry. Nor was there any resident local population, other than "two elderly Lapps".

During periods when experiments were conducted, public access to the area would have to be restricted, he then underlined. This affected mainly the interests of the Lapps. However, it should be possible to resolve the problem in the same way as at the Vidsel range, where an agreement was reached which essentially meant that reindeer herding was not prevented, and could continue as normal, but during launches the herdsman were flown out of the area by helicopter.

In order to be able to tackle the question why it would not be feasible to launch from the proposed Norwegian launch site at Andøya, the memorandum concluded with a comparison between the possible experiment options there and at Kiruna. The findings were not favourable to Andøya. Launches there would take place over the sea, which would mean that shipping would be disrupted in the same way as reindeer herding was at Kiruna. However, the difference was that for each individual launch, shipping had to be suspended one day in advance, which limited the possibilities of investigating specially occurring phenomena at short notice. At Kiruna, on the other hand, it would be possible to close the area for the entire experiment period by flying out the herdsman. Furthermore, the advantage of a land-based range was that instruments could be recovered after the launch, which could not be done at sea. It is pointed out that experiments where recovery was necessary could be expected to increase in future.

Hultqvist worked for ESRANGE in two ways. In Sweden the working group continued its investigations, including looking into which rocket types could be envisaged at Kiruna. At the same time, discussions began within COPERS regarding the programme and convention for ESRO. As has already been mentioned, the Swedes played an active role. Hultqvist did not miss the opportunity, as chairman of the COPERS research group, to put the case for Kiruna.

In the course of the discussions in COPERS, it was found that there were three sites in the northern auroral zone to choose between. Nassarssuaq in Greenland, Andøya in Norway

and Kiruna. Nassarssuaq was rejected on the grounds that it would be too expensive; it was quite simply too far away. Andöya was rejected because impact would be at sea, with the ensuing recovery difficulties, particularly during winter. The same arguments appear in the COPERS documents as in Hultqvist's internal memorandum regarding ESRANGE. Factors in favour of Kiruna included good communications, proximity to a community with housing, schools, cultural attractions etc and, last but not least, proximity to a scientific laboratory within the relevant field of research – Kiruna Geophysical Observatory (KGO). The only concern was "one or two dozen Lapps" in the impact area, but this was waved aside.

However, the Swedish delegation very soon appears to have reached a deadlock. How far could they go in their promises of a Swedish launch site in the northern auroral zone? Would it be possible to propose Kiruna officially during the formulation of ESRO's scientific programme?

On 16 June 1961 there was another informal session of cabinet, this time concentrating primarily on the Kiruna issue. The space contingent was present in a large delegation – Hulthén, Alfvén, Funke, Brunberg and Brising, who had replaced Sterky to represent the interests of applications and industry. The Committee had drawn up a memorandum in advance, "twenty copies of which had been delivered to O. Palme", secretary in the Cabinet Office for further distribution within the government. Brising also presented a memorandum of his own.

The Committee largely repeated the arguments which were put forward at the session in January. It stressed a point on which Hulthén would insist – that space research was not a new field of research, but it was the technology that was new. It was that which made possible "revolutionary advances in a number of important sciences", for example meteorology, where heat radiation from the Earth could be measured and cloud formations observed, geophysics, where the Earth's radiation belts could be analysed, astronomy, where it was possible to foresee a new era of research without the disruptive effect of the atmosphere, as well as physics and biology, where the study of elementary life forms could make it possible to address successfully the question of the origin of life.

The COPERS cooperation was described with reference to the ongoing programme discussions. One is given the impression that it was the first draft of ESRO's programme document, the "Blue Book", which was the source. The subject then turned to Kiruna. A rocket base for high-altitude rockets in the northern auroral zone was the first item on the project list drawn up by COPERS. An area to the north of Kiruna would be suitable for the purpose. The investment costs were now estimated at around SEK 15 million – almost 12 million more than Hultqvist's initial calculation – and the annual costs at around SEK 5 million.

To avoid awkward misunderstandings it was emphasised that the costs would be borne by ESRO. Furthermore, it was pointed out that informal contacts with Kiruna and with the Lapps had indicated that it would be entirely possible to "carry out rocket launches to the

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full satisfaction of all interested parties". There would be great benefits "for Sweden and for Upper Norrland".

An official Swedish offer to make the area in question available to the organisation, if it comes into being, would increase our chances of having a substantial part of European space research activity based in Sweden.

The national research was outlined, as well as the launch which was planned to take place at Vidsel later that summer. However, it was not known for how long it would be possible to use Vidsel, which was, moreover, too small. In the long term it was necessary – also from the point of view of the national effort – to have access to a "rocket base connected to KGO".

The document from the Space Research Committee is well written and gives an excellent overview of the arguments and facts. However, compared to the memorandum presented by Brising it appeared quite conventional. He had a much broader vision and only touched on the ESRANGE issue; in his view it was important to bring the government to the realisation that much more than basic research and a possible base in Norrland was at stake. This was in fact the first time that industrial aspects were seriously considered.

The activities outlined by Brising can be encapsulated under the term "space activity", even though the term had not yet come into use. The Space Research Committee was not ignorant of the industrial aspects. At an early stage, contact had been made with the aviation industry and discussions had been held with Brising and his closest colleague at SAAB, Dr Tore Gullstrand, and with Dr Christian Jacobaeus from LM Ericsson and Dr Gunnar Broman from Flygmotor in Trollhättan who later even represented Sweden in the COPERS space transport group.

In a memorandum in 1960, SAAB had already expressed a keen interest in establishing itself in the space sector. Furthermore, in a letter to Brunberg in April 1961, Brising had explained why the company was interested.

We have established that the long-term industrial and commercial opportunities are highly significant, but that a substantial technical and economic background is required in order to be able to implement the various projects, so large that only the superpowers have sufficient capacity. We would hope for European industrial cooperation with economically and commercially reasonable objectives and firm long-term planning. Under those circumstances, we are very interested and, that being the case, can progressively release capacity for that purpose.

In his report to the government in June, he further developed these points. He drew a distinction between space exploration and space exploitation. Space exploration (space research) studied space and its characteristics and utilised space technology in order to achieve various fundamental research objectives. Space exploitation, on the other hand, took advantage of the possibilities which the space environment could offer. This required

research with technical objectives in the form of development and production of new equipment and technology.

According to Brising, it was still difficult to outline all the possibilities of space exploitation, since the activity was new and it was a phase of rapid development in which new projects emerged almost daily. But some areas could be highlighted even now. Telecommunications and meteorological satellites should be in operation and commercially competitive within five to seven years. The observation technology used in weather satellites could also be used for military surveillance, he pointed out – “an optimist can of course hope for such an effective surveillance of phenomena on the Earth’s surface under UN auspices that national efforts to the same end become superfluous”.

The next imminent possibility was the utilisation of the inherent characteristics of the space environment, he continued – the sterile environment, weightlessness, the almost total vacuum state which should be able to be used for various types of industrial production. The high transportation costs for setting up space laboratories could be offset by low operating and maintenance costs. In the long term, it should be possible to use other celestial bodies – the Moon, asteroids, neighbouring planets.

In summary it should be possible to say that initial commercial exploitation of space in the near future will almost certainly take place. It will involve very little science fiction but a great deal of hard technical work and precise economic calculations.

Brising closed his memorandum by calling for Swedish participation in both ESRO and Blue Streak, or the “Strasbourg project” as he called it, which in his view sought to create an organisation which would not only pursue the development of launchers, but also develop and produce space hardware for application purposes, “government and industrial cooperation of a considerably greater magnitude than anything attempted thus far”. The scientific cooperation within ESRO could not really be effective if “European cooperation is not established above all in the field of space exploitation for other purposes. The Strasbourg project was probably the only way to begin working fairly quickly to reduce to some degree the lead enjoyed by the United States and the Soviet Union”.

Events would prove Brising right. It was only when ESRO and ELDO were combined within ESA to take responsibility for both space research and space exploitation that Europe was able to keep up with the superpowers. This was never possible for ESRO alone. ELDO was not successful either, but that is largely another story. It is also interesting to note that, even at this early stage, Brising foresaw the utilisation of space for peaceful surveillance and for industrial processes in a weightless environment.

It is not known what effect his presentation had on the government headed by Prime Minister Erlander and with Edenman as “minister for space”. The informal session of cabinet closed with two statements from the Space Research Committee.

1. Sweden should declare that it is prepared to make available an area in Upper Norrland to the north of Kiruna for civil rocket tests under European auspices on the condition that European cooperation is set up and that the costs are borne by that common organisation.
2. A committee should be set up to examine the future position of Swedish space research within Swedish science and industry. Consideration should be given to the establishment of a space research council similar to the National Council for Atomic Research.

There is much to suggest that the government accepted the line of the Space Research Committee, at least initially; the detailed decision-making was presumably deferred until the budgetary work in the autumn, as was the usual practice. During the summer of 1961, the Kiruna investigations were intensified and took on an almost semi-official character, probably with the consent of at least the Ministry of Education and Culture. In August – before commencement of the budgetary work – the Space Research Committee informally handed over to the Ministry draft instructions for a commission of inquiry to examine the objectives and working methods of Swedish space research.

Even though the attitude to space activities was still probably lukewarm and uninterested, the government took a positive view in principle on research and international research cooperation. The state of the national economy was healthy and there was great optimism and a belief in development. It was roughly at this time that the first ideas for a government consultative committee on research emerged. Sweden had earlier joined CERN and very recently it had decided to become a member of ESO (European Southern Observatory). Simply to jettison a proposal for similar European cooperation was contrary to policy, at least as long as the costs could be regarded as fairly reasonable, and in that regard there had not yet been any definitive information. In addition, consideration also had to be given to the proposal, which was of great interest to the Chancery, for a launch base in Upper Norrland, a region which was a constant source of concern. Another not entirely irrelevant factor was the positive attitude of the aviation industry – its dependence on military projects was also a constant headache and perhaps a possibility of a civil alternative was in sight.

More important than this still fairly uncertain card were the purely foreign-policy aspects. At that precise time, the issue of Sweden's position with regard to the EU – or the EEC as it was still called – was under discussion in the government. In August, Prime Minister Erlander delivered his so-called "Metalltal" address. Sweden was, he said, greatly interested in European economic cooperation, but only in such a way that it retained its non-alignment and sovereignty. In reality, this precluded full membership of the EEC; only associate membership was conceivable and in December an application was made by Sweden.

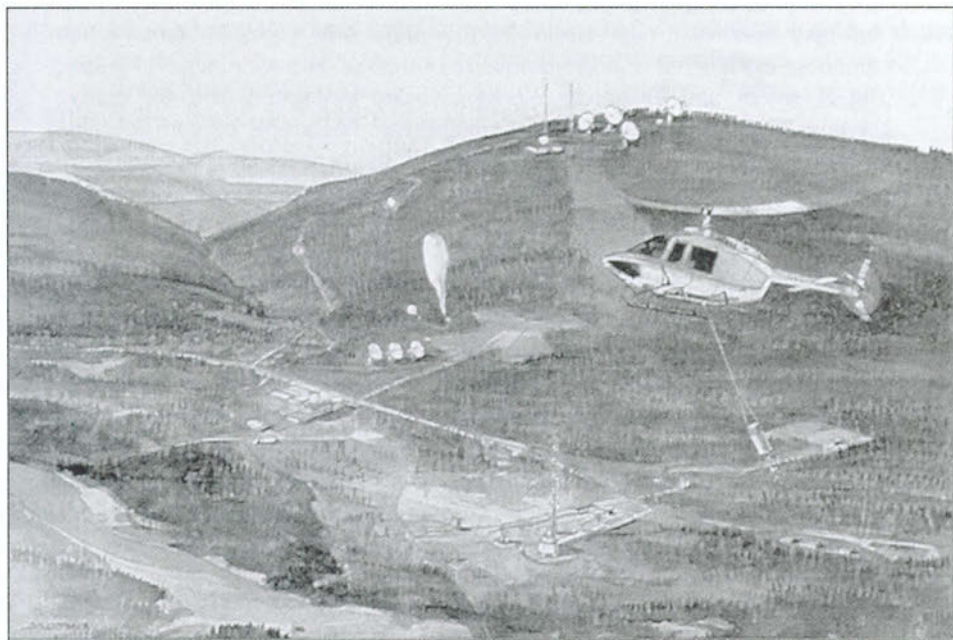
The indirect consequence of this was an attitude which would hold for the next thirty years or, broadly speaking, until Sweden applied for membership of the EU. As soon as the opportunity arose, it would show it was as European-minded as possible in all areas of

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cooperation which were uncontroversial from the foreign policy point of view. Space research was one such area – it was peaceful, it had no connection with either the EEC, the WEU or NATO, which might be doubtful in the case of the Strasbourg project. The Kiruna project would perhaps even be able to make ESRO membership profitable for the national economy. Even though it was still too early to take a final decision, there was everything to indicate that there should be a thorough study and analysis of the implications of membership. For the present the Space Research Committee was therefore able to continue with its Kiruna investigations.

It was very active in doing so. The National Defence Research Institute (FOA) was entrusted with the task of investigating costs etc, and subsequently the engineering firm Orrje & Co was brought in. However, the most important task was now to win over all those who were affected, both within COPERS and at home in Sweden.

Formally, COPERS had still not taken any decision, even though there was great interest in a rocket base in the north. At the beginning of July, the COPERS working group on space transport, led by its chairman Jean Vandekerckhove, visited Sweden. After discussions in Stockholm with the Space Research Committee, the group travelled to Kiruna for three days. Foreign nationals were not permitted to fly over the area which Hultqvist had in mind for the launch site, but the Chief of the Defence Staff granted a dispensation for Vandekerckhove and his colleagues, the Frenchman Blassel, the Englishman Becker, the Norwegian Christensen and the Dane Refslund. On 12 July, together with Hulthén and Hultqvist, they viewed the area from a helicopter. They also visited by car. Hultqvist reported:



The radar mountain at ESRANGE. Photo: Swedish Space Corporation

I brought them out to Vittangi river along an almost nonexistent road through the open country from Paksuniemi near Jukkasjärvi. We climbed what is now called the radar mountain and very quickly found the obvious locations for all the major parts of the facility: main building, launching area and radar station.

The viewings evidently proved satisfactory and, with high hopes for COPERS' future support, it was now possible to proceed on the home front. On 31 August, the Space Research Committee, in conjunction with COPERS, organised a wide-ranging information meeting at Malmfälten college in Kiruna. The aim was to inform anyone who might conceivably be affected in any way by the project and to ascertain their reactions and views. Invitations to the meeting were sent to representatives of the Ministry of Foreign Affairs and the Ministry of Education and Culture, the town of Kiruna, the municipality of Karesuando, the Norrbotten County Administrative Board, the defence staff, the National Board of Forests, the National Power Board, the National Board of Civil Aviation, as well as representatives of the Lapps, the tourist industry, nature conservation, hunting and fishing interest groups etc. From COPERS, the meeting was attended by Auger which demonstrated the importance attached to it. The press were also invited.

At the meeting, the chair was taken by Hulthén and the secretary was Anders Thor, recently employed by the Space Research Committee's secretariat. Hulthén gave an introduction, basing his statement on the findings and information obtained within COPERS and in local working groups with the assistance of the FOA. He began by speaking about the aims of COPERS and the wish to locate a base for high-altitude rockets in Upper Norrland.

The Scientific and Technical Working Group has found that, for many reasons, Kiruna would be the most suitable site in Europe for such a base. The proximity to a relatively large town with the benefits and opportunities offered would mean a great deal for the spirit of personnel. Communications are excellent ...

It is important that north of Kiruna there is a large area of land where the launched rockets will be able to come down and where, to a large extent, it will be possible to recover instruments. Last but not least, in Kiruna there is a geophysical observatory which would be a suitable foundation for activity of that nature, and with which fruitful cooperation could take place.

According to Hulthén, the facility would comprise a headquarters co-located with KGO, possibly with a radar and telemetry station nearby, together with a launch site with supply stores, preparation hall and a couple of launch pads, as well as a further radar station elsewhere. A suitable place for the launch site would be a point south of the Vittangi river just opposite the outflow of the Sekkujokki immediately to the south of Soppero. A technically less favourable alternative – a site 6 km further to the north-east – had also been studied. The launch site would be enclosed and require an area of around one square

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kilometre. Investment costs were now estimated, on the basis of calculations made in COPERS and later reproduced in the Blue Book, at SEK 18 million and operating costs were still estimated to be around SEK 5 million per year. It was expected to employ almost 100 people, including 30 academics and engineers.

Hulthén went on to stress that the government had not yet taken any decision but at the same time drew attention to the great benefits for the district if the facility were established – job opportunities, a valuable addition to the cultural landscape, stronger links with Europe. Naturally, however, activity at a rocket base did bring certain inconveniences.

The risks at the launch site itself could be eliminated by enclosing the site and employing guards, he said. As far as impacts were concerned, it was to be noted that the falling rocket parts did not contain any explosive. Assuming the current two-stage rockets are used, it could be expected that the burnt-out first stage weighing 50-100 kg would impact one or two kilometres from the launch site and that area would have to be cleared. The second stage and the nose cone, together weighing up to 50 kg, could be expected to impact around 70-90 km north-north-west of the launching site.

It will be fairly spread out and the burnt-out second stage can be expected to impact somewhere within a radius of perhaps thirty kilometres. This means that the actual risk for a person in the area is very low, which can be illustrated with the following example: assuming that a person stays for a whole year in that area with a thirty kilometre radius and that, during that period, fifty rockets are launched which come down in the area. The risk that by some chance a nose cone will fall closer than three metres to the person in question is 1 in 2.000.000. By comparison, reference can be made to the fact that the risk of an average Swede during that period being seriously injured in a traffic accident is around 1 in 2000 or about 1000 times greater.

All the same, there had to be effective protection. Two types of measures were conceivable: evacuation and shelters, or possibly a combination of the two, together with an effective warning system. He added that, of course, financial compensation would be paid for losses in the form of lost working hours, any damage which might occur etc. They were also prepared to suspend launches during certain times of the year out of consideration for reindeer breeding. Hulthén closed by stressing that the interests of the Lapps had to be fully respected, but that consideration also had to be given to other interests – “nature conservation, tourism, fishing and hunting, and of course defence requirements”.

Hulthén's statement shows that preparations had now come a long way – a site had been found for the base itself and it was more or less clear what facilities were required. The ESRANGE which was outlined in the statement displays strong similarities with the facility which eventually came into being, even though they were still insisting on the idea of the headquarters being co-located with KGO. The thinking behind that idea appears to

have been that ESRANGE, like the other ESRO facilities, should conduct its own research, but, as we have already seen, all ideas of this kind were abandoned during the planning in COPERS.

Hulthén was followed by Funke who reported on international scientific cooperation. He made sure he alluded to the Maupertuis French expedition to Lapland in 1730s to measure the length of a degree as an example. Brunberg explained the scientific considerations behind the desire for a rocket base and Bolin described the first Swedish rocket experiments which had been carried out at Vidsel two weeks earlier and also showed a film recording of the launchings.

The discussion was then opened up. Representatives of the town of Kiruna declared that they were favourable; the representative from the tourist board hoped that the rocket base would be a good tourist attraction and that it would be opened to visitors. The officer for Lapp affairs, E. Hedbäck, pointed out that the existence of 700 Lapps – it was no longer a matter of a few dozen – depended on reindeer herding within the proposed area. He drew attention to the possibility of setting up shelters close to settlements as an alternative to evacuation and also underlined the importance of telephone communications. Guarantees of compensation for damage to property were a precondition.

However, it was not only economic interests that were raised.

At this time, ecology and environmental conservation were still unknown concepts. Rachel Carson's "Silent Spring" had not yet been published. However, Professor Einar Du Rietz, a plant biologist from Uppsala present in his capacity as representative of the nature conservation committee of the Royal Academy of Sciences, put the case for the environment. He pointed out that the impact area was "wholly unique" for biological research – there were plants and lichens and an "unparalleled" bird life as well as "bogs with never-ending peat". To what degree would nature be damaged and would it be possible at all to carry out biological research in the area?

Auger reassured him that it would be possible in future and asserted that nature would not be damaged. Nevertheless, Du Rietz wondered why the Norwegians' planned base at Andöya was not being used. Hulthén replied by setting out all the reasons for which Andöya was not favourable – the same arguments given by Hultqvist in his memorandum in March.

The military also wanted the area to be untouched; their reason was that it should not become of strategic interest for an enemy. Colonel T. Wigforss pointed out that roads in the area were not therefore desirable. Hulthén answered by stating that, from a security point of view, the objectives of ESRO and the military were the same – the impact area should remain difficult to access. Recovery of payloads would be done by helicopter.

The discussion closed with Auger underlining that it was necessary to obtain a prompt answer from the Swedish government whether or not they were interested. There were several countries which were interested in sounding rocket bases, he added as a threat.

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The newspapers gave broad coverage to the meeting. On 1 September, the local and national press broke the news that space rockets might be launched from Kiruna. "Kiruna to be Europe's Space Base. Review gives positive response", wrote the *Norrbottnenskuriren*, while the *Norrländska Socialdemokraten* was rather more cautious: "The first stage towards a rocket base in Kiruna completed". *Svenska Dagbladet* pointed out that the space rocket base would require investment of SEK 18 million, while *Dagens Nyheter's* headline read: "Kiruna welcomes a space rocket base". The evening newspapers were also interested. "Rocket range to be tourist attraction", was *Expressen's* headline, whilst *Aftonbladet* promised "first space shot from Europe's rocket base in 1963".

Auger stopped for a further day in Kiruna. With the permission of the Defence Staff, he was able to fly over the area. He reported:

.... I still remember the picture I had of it as, with a few colleagues, I flew in a tiny aircraft over the extraordinary landscape of the lakes and hills of northern Sweden. I was fortunate enough to see the Kebnekaise, and couldn't help remembering the wild goose carrying the dwarf Nils Holgersson...

Plutnik and the National Research Programme

At the information meeting on 31 August 1961, Bert Bolin had described the first Swedish rocket experiment a few weeks earlier at Vidsel. The Space Research Committee had acted quickly. After only two years, the first step into space had been taken.

From the very beginning it had been clear that the Committee's first task was to establish a national space research programme based on experiments in space – we have seen (page 17) how doubts were even expressed over participation in European cooperation for fear that domestic activities would suffer. It was also clear that that activity would be conducted using sounding rockets and there was not even the slightest thought of a Swedish satellite, as had been pointed out by, among others, Alfvén. On the other hand, they were not opposed to developing their own sounding rockets – as early as October 1959 Åke Hjertstrand, who represented the Swedish Interplanetary Society on the Space Research Committee, together with Lars-Henrik Ågren, presented a proposal for a two-stage rocket, the first in a series of similar proposals over the next few years which would all share the same fate and remain on the drawing board. The Hjertstrand-Ågren rocket was intended to be able to send up payloads to an altitude of 65-75 km.

Two years later – in 1961 – the Swedish delegation presented proposals for three variants of sounding rockets in COPERS, called HR 1, HR 2 and HR 3. HR 1 was a two-stage rocket, where the first stage was liquid-propelled, while the second was propelled by solid fuel. It was expected to be able to take 25 kg to an altitude of 310 km and 5 kg to an altitude of 400 km. The costs were estimated to be US\$ 1200. HR 2 had only one stage which could take 25 kg to an altitude of 185 km. HR 3 was a two-stage rocket in which both stages were propelled by solid fuel. It was estimated to be able to lift 5 kg to an altitude of 80 km.

There was no shortage of proposals for experiments either. By autumn 1959, Bolin and his colleagues at the Meteorological Institute at Stockholm University (MISU), Pierre Welanders and Georg Witt, presented the Space Research Committee with proposals for sounding rocket experiments or, as they were still called at that time, experiments with "high-altitude rockets". Similar proposals also came from Bengt Hultqvist in Kiruna. Later, proposals were also submitted by Willi Stoffregen and the Uppsala Ionospheric Observatory set up by the FOA. As early as March 1960, Brunberg was able to report on fairly advanced plans (page 20) for purchasing Arcas rockets in the United States for experiments in the fields of meteorology and astrophysics.

In its first appropriation proposal – for the 1961/62 financial year – the Space Research Committee requested SEK 1.500.000 for primarily national activities. In the government budget bill, the Committee's proposal was mentioned, but no measures were taken.

For the time being, it therefore had to be satisfied with contributions from the research councils and the FOA. It goes without saying that these were more modest than the

appropriation requests. During the entire lifetime of the Space Research Committee from 1959 to 1962, it received around SEK 880.000, almost half of which, SEK 432.000, came from the FOA, SEK 158.000 each from the Natural Science Research Council (NFR) and the Atomic Research Council (AFR), SEK 130.000 from the Council for Technical Research (TFR) and a symbolic contribution of SEK 1000 from the Telecommunications Administration, the latter mainly bearing witness to Sterky's great personal commitment.

The FOA's large contribution was motivated by its interest in both rocket launchings and fundamental research in the field. The research institute's focus at that time was broader than it is today, there was a relatively large amount of money and contributions to basic research without a direct military interest were regarded as a natural part of activity to develop knowledge in general.

It might be rather surprising, on the other hand, that the AFR's contributions is as large as that of the NFR; however, this can be explained by the fact that Funke was chief secretary of both councils and it was evidently important to him that space research should be regarded as an interest common to the entire natural science and technical research communities.

In October 1959, the Space Research Committee had set up a working party consisting of Alfvén, Bolin, Brunberg, Hulthén and the FOA representative on the Committee, Nils Henrik Lundquist. The working party was given the task to examine "possible Swedish experiments and possibly build a Swedish high-altitude rocket". At the same time, in order to gain an understanding of the situation, a questionnaire was circulated to institutions and researchers regarding their interest in space experiments and any plans on their part. The survey largely confirmed what was already known; this was reaffirmed by the allocation of budget appropriations. Of the SEK 880.000 from 1959 to 1962, roughly SEK 650.000 was apportioned to the researchers who had previously applied for funding and who were well known in the Committee. Bolin received SEK 458.000, Hultqvist SEK 125.000, Stoffregen SEK 45.000 and E. Tengström from the Geodetic Institute in Uppsala SEK 22.000. Slightly more than SEK 170.000 was earmarked for administration etc, while COPERS received SEK 42.000.

The allocation of appropriations was done partly in the knowledge that in certain cases the money would at present extend only to preparatory work, for example development of instruments, while experiments would have to wait for the time being. Thus, part of Hultqvist's grant was used to pay Johannes Ortner's salary at the KGO.

Bolin and his colleagues stated in their applications that it had been possible using balloons, during the Geophysical Year in particular, to clarify atmospheric phenomena at altitudes up to 30 km. In doing so, phenomena had been revealed at even higher altitudes which could be reached only with rockets, such as fluctuations within intensive airstreams with speeds of up to 100 m/sec in polar areas, the "jet streams". The effect of such fluctuations on meteorological processes at lower altitudes should be studied. Data should also be collected from "noctilucent cloud" at altitudes higher than 30 km in order to

attempt to clarify the composition of that cloud and its movements on account of wind conditions.

Hultqvist's applications related to rocket investigations of "polar cap absorption". Following a large solar flare on 23 February 1956 a very high absorption of radio waves in the VHF band over the polar caps had been observed north of 60° geomagnetic latitude. This was the first time that this phenomenon had been reported, and subsequent observations showed that solar flares were generally followed by radio wave absorption combined with aurora. The absorption was thought to be caused by proton radiation from the Sun. The proton flux and its energy spectrum would therefore be measured using rocket-borne equipment. This experiment would contribute to the development of knowledge of the physics of cosmic radiation and, from a practical point of view, to better information concerning the effects of absorption on radio communications in polar regions.

Stoffregen's proposal was similar to Hultqvist's, relating to measurement of electron density in the ionosphere and studies of artificial auroral emissions. That experiment was likewise considered to hold practical significance for the understanding of radio communication problems.

Lastly, Tengström's proposal for an experiment dealt with measurements of different satellite orbits at different points in time and would enable the Earth's gravitation field to be determined more precisely than before. It was stated that a technical by-product of that experiment was clarification of the braking effect of the atmosphere on satellites.

The proposals – particularly those in astrophysics – set the way forward for Swedish research for the years ahead. The common factor for these first applications was that they underlined the practical importance of the experiments almost more than the purely scientific significance. The applicants were probably well aware that the research community was sceptical towards space research – an expensive cuckoo in the nest in competition for funding. It was therefore necessary to make clear to the awarding bodies – not so much the Space Research Committee as the government and the Parliament which held ultimate responsibility for cash flow and which were considered to be sensitive to utilitarian arguments – that it was a matter not only of being able to learn more about the universe, but also of relatively tangible applications.

It was not only physicists and meteorologists who were interested in space. In 1960 the International Astronautical Federation (IAF) held a conference in Stockholm. At that conference a committee for space medicine and space biology was formed, chaired by the Swedish professor, Carl-Johan Clemenson.

However, before a national programme could be set in motion, the Space Research Committee first had to resolve a whole series of awkward problems. First it had to find suitable rockets, to obtain the money with which to purchase them (they were expensive), and a site from which to launch them.

Work was done on several fronts at once. Scandinavian cooperation appears to have been considered at an early stage. Contacts with Norway were particularly promising. As early as December 1959 Herlofson reported a meeting with Finn Lied, head of the Research Institute of the Norwegian National Defence in Oslo, at which it emerged that the Norwegians also had plans to build their own sounding rockets and their own launching site. The contact was pursued in formal discussions between the Swedish Space Research Committee and the Norwegian Space Research Committee of the Royal Norwegian Council for Scientific and Industrial Research, represented by Finn Lied, its chairman Professor Rosseland and its secretary Björn Landmark. Danish researchers also attended one of these meetings.

But even though the contacts resulted in the formation of the Scandinavian working group for space research (SAR), it seems the practical cooperation plans gradually petered out, possibly because both the Swedes and the Norwegians found that – at least for the time being – they could manage fairly well by themselves. SAR nevertheless came to act as a forum for information and, to a certain extent, for planning of future activities in order to avoid duplication by coordinating the institutions' various experiments.

At the same time, contacts were initiated with the United States in order to procure rockets. In November 1959 Alfvén offered to contact space authorities and research institutions in the United States during a planned visit there. In February 1960, he was able to report a successful meeting with NASA in Washington. Sweden was welcome to purchase the rockets needed for its research – it was thought that Nike-Cajun rockets would be particularly suitable – and, furthermore, Swedish technicians were welcome to NASA for training in the launching technology.

The contacts were pursued with great success by Bolin who, in August 1960, was able to report that, through the Office of Naval Research, NASA had offered MISU five Arcas rockets and a launching device free of charge – subsequently scientific cooperation would emerge, including studies of noctilucent cloud.

A central role was played here by an American guest researcher at MISU, the meteorologist and naval officer Willard S. Houston. He had experience of his own in the launch of Arcas rockets and the right personal contacts in the US navy, which had developed Arcas. In order to make technical headway on the Swedish side, Bolin, through the intermediary of Hulthén, had already employed Lennart Lübeck at MISU in June 1960. Together with Houston, Lübeck, who had just passed his examinations at KTH, now began to prepare the first launch of Arcas.

On the basis of the generous rocket offer, a cooperation agreement was signed between the Space Research Committee and NASA in April 1961.

The NASA contacts made by Alfvén and Bolin constituted an opening. It was now necessary to set up a launch site. The air force's missile launch field at Vidsel in Upper Norrland or as it is called somewhat secretly in documents "the launching range south-west of Jokkmokk", could offer a solution. There was experience of similar launches,

there were security measures, there was – first and foremost – an isolated area where rockets with their experimental loads could impact without danger to the public. Just a few days after Alfvén's report, the Committee made a written request to the air force to make available the "Royal Swedish Air Force Administration test site (missile launching range) in Norrland (RFN)", as it was officially called.

The reaction was favourable and discussions were opened. The Missile Division of the Royal Swedish Air Force Administration investigated the matter and on 29 June the official response arrived from the Commander-in-Chief of the Air Force. It was positive, but there were many conditions attached. The National Defence's own launches would have to take priority, but in the gaps between those there should be space to launch rockets from Nausta in the north-west part of the range, provided technical and organisation coordination was established. Issues of secrecy would have to be accorded particular attention, because the majority of the military activity was secret. Lists of participants would have to be forwarded and personnel could remain only in designated areas. The presence of foreign nationals was subject to a special government order.

The launches naturally should not cause damage outside the area either. Even though they were willing to study the Committee's calculations regarding the risk zone, they were not prepared to take responsibility for either the calculations or any possible damage. Additional expenditure at the launch range would have to be borne by the Committee.

The letter concluded with a request which, one suspects, was connected to the ESRANGE discussions which the Space Research Committee had just initiated – at least it was referred to indirectly in the Committee's appropriation proposal later that year.

In view of the fact that permission to use RFN for the Committee's rocket launches is only temporary and may subsequently need to be reviewed, it would appear to be important for the Committee to continue examining options for moving launches to another site in due course.

Plans were now concentrating on launching one or two rockets in summer 1961. The rockets were already in Sweden; the air force had undertaken to store them for the time being. MISU would take responsibility for the experiment which would involve observation of noctilucent cloud. Two identical launches were envisaged.

A total of around thirty personnel were employed, formally at MISU. The project director was Bolin. Lars Rey from the Missile Division of the Royal Swedish Air Force Administration was put in charge of technical matters, replacing Lübeck, who had to perform his military service. However, Rey's age and position were considered to be insufficient and, consequently, Tord Lundblad was seconded from the FOA as chief research officer. Lundblad, who took up his post on 1 June, was able to begin by undergoing a few weeks' training at NASA on Wallops Island in the United States. In addition to Rey and Lübeck, the assistants included Johan Martin-Löf and Fredrik Engström – they were now given a baptism of fire. Almost all of these people would go on to play some important role in space activity.

The launch required considerable administrative preparations, including consultation with Norrbotten county administrative board and the National Board of Forests. Much concern was caused by the fact that neither MISU nor the Space Research Committee was deemed to have its own status as a government agency. They could not therefore give safety and protection guarantees or accept financial liability if anything went wrong. Nor did they have the right to classify documents and the military required the security regulations to be classified as secret.

The Committee therefore wrote to the General Accounting Office in the last days of that venerable office to request assistance in resolving the liability issue. The reply was received on 12 July from the National Audit Bureau (RRV) which had come into being twelve days earlier. The RRV believed that the issue was already resolved – the FOA had “instructed” Lundblad to serve as research officer. As a result of this administrative ingenuity, the launches could be regarded as official activity and the FOA could thus also accept liability for the risk zone calculations made by Rey and financial liability for possible damage. The FOA also came to the rescue on the matter of security classification.

Now it was possible to begin. On 31 July 1961, all the personnel were in place and based at the Vårdshuset Renkronan inn in Vidsel. From there it was 120 kilometres to the test site to which they were transported each day by bus and car. The staff were divided into four groups, one for scientific observations, one for weather forecasts, one for preparation and firing of rockets and one for telecommunications and measurement systems.

It was later found that the groups' work was in reality so interdependent that they were working more or less as a single team, a very well-motivated and enthusiastic team where everyone was willing to lend a hand where needed. Even the meteorologists did not concentrate solely on weather forecasts.

At the launch site a number of temporary installations were set up, including apparatus for taking acoustic measurements of launches. At the main building about 300 m from the rocket site were the launch director and personnel and the telecommunications centre.

There were various theories surrounding the origin of noctilucent cloud. It was known that it was composed of very small particles which hovered at an altitude of 80-85 km. According to one theory, these particles were formed as a result of vaporisation of meteorites when they hit the Earth's atmosphere at an altitude of approximately 90 km. As a result of stratification and wind turbulence, the particles were then collected in a layer, the noctilucent cloud. In order to test that theory, it was now planned to discharge artificial particles at an altitude of 90 km. By studying their behaviour, it would be possible to obtain information about how the noctilucent cloud is formed and also its physical properties.

The Arcas rocket was a small, fin-stabilised, unguided rocket which was propelled by a rocket engine with solid fuel. With a 4 kg payload it could reach an altitude of 90 km. It weighed 35 kg, was 204 cm in length and had a diameter of 11.3 cm. The maximum speed was 4000 km/h. The launch was from a tube with a gas-proof end piece. At the top

of the rocket was placed a nose cone specially manufactured by AB Bofors, consisting of a smoke charge of magnesium oxide which would make a dust cloud with talc-like particles, a few thousandths of a millimetre in size. The smoke charge would be released when the nose cone was separated from the rocket by an explosive device just before the top of the rocket's trajectory. The creation of the dust cloud and its movements would be observed and recorded from a 15 km-long baseline in Kristineberg near Lycksele, around 150 km to the south. The observations required clear evening weather conditions with low winds and the relevant altitude layer had to be still sunlit. A suitable time period was expected to occur from 10 to 20 August.

Everything appeared to be ready. But then something happened which should possibly have been foreseen. The Space Research Committee had decided not to issue any publicity until after the launch. However, the media got wind of what was happening and wanted to come and watch. The county administrative board, the Defence Staff and the military command at Vidsel reacted instinctively – a preview for the press, radio and TV could lead to the “dissemination of unreliable information” which would damage both the space researchers and the military authorities.

The media attention was naturally the result of the great news value which was still attached to anything related to space and space shots. In addition 1961 was a space year like no other; a few months earlier Yuri Gagarin, the first man in space, had completed an orbit of the Earth in Vostok 1. He was followed shortly afterwards by the American Alan Shepard in the Mercury 3 capsule. In May, President Kennedy decreed that it was now time for the Moon. Then, at the beginning of August, the Russian Herman Titov completed 17 orbits round the Earth in Vostok 2. Here, Sweden was about to fire its first space shot and one can understand how the press felt when they were not permitted to be there. In addition, it was taking place at the Vidsel range, a site surrounded by great secrecy and which barely existed officially – no journalists had ever been admitted into the area. At nearby Nausta, as part of its studies of the effects of nuclear weapons, the FOA had detonated the largest TNT charge ever in Sweden and they did not want to show the hole.

The situation eventually became intolerable; they had to give way and they did so in the form of a preview of the launch site on 9 August for about thirty journalists from all over the country. On 10 August the Dagens Nyheter newspaper ran a large front-page report under the headline “First Swedish space shot from launch pad in Lapland. 35 kilo Plutnik expected to reach 80 kilometres”. The subsequent text is correct and very closely follows the briefing paper put together by Lübeck and Rey for the journalists. The primitive conditions are made particularly clear: “the central office is housed in a couple of the regional highway administration's rest huts, the workshop in a tent and not even the launch pad seems particularly impressive”. Bolin explained that the risk of an accident was “practically none”, since the fifteen people firing the rocket would be safely protected in a concrete bunker. The tone of the article is friendly – without exception the press visit appeared to have produced a result which in the long term should have furthered the cause of the Space Research Committee.

At 22.10 on 14 August it was time for Plutnik, as the press had christened the rocket. The launch, which was also witnessed by Hulthén, Hultqvist, Brunberg and Ortner, went according to plan. The rocket could be followed with the naked eye to an altitude of 18 km. However, the nose cone with its talc cloud could not be seen, nor recorded with instruments. It was clear from the acoustic measurements that the explosion was never triggered – there was no cloud and the nose cone disappeared, together with the rocket, in the wilderness of the interior of Lapland. Nevertheless, by recording the propagation of the sound when the rocket broke the sound barrier, it was possible to assimilate valuable data concerning temperature and wind at the relevant altitudes.

Because it was not known for certain why the explosion was not triggered, the second planned launch was cancelled. The launch and its organisation had gone satisfactorily, which was in itself an important result. The greatest benefit was the experience of planning and execution, wrote Rey in a report. They had learnt for the next time.

And Sweden had made its first appearance in space.

The Government Decides

Three days before the information meeting in Kiruna regarding ESRANGE – on 28 August 1961 – the Space Research Committee had submitted its appropriation proposal for the 1962/63 financial year to the government. The situation had undeniably changed during the previous year. The government had been informed on two occasions of the Committee's plans, which had not been rejected. Within COPERS the idea of a Swedish launch site in Upper Norrland had been embraced. And Sweden had made its first appearance in space, showing what it could do. Now it was time to go further.

The appropriation proposal was introduced by a general overview of "the importance of space research". It was optimistic and could be described most simply as a concoction of the various memoranda which were used in the preparatory meetings with the government during the course of the year – see pages 56 and 61 above. Great emphasis is laid on possible applications in meteorology, telecommunications, metallurgy, automatic control systems etc – as usual they were guilty of a certain over-confidence in arguments of this type.

The international cooperation – including the ESRANGE proposal – was presented in summary, since the government was aware of what was in progress. There was, on the other hand, a detailed presentation of Swedish space research.

There was a description of Bolin's space shot at Vidsel. There was wisely no mention of the sorry fate of the nose cone, simply a statement that processing of the scientific data from the launch was in progress. In addition to the research projects described in the previous chapter (see page 71), two new proposals were now presented, although there appear to have been given lower priority by the Committee.

The first originated from the Committee's newly arrived assistant secretary, Anders Thor. It consisted in setting up a data processing centre at KTH to take over and develop the monitoring and recording of satellite signals, which had been begun at the Telecommunications Administration's control station at the town of Enköping.

The second was a new proposal from E. Tengström at Uppsala. He wanted to launch small rockets to altitudes of up to 100 km where an explosive charge with a brilliant flash would be triggered. The flashes would be photographed from a number of ground stations. Through triangulation of the position of the flashes in the night sky, the relative positions of the ground stations could be determined with great precision. It was stated that a possible practical result was the determination of "the island of Gotland's position in relation to the mainland with previously unattainable precision".

Almost all the experiments required rockets, it was pointed out. One Arcas rocket cost SEK 6000, but for the geophysical and geodetic experiments two-stage Nike-Cajun or

Phoenix rockets were needed, and they cost around SEK 40.000 each. In the longer term, efforts should therefore be made to establish domestic production. "Interest has been shown on the part of industry", it was stated.

The appropriation proposal concluded in a request for SEK 2.5 million to finance domestic research. Possible costs for participation in COPERS/ESRO were not included. It was evidently expected that a commission of inquiry into the organisation of space research was imminent. "Without forestalling any inquiry into the future of Swedish space research, it can be stated that research work has been started which it is particularly important to complete. That is the reason the Committee has submitted this estimate".

There was good reason to believe that something was finally happening. At the same time as the appropriation proposal, Brunberg privately sent to Undersecretary of State Hans Löwbeer at the Ministry of Education and Culture a proposal for a commission of inquiry into the objectives and working methods of Swedish space research which he approved. In addition, he sent a memorandum containing arguments regarding the measures which were necessary in order to realise the ESRANGE project. The instructions had been drawn up in the Space Research Committee's working group. They began with a long description which was also the same – sometimes word-for-word – as earlier memoranda and appropriation proposals. The only new addition was global space statistics – thus far, since 1957, 60 satellites had been launched, around one quarter of which were Soviet. In addition, five space probes had been sent up, one round the Moon and four round the Sun. Around 30 of the satellites were still in orbit. I will return to the instructions below.

The ESRANGE memorandum did not actually contain anything new, other than a statement that COPERS expected to put forward a proposal on the organisation of ESRO (convention etc) during autumn 1961 which – if Sweden were to join – required a bill to be brought before Parliament in spring 1962. In actual fact it was not ready until early summer 1962. Forecasts of how long the organisation's cooperation negotiations will take have always been characterised within ESRO/ESA by an unrealistic optimism, which has probably been necessary in order to exert pressure on the delegates.

Time was pressing, however. Therefore, the Space Research Committee, probably with the consent of the Ministry, brought in bodies including the FOA, the National Land Survey Board and the Telecommunications Administration into the ESRANGE investigations to look at communications, power supply etc. The Geological Survey of Sweden (SGU) investigated whether ore was present in large quantities in the area – it was not. In June, the State Railways had been consulted to ascertain the cost paid for running over a reindeer – an appropriate point of reference for establishing the cost for reindeer killed by rockets.

As has already been mentioned, the mood in the government was to a great extent positively cautious, even though one or two negative views were expressed. They had now gone so far that they had to take a certain responsibility for the preparations, initially by familiarising themselves with the various issues in internal discussions. Some pencilled notes made by Löwbeer in September 1961 reveal the mood: "Positive reaction. General

positive attitude. No definite commitment...”, he noted regarding Swedish participation. With regard to ESRANGE he wrote: “Interested, why not. But no offer, still a little cautious, no direct activity. Like to continue inquiry...Check with Ministry of Finance!!”

However, for Hulthén and his fellow delegates in COPERS it was evidently not so easy to establish a generally positive mood without even being able to give any indication of a final answer. At the beginning of October 1961, Hulthén wrote to the Ministry – despite its sober, correct tone, the letter almost sounds like a desperate cry. He complained that time and again “the Swedish delegation was asked the question whether any indication of the Swedish government’s interest could be expected in the near future...”. The preparations within COPERS had now gone so far “that it is not possible to go any further without the assistance of the Swedish authorities”. They needed to begin work on the site by spring 1962, it was claimed with customary optimism. (In actual fact, work did not start until 1964). Auger and his colleagues were threatening that if they did not get a clear “yes” or “no” to ESRANGE as soon as possible, they would begin to look at other alternatives. Otherwise, there was the danger that “the plans for a rocket base in the northern auroral zone would be abandoned and interest would be turned to an existing base in Sardinia, which has been informally offered...”. Hulthén therefore hoped that the government would inform COPERS at least provisionally of its position. Furthermore, the necessary investigations should now be initiated, since time was short if a decision was to be taken in spring 1962.

But it was not easy for Löwbeer and his colleagues either, particularly Rune Fremlin. Their hands were tied. The whole ESRO issue was bound up in the budget work of autumn 1961 which strictly followed a fixed timetable and would not be concluded until just before Christmas. At the beginning of October the relevant ministry had still not even ascertained the reaction of the Ministry of Finance to its proposal.

However, by the end of October the budget work had progressed so far that the Ministry of Education and Culture was able to contact other affected ministries and authorities. A list was drawn up of the issues which the project raised. It was sent out to eight other ministries, together with an invitation to discussions on 28 October. Enclosed with the invitation was also a brief memorandum concerning the activities of ESRO, the location of the proposed base area etc.

The list of issues was huge and the following points required clarification before a decision could be taken, i.e. the consequences:

- for Swedish foreign and defence policy
- for the Lapps, the local population and land owners
- for the local labour market
- for nature conservation and tourism
- in social and cultural terms
- legally, for example with regard to liability and immunity of personnel
- financially, with regard to taxation, customs duties etc

– for communications policy – the implications for air transport, the requirements for power supply, roads, telephone, radio, radar

That meeting gave the investigation a kick start. A large number of authorities and organisations had one month within which to comment on the proposal as presented in the memorandum which was sent out with the invitation. Their opinions were generally positive, the proposed area was regarded as broadly suitable and it was considered that the rocket launches would not cause any great inconvenience to forestry or any mining.

The Royal Academy of Sciences, whose representative had spoken emphatically in support of nature conservation interests in August and therefore recommended Andöya, now asserted that the plans did not constitute any risk to nature. The base would be a mutual stimulus and benefit for KGO and the location was regarded as "almost exceptionally promising". The *Defence Staff* regarded the activity at the base to be indirectly valuable for defence on account of the role it presumed it would play in stimulating research. Similar arguments were put forward by the FOA. The *Office of Mine Inspectors for the Northern District* pointed out that there were in fact copper ore deposits on which a concession had been taken out, but that there were no plans for prospecting or quarrying. The *Swedish Meteorological and Hydrological Institute (SMHI)* stressed the great importance of space research for meteorology and hoped that in the long term a station could be built, connected to the ESRO base, to receive meteorological data from satellites. The *Norrbotten County Labour Board* did not see any great problems from the labour market point of view, even though there was currently high employment in the Kiruna area. Only the *Swedish Mountaineers Club* and the *Swedish Society for the Conservation of Nature* objected "firmly" and advocated Andöya as a better alternative.

After the meeting Hulthén was given the task of taking matters further. He did so quickly. By 31 October, he delivered a first memorandum, which was followed on 7 November by a second, setting out COPERS' cost estimates for the first eight years of ESRO and calculations of the risk area for the proposed base worked out by Lars Rey. On 17 November he had completed a third memorandum with proposals for the boundaries of the rocket range.

Hulthén's three memoranda were largely the same as his statements at the information meeting in Kiruna on 31 August (see page 66ff). Obviously there is greater detail, in particular with regard to costs and the drawing up of boundaries. On a few significant points there are difference from his August statement. Hulthén was now arguing in favour of extending the rocket range into Norwegian territory, an idea which had been discussed at a Scandinavian space cooperation meeting in Bergen, where it had been endorsed. Later it must have been forgotten, however, since there was no future reference to it.

In addition, when Hulthén had spoken in August about safety, he had mentioned a combination of evacuation and shelters. Now he had other ideas. Much later he explained:

The lawyers in the Ministry of Education and Culture initially required that before each launch everyone within the impact area be evacuated by

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helicopter. We then compiled statistics for helicopter accidents and it was found to be between 100 and 1000 times more dangerous to lift a person out by helicopter than to let them remain unprotected in the area.

Therefore, he now argued in favour of shelters in conjunction with an effective warning system.

The probability of an impact outside the risk area was estimated by Rey to be 0.7%. He made certain to point out that, for the Arcas launch in the summer, it had been estimated at 1%, which had been regarded as acceptable. The calculations were based on 50 launches a year with three types of rocket, the American Nike-Cajun, the French Veronique and the British Skylark. Rey's memorandum was quickly forwarded to the Air Force Administration, which had no objections.

On 10 November 1961, the government instructed Lennart Persson, a judge at the Water Rights Court, in conjunction with the Lapps in the area and the National Union of the Swedish Lapp People (SSR) and affected public authorities, to investigate the consequences which a rocket range would have for the Lapps and to formulate proposals for safety and compensation measures.

The secretary to the investigator was Hans Svahn. During the 1970s, he would once again come into close contact with space matters as a permanent undersecretary at the Ministry of Industry.

Persson and Svahn worked quickly, taking Hulthén's memoranda as the basis. Almost immediately, discussions were convened in Kiruna on 5 December. In addition to the Lapp representatives, participants included Hulthén, Hultqvist and Fremlin. Rey's proposals for safety measures at the launch site and in the risk areas were presented as the basis for the discussion.

It was proposed that the launch site be enclosed by a fence. It should be prohibited to remain within risk area 1, where the first stage would impact, during launches. Warning signals, with sirens and flags, and warning signs were proposed. Within risk area 2, the impact area for the second stage and the nose cone and payloads, four shelters were proposed. In addition, reindeer herdsman in the area would have access to portable radio receivers to which warnings would be sent a certain time in advance. Lastly, a single carriageway would be built from the existing road between Vittangi and Karesuando to Lake Pulsujärvi where there was a Lapp camp. The aim was declared to be to facilitate evacuation during periods when reindeer breeding took place, but no secret was made of the fact that it was primarily to accommodate a demand from the Lapps, as the reindeer breeding would benefit from the road.

The road proposal actually ran counter to a view which had been put forward by the National Defence and also, several times, by Hulthén – that new roads should be avoided both for military reasons and because they could be expected to attract tourists to the area. However, the price had to be paid and the Lapps were skilful negotiators. They had had

access to the memorandum prepared by Persson and Svahn in advance and, on the basis of its proposals, worked out in detail their conditions at an SSR board meeting the day before the meeting in Kiruna. If the road was not built for military or other reasons, they threatened that the launches would have to be suspended for the entire period from September to December.

Lastly, both collective and individual compensation was recommended for interference and possible damage. No sum was named – it would be negotiated later.

After the meeting, Persson and Svahn quickly drew up their proposal which was submitted to the Ministry of Education and Culture on 29 December. They stated that four Lapp villages – Kōnkämä, Lainivuoma, Saarivuoma and Talma – were affected by the rocket range. Within the area were four permanent Lapp camps with roughly 650 Lapps and almost 30.000 reindeer, plus 17 reindeer herdsman's cottages. As far as safety measures were concerned, the earlier proposals were followed, although the number of shelters had now risen to six. It was also recommended that telephone lines be extended to the Lapp camps.

As regards compensation, it was assumed that there would be 50 launches each year and that during the entire year there would be an average of 100 Lapps in the area. The Lapps were assumed to remain in the shelters for four hours during each launch, instead of carrying on reindeer herding. As a result they would incur an economic loss which was estimated at SEK 4 per hour. On that basis, it was possible to arrive at the following formula: $100 \text{ Lapps} \times 4 \text{ hours} \times \text{SEK } 4 \times 50 \text{ launches} = \text{SEK } 80.000 \text{ loss each year}$. If that sum was capitalised on the basis of an annual interest rate of 4%, there was SEK 2.000.000, SEK 1.750.000 of which should go towards the construction and maintenance of the Pulsujärvi road, whilst the remaining SEK 250.000 would be used to support reindeer breeding in the Lapp villages of Kōnkämä and Talma. In addition, SEK 10.000 would be paid to the State Lapp Fund as compensation for loss of reindeer pasture within the launch area itself. Lastly, it was proposed that the four Lapp villages should share SEK 5000 each year as compensation for reindeer which could conceivably be killed by falling rockets. Now, with hindsight, it can be observed that, during 30 years of launches at ESRANGE, not a single reindeer has perished – the proposal, it still had not been finally agreed, must also have seemed excellent for the Lapps in that respect.

At the same time as the Lapp inquiry, Bengt Hultqvist, assisted by a lawyer, Folke Granström from Kiruna, and a forestry expert, Bror Boström, had held negotiations with land owners in the area. Those affected were members of the village community in Soppero who had "forest allotments" in the area and the owners of the Liedakka homestead at Karesuando and two farms in Vittangi. The Soppero forest allotments were located within risk area 1 and an annual lease was proposed amounting to SEK 30.000. In addition, both the village community and the farm owners would receive a small amount of compensation for interruptions to work, possible damage etc.

The Ministry of Education and Culture quickly sent out Persson's proposal for rapid consideration. The response was consistently positive. The *Defence Staff* supported the

road proposal but demanded discussions with the military authorities on the final planning of the route. The *Norrbottnen county administrative board* concurred with the proposed safety and protection measures, as did the SSR which believed, however, that it should be sufficient to allocate SEK 1.5 million of the proposed SEK 2 million compensation to the Pulsujärvi road, so that the amount allocated to the measures to support reindeer breeding could be increased to SEK 500.000. It was also thought necessary to establish a body for cooperation between ESRO and the Lapps.

Thus the basis for a decision regarding ESRANGE was established. However, the key issue – the ESRO Convention and who would sign – was still unclear. The Convention was still being negotiated within COPERS and there was complete disagreement. One country after another threatened not to join. Therefore, on 3 January 1962 Fremlin asked the Ministry of Foreign Affairs to investigate the views of the various COPERS states and whether they were envisaging membership. The response was encouraging. Most expected that they would join, provided costs were not too high. Only Norway was unable to outline its position. The Austrians were positive, but uncertain over the Soviet attitude with regard to non-alignment. The Soviet ambassador had expressed serious misgivings but, as it transpired, had confused ESRO and ELDO and now the Austrians did not know exactly how they stood *vis-à-vis* the Soviet Union. The most positive view was that of France – the government had already been given the power in principle, in cabinet with General De Gaulle, to sign both the ESRO and ELDO conventions.

The Space Research Committee was naturally concerned that no answer was forthcoming from the government. Some time around the turn of the year from 1961 to 1962, it called on Rickard Sandler who, in his capacity as chairman of the board at KGO, could be expected to have a certain interest in space research. He was presented with a comprehensive account of events thus far. It emerged that the Ministry of Education and Culture, for which read the Ministry of Finance, refused to take a decision before COPERS concluded its work on the Convention. Furthermore, it wanted the costs of membership of COPERS for the current 1961/62 financial year – around SEK 250.000 – to be borne by the research councils. That demand was evidently an additional concern for the Committee; even without this, Swedish space research was “on a backburner”, and the relatively small sums paid by the research councils were needed primarily for the campaign the following summer at the Vidsel range.

The result was that Sandler undertook to bring a motion before the Parliament and asked Brunberg to draw up a text. It was delivered on 20 January 1962 and was fairly lengthy. Sandler shortened it ruthlessly and tabled the motion on 26 January in the upper chamber, together with the Liberal, Hugo Osvald, a professor at the Royal Agricultural College and board chairman of the International Meteorological Institute in Stockholm, of which Bert Bolin was the director.

It stated that “the fact that the government has not yet taken a decision on the issue of an increased appropriation” for space research should not mean that the Committee’s investigations “are interrupted on account of a lack of funding for the bodies, including the Natural Science Research Council, which have thus far funded its activity on a

provisional basis". Those tabling the motion therefore proposed that the Natural Science Research Council be accorded a further SEK 500.000 in addition to the appropriation authorised by the government. The same motion was put forward by Elias Jönsson and Cecilia Nettelbrandt in the lower chamber.

The motions fell by the wayside in due course, since the government presented a space research bill.

In the long term, despite statements that the ESRO Convention had to be finalised, the Government could not wait for ever. In the government budget proposals, the Minister for Education and Culture, Ragnar Edenman, had declared that he had still not made any decision on the request by the Space Research Committee because the inquiry on "Swedish participation in international space research" was still on-going. Now, at the beginning of 1962, all the papers – at least as regards Kiruna – were on the table, including a highly positive report on the views of the bodies to which the matter had been referred. However, it was a problem that the negotiations – or quarrels – over the formulation of the ESRO Convention were still unresolved with regard to almost the most important issue, the handling of the budget process. That can be seen from the copy of the memorandum which Löwbeer had with him when he put forward the case for space research at an informal session of cabinet on 9 February 1962. Eleven of the fifteen members of the government were present, headed by Tage Erlander. A few brief notes by Löwbeer reveal the tone of the meeting. "Undén: We can't be outside...hard to object. Sträng: condition on unanimity. Prop for 280.000. Budget question re: 1 mkr to Sw space res. Still no final decision. Unanimity condition re ELDO. Kiruna must be included."

The notes are easy to interpret. Foreign Minister Undén took the view that Sweden – probably with a view to European cooperation – should join ESRO. The amounts of money mentioned allude on the one hand to the cost of membership of COPERS during that financial year – it had now risen to SEK 280.000 – and on the other to the fact that Finance Minister Sträng still did not appear ready to give a response on the size of the appropriation for national space research – evidently the SEK 1 million which was discussed was a significant cut compared with the SEK 2.5 million requested by the Space Research Committee. In addition, the Finance Minister laid down a condition for unanimity on budget decisions. As has already been mentioned (page 35), in the subsequent negotiations the Swedish delegation won through with its wishes on this point and also on the issue that the uncertainty of ELDO's future role from the point of view of non-alignment dictated the need for unanimity in the case of decisions concerning cooperation with other organisations (cf. page 44). Lastly, it is clear that Kiruna as the location for ESRANGE was a condition for Swedish participation.

However, to the very last it was uncertain whether it would be possible to present any proposal for the Convention to the Parliament. The unanimity requirement for certain budget decisions was highly controversial in COPERS – only France, the United Kingdom and Sweden supported the proposal. Even in mid-February, there was disagreement over both this point and the size of the eight-year budget. Auger was evidently against any proposal which entailed a restriction of the decision-making power

of the secretariat and he had the support of several of the small countries. Frenetic diplomatic activity developed behind the scenes, in particular in order to seek to persuade the British to refrain from adopting such an "inflexible" position by requiring a right of veto. A statement by a senior official in the Swiss Foreign Ministry to the Swedish ambassador in Berne typifies the feelings. "Of course it could not be right for a virtually underdeveloped country like ... to be able to block decisions desired by the other participating countries."

Nevertheless, the small countries gave way to Britain and France. At a meeting in COPERS on 21-23 February preliminary agreement was reached over voting rules. Sweden played a key role in the final negotiations. An unusual feature was that the British government expressed its gratitude for the conduct of the Swedish delegations. A Swedish Foreign Ministry memorandum reported:

Mr Cartledge, secretary at the British embassy here, today conveyed the appreciation of the British government, as instructed, for the work done by the Swedish delegation at the meeting with COPERS in Paris on 21-23 February regarding European space cooperation. The key points of the ESRO Convention relating to voting rules and the size of the budget had been drafted in accordance with the wishes of the British government. It had been noted that this was in no small measure the result of work done by the Swedish delegation.

"Show to Mr Edenman. It is not every day that we get such praise!" noted Löwbeer with satisfaction on his copy of the memorandum.

The difficult question of where the various ESRO facilities should be located was an outstanding item on the COPERS agenda, but the Swedish government did not wait for that decision. The location of ESRANGE was uncontroversial and, in practice, already decided. Consequently, it was now thought the ESRO matter could confidently be placed in the hands of the Parliament. At a cabinet meeting on 2 March 1962 the government approved Bill 1962:85 "concerning *inter-alia* Sweden's accession to a convention establishing the European Space Research Organisation".

The fact that the bill was approved on 2 March did not mean, however, that it went before the Parliament that same day. It was not even printed in its final version. The responsible officials had a nerve-racking time. While the COPERS member states had now reached agreement on the text of the Convention, after the meeting on 21-23 February, it now had to be finalised by the secretariat and this took time. Only on 3 March was the embassy in Paris able to send a text to Stockholm. This unfortunately proved to be a preliminary text, however. Over the next few days the telex equipment between Paris and Stockholm was pushed to the limit. The final amendments arrived on 17 March and could be inserted in the bill which was submitted to the Parliament before the expiry of the period prescribed by statute for the submission of bills.

The bill was introduced with a report on the proposed Convention – the text was attached as an annex. Extensive reference was made to the Blue Book setting out ESRO's scientific programme, as well as the proposal for a rocket base near Kiruna, where the statement was largely based on Hulthén's memoranda. The boundaries of the rocket range were set out in detail. It would be around 120 km long in a north-south direction and around 75 km east-west. The term "space" was defined as all areas "beyond the altitude in the Earth's atmosphere which could be reached by balloon, around 30 km". A summary of Persson's investigation and the views of the bodies consulted were outlined. Lastly, the Space Research Committee's appropriation proposal was reproduced.

The report was followed by the statement by the Minister for Education and Culture, Ragnar Edenman. He began by stating that space research was "not a new research field, but a new technology". That technology could be used in many different areas – in astrophysics and astronomy, in meteorology and medicine, particularly physiological climatology "and the still tentative studies of the significance of climatic and radiation factors for health", he stated somewhat surprisingly. However, the technology was expensive, he stressed. "No European country, apart from the largest, could by itself make sufficient resources available for a research programme which come close to satisfying all the wishes of the scientists." It was therefore logical for Sweden to take part in the negotiations on a European programme of peaceful space research cooperation.

In the proposal for the ESRO Convention the rules on voting on budget issues were of particular interest, he pointed out. The Swedish delegation had insisted that the three-year budget ceiling should be agreed by unanimity, in particular so that member states did not "incur expenditure beyond that which they had legitimate reason" to expect. "That became the final result of the negotiations".

The provisions governing cooperation between ESRO and non-Member States or other international organisations were also of interest. Certain countries, including Sweden, believed "for general reasons" – ELDO could naturally not be identified as a particularly dangerous cooperation partner – that such cooperation decisions should also be taken unanimously. "This was the position which was finally agreed on". After thus eliminating the points which might be regarded as precarious, the Minister stated that the result of the negotiations was acceptable and that – as stated in the bills of that time – His Royal Majesty, i.e. the government, should obtain the approval of the Parliament for Sweden's accession to the Convention "in essential conformity" with the current proposal. "If, in connection with the signature or in due course, minor modifications or additions to the texts in question are required, I presume that the consent of parliament will not have to be obtained". This latter addition was prudent and proved to be well-needed.

The costs of Swedish participation were estimated to be SEK 77.5 million for the first eight-year period, SEK 280.088 of which would be prior to the entry into force of the Convention, which was expected to be in December 1962 – it actual fact it would take until June 1964.

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It is therefore a sizeable appropriation which is necessitated by the accession to the European Space Research Organisation which I recommend. For several reasons I nevertheless support this, with the associated consequences for the national budget. Swedish research will gain considerable experience and Swedish industry will be able to build on quality and technical innovation and will have access in its development work to practical know-how in a number of technically important fields.

It is possible to glimpse here the germ of an industrial policy in the space sector. A typical characteristic of the time is the slightly boastful tone with regard to quality and technical innovation – as we will soon see, the over-confidence in Swedish industry's ability to assert its position would lead to serious disappointments.

Edenman moved on to the ESRANGE question. He pointed out with honesty that COPERS had not yet taken a decision on the location of the ESRO institutions, but proposed nonetheless that the government seek authority from the parliament to reach agreement on the lease of land etc "in case it is decided that ESRO's rocket range within the northern auroral zone should be located in the Kiruna area and on the condition that satisfactory conditions from the Swedish pointed of view can be secured".

It is important that in the negotiations with ESRO on the Kiruna project the views and wishes expressed by the Swedish authorities, organisations and other interested parties as the matter is dealt with are respected as far as possible. The guiding principle in such negotiations must be that restrictions on sovereignty must not be allowed and that there must be no restrictions on individual personal freedom which conflict with or are contrary to Swedish legislation or legal practice. Furthermore, regard must be had to two factors – first, the arrangements for utilising the range must be such that the Swedish government reserves the right, if national interests so require, to have a satisfactory control of activities and be able to restrict utilisation by ESRO and, secondly, it should be possible to review the agreed provisions of the agreement if significant changes in circumstances occur, in particular as regards the extent of activities.

There was no great international experience in the Ministry of Education and Culture at that time. While it participated actively within its fields in the OECD and the Council of Europe, that was primarily in relation to investigations of education and research policy and recommendations of various types, not the purely economic and legal negotiations which the Kiruna project entailed. It appears that there was a feeling that almost anything could happen and it was thought best to guard against unforeseen circumstances. It was also important that no one should feel that there was any "monkey business" or secretiveness. The bill therefore contained an additional provision in which the Minister appealed the Parliament – if, in the course of negotiations, issues arose which were of such a nature as to require the cooperation of the Parliament, the government power to sign the agreement could not be used.

Surprisingly there was practically no mention of the benefits for the national economy of having a major international establishment in Lapland. There was virtually no response to the ambitious list of problems from October. There was no reference to the size of the labour force which might be employed at the building itself. Nor was there mention of the cultural and social implications of an international resident population. While the number of staff was estimated at 90, of whom 30 would be researchers and technicians, there was no reference to what that would mean for the municipality. On the other hand, the fairly modest and very short-term gains for the State budget were highlighted. The project was expected to cost ESRO around SEK 29 million for the first three years, 17 million of which was for investments, while the Swedish contribution to the organisation during that period could be estimated to be around SEK 20 million.

When Edenman addressed the issue of the contribution to Swedish space research, the section began with an interesting statement which showed that the minister had listened to the arguments of the Space Research Committee.

As regards the question of a contribution to Swedish space research, I wish to point out from the outset that the possibilities for utilising experiences and results of cooperation in ESRO will be greater if a national investment is made in space research. As can be seen from the reports delivered thus far for ESRO's scientific programme, it also depends on the establishment of national activity. Through participation in European space research cooperation, resources should thus be made available for Swedish space research.

However, in deciding the size of those resources, the Minister for Education and Culture, who was probably speaking for the Minister for Finance, Gunnar Sträng, stated that "in my view, consideration should be given to the relatively very sizeable economic investment which is expected to be made by Sweden within the framework of the European space cooperation organisation". Furthermore, the issue of coordination between Swedish space research and ESRO was still unclear. An appropriation of SEK 1 million was therefore recommended (see page 86) – as has already been mentioned, the Space Research Committee had requested 2.5 million.

Lastly, the Minister for Education and Culture addressed the question of a commission of inquiry into the organisation of space research in Sweden. Special expert advice was required for the purpose. Attention should be given to the following problems:

The committee should investigate the organisational form for conducting Swedish space research – for example attachment to one or more research councils or establishment of a separate research council – which can be judged most suitable from a variety of points of view. In this connection there should also be an examination of the issue of the most appropriate form for coordination of Swedish research with activities within ESRO and other international space research bodies, for example within the United Nations. The committee should also present at least an outline of the longer-

term prospects of Swedish space research and give alternative cost estimates for this. The proposal made by the committee on various points should be formulated having regard to the obvious interest which Swedish industry has in this respect.

I consider it appropriate that the national committee which should be convened if these recommendations are approved, in addition to its investigative function, should also, on a temporary basis, have the task of holding and distributing the abovementioned appropriation to Swedish space research.

The fact that the committee was able to hold its own research appropriation did not mean that any decision had been taken on the future organisational form, the Minister finally added for the safety's sake.

Brunberg's August guidelines envisaged a space research council. The commission of inquiry would examine its organisation and working methods. Now the Minister was keeping the matter open by also suggesting the possibility of attachment to existing research councils. That idea would eventually play a fateful role.

Matters proceeded quickly in the Parliament. No motions were introduced. There was merely a brief debate in the lower chamber. The Stockholm communist Johansson called for "vigilance" and warned that accession to ESRO would be one step towards the Atlantic Pact and "away from the path of non-alignment and non-alignment". On 9 May the chambers decided to approve Sweden's accession to the ESRO Convention. It only remained for the government to implement the Parliament's decision.

This was done on 14 June 1962, when representatives of Belgium, France, Italy, the Netherlands, Switzerland, Spain, Sweden, Great Britain and the Federal Republic of Germany met in Paris and signed the Convention. Later, the Convention was also signed by Denmark and Austria, although Austria would back out before it entered into force. It was Hulthén who signed on behalf of Sweden – "the only time in my life when I was able to act as a 'plenipotentiary' for the Kingdom of Sweden", he explained.

However, this should not suggest that the Convention had thus entered into force. It first had to be ratified by at least six of the eleven signatory states whose budget contributions also had to amount to at least 75% of the agreed scale of contributions. The six states had to include those on whose territory an ESRO facility was planned, i.e. France, the Federal Republic of Germany, Italy, the Netherlands and Sweden. Pending the completion of the ratification procedures, which would take almost two years, COPERS was still in operation. Legally, this was possible by repeatedly extending the Meyrin agreement. Before ratification, Sweden would await the result of the commission of inquiry on space which had been announced.

When the Space Research Committee proposed an inquiry, it was envisaged that it would be done very quickly and that the findings could be presented together with the ESRO

Convention in spring 1962. It can be seen from Löwbeer's revised version of the draft sent to him by Brunberg in August 1961 that the Ministry was not ignorant of this. It stated that the findings of the inquiry would be presented before the end of 1961. It was realised very quickly, however, that this was entirely unrealistic. As we have seen, it was decided instead to include instructions for the inquiry in the bill and, as an interim measure, allow the prospective committee also to hold the appropriation which national space research required in order to be able to continue the experiments which had been begun.

The bill did not address the composition of the commission of inquiry. When the Space Research Committee came up with the idea, it envisaged a committee consisting of representatives of science, technology, defence research, industry and international commercial and economic interests. In March 1962 Löwbeer asked Hulthén to propose names – there should not be more than seven members. In his response, Hulthén pointed out that, of the seven, "at least three, preferably four" should be researchers, because the committee would also act as a research council. He suggested Hannes Alfvén and Bertil Lindblad as the representatives of space physics and astronomy as well as "one other researcher". From industry, Lars Brising should be included – he had recently become chairman of the newly formed Working Group on Space Technology of the Swedish Association for Metalworking. The FOA should also have a representative. The practical space applications should not be forgotten either – Håkan Sterky from the Telecommunications Administration was an obvious candidate, together with a representative for meteorology. Aeronautics should preferably also be represented through the Aeronautical Research Institute (FFA). Lastly, Funke should be included, since his experience of research administration was required.

The government largely followed Hulthén's suggestions. Three researchers were appointed, Alfvén, Lindblad and, of course, Hulthén himself. However, only Sterky was chosen from the applications side. On the other hand – and this is interesting to note – the influence of industry was strengthened with the appointment of Jacobaeus in addition to Brising. Thus, both SAAB and LM Ericsson had a foot in the door of space activity. The FOA and the FFA were not included. However, Funke was evidently indispensable in an inquiry of this kind, since he had great experience of international research cooperation.

A chairman was also required and it had to be a person who stood outside the various party interests, but who had experience of government policy and administration in an international context. An ideal man was found in Gustav Cedervall, a county governor, with a past as a head of division at the Ministry of Finance and as Undersecretary of State at the Ministry of Trade.

Fremlin was called in as an expert for the inquiry and was later joined by Bolin and Hultqvist. Brunberg became the secretary.

The instructions for the inquiry were identical to those stated in the bill.

The space bill of 1962 was the founding document for Swedish space activity. It signified recognition by the government of space as a resource to be utilised. Sweden was prepared to enter into European cooperation and, for that purpose, national activity was required. It was also prepared to collaborate in a European launch base near Kiruna, which signified recognition of the natural resource represented by the country's geographical location in a space context. In addition, the government and the Parliament had drawn up instructions for the ESRANGE negotiations and for the imminent inquiry.

With hindsight, it appears remarkable that the fundamental issue of membership of ESRO was not referred for consideration by the interested bodies. Only authorities and organisations which were directly affected by the attendant issue of ESRANGE were able to comment. It would later be said, certainly, that the government slipped Sweden into ESRO by the back door, without the affected university and research authorities having the opportunity to say what they thought. Certainly there was the defence that accession to the organisation took place only when the Convention was ratified, which was done only in 1964, after the space inquiry had been referred for general consideration. However, from a political point of view, a defection was then quite impossible. In practice, Sweden joined ESRO when it signed the Convention.

The serious time pressure necessitated the bold step of outlining a draft Convention which had not been finalised. When the Minister boasted of the efforts of the Swedish delegation in the negotiations on voting rules, in reality the good results of the negotiations were only preliminary. This cannot be seen in the bill. During the continued negotiations in COPERS the issue of voting rules arose time and again. In April-June 1962 the sensitive issue of cooperation with other organisations, i.e. ELDO, was still being discussed. One wonders what would have happened if the results of the negotiations as described in the bill had not held firm during the difficult discussions regarding the location of the various ESRO facilities, which lasted for the entire spring of 1962. It was not possible to be certain until the ink on the signatures on the Convention had dried on 14 June. The government made a bold move – one suspects that the man behind this was the skilful administrator Löwbeer, who was not afraid to be daring if such action was required. The decision to take a chance rather than wait, thereby making ESRANGE more difficult, or perhaps impossible, proved to be correct and it was not necessary to withdraw the bill, which would obviously have been awkward. The final text of the Convention certainly differed in a few not entirely insignificant respects from the text which was presented to the Parliament. From a practical political perspective, however, the differences were minor, at least as far as Sweden was concerned.

The 1962 bill does not contain much by way of the reasoning behind the Swedish space commitment. Nor does it place the space activity in a broader international context. However, there was no doubt that participation in ESRO had been judged from the point of view of not only research policy, but also foreign policy. In August 1961, as has already been mentioned, the Prime Minister Tage Erlander had given his EEC address – Sweden would not join the EU, or the EEC as it was then called. However, in making that declaration, it was also important for Swedish foreign policy to appear as European as possible in all areas where it was possible without involving the element of military or

non-alignment policy. Peaceful European research cooperation was ideal from that point of view. The above-mentioned note by Löwbeer regarding the statement by Foreign Minister Undén at the government preparatory meeting on space is illuminating – “we can’t be outside”.

Two papers from the same period provide a good complementary picture – an article by Lamek Hulthén from spring 1962 on ESRO’s programme and a briefing paper on current space issues which Axel Edelstam gave to Foreign Ministry staff in the autumn of 1962.

Edelstam recalled that space technology had become “one of the key elements in the race for world supremacy between the superpowers”.

Who could have suspected five years ago that, during this short space of time, nine men would have made journeys in space, that we would be able to transmit television programmes via satellite from the American continent to the European and vice versa, or that we would be able to obtain detailed information regarding the Moon and even the planets Venus and Mars using space vehicles.

The Americans had been prepared to allow developments to be directed by the technical and scientific advances which had gradually been made, he continued. Manned space travel therefore occupied a “fairly modest position” in the US programme. The Russians, on the other hand, based their activity on a highly “selective” method. In the allocation of research resources, prioritisation was done on the basis of the political value of the various areas.

The Russian successes in manned space travel are consequently considered to be based on a clear and early declaration of intent by the government to make space research, and in particular the aspects of it which are connected with “man in space”, a national effort. At the same time, it is obvious that the Soviet Union would not have achieved its successes in this area if it had not had available a very large supply of scientific resources in the form of trained technicians and functional research institutes, together with an effective organisation with the capacity to direct those resources towards the objectives set by the politicians.

After then describing the Soviet and American manned space programmes, where the American’s aim was a Moon landing, he observed that for some time the Russians had enjoyed a lead which they would probably do their utmost to maintain. Everything suggested that in the next twenty years they would concentrate their efforts on manned space travel, not only to the Moon, but also to Mars and Venus. The reason for their successes was said to be that they had made greater advances in rocket technology than the Americans.

Nevertheless, Edelstam pointed out, the American successes in other important areas should not be overlooked.

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One need only point to the Telstar communications satellite, which represents the opening of a new era, which will revolutionise long-distance communications technology. In addition, there are the Tiros and Nimbus weather satellites, which make it possible for the first time to map the world's weather conditions from space and through which it is expected that considerable savings will be made as a result of improved forecasting and earlier detection of, for example, icebergs and typhoons at sea and forest fires in remote areas.

With the benefit of hindsight we can see that it became these more down-to-Earth applications which would dominate over the next twenty years. They would deglamourise space technology and make it a part of everyday life. Even such a spectacular undertaking as the American Moon landings became ancillary.

Edelstam also reported that the Telecommunications Administration had now taken an interest in developing space communications. The telecommunications boards in Denmark, Norway and Sweden had recently formed a joint committee, the Scandinavian Communications Satellite Committee, whose tasks included looking into the possibility of setting up, in cooperation with NASA, a joint Scandinavian ground station for satellite communications.

In addition, Swedish industry had formed the Swedish Association for Metalworking "Working Group on Space Technology", which formed part of the newly formed European industrial organisation, Eurospace. Those interested on the Swedish side were Saab, LM Ericsson, AGA, ASEA, Flygmotor and Bofors.

As regards the situation in Sweden, Edelstam pointed out that "only with the decision by this year's Parliament can Swedish space research be said to have started an independent existence". The Vidsel tests were described, as were the ESRO Convention and ESRANGE.

It is interesting to see what Hulthén wrote. Anyone reading the bill might perhaps at times be led to believe that ESRO sought to centralise European space research. However, Hulthén straightened things out – it was quite the opposite, he pointed out. There was a need for joint technical resources which cooperation would provide. The scientific work – "planning of experiments, work with scientific apparatus, theoretical treatment and publication of results obtained" – would normally be done by various research groups in Europe at their institutions. ESRO's most important task would be "to organise and pay for engineering work" and coordination of payloads in sounding rockets and satellites. "Since ESRO is a scientific organisation according to its purpose, it will therefore be highly technical in its practical outworking".

He stated that only sounding rockets would be launched from Kiruna. For satellites and space probes, ESRO would have to rent bases outside Europe. "It is expected that each launch will cost as much as the rocket itself, which can be estimated at SEK 5 million for a small satellite and SEK 11 million for a space probe or a large satellite". Even with the

value of money at that time, the economic optimism within ESRO appears extremely high. However, in fairness, it should be added that there had been no experience on which to base calculations.

The comment that no satellites would be launched from ESRANGE was certainly needed. The press were circulating highly imaginative stories. Stockholms Tidningen thus claimed on 27 February 1962 that, during the first few years, 450 Arcas rockets would be launched, together with ten or so satellites. Wilfrid Fleisher, the Stockholm correspondent of the New York Herald Tribune, displayed even more imagination – he appeared to believe that the entire ESRO programme would be based in Kiruna.

On 28 February, under the headline "Rockets for Peace in Far North. 11 Nations to Build Base in Sweden", the following appeared:

Sweden is to build a rocket base, a sort of Canaveral, near the town of Kiruna, in the far north of this country above the Arctic Circle, to launch a series of rockets and satellites according to plans worked out by the eleven nations represented in the European Space Research Organisation.

The project calls for an expenditure of \$ 300.000.000 in eight years and for launching of two Moon satellites, four space laboratories, thirty-six globe-circling satellites and 450 altitude rockets.

The local inhabitants would be moved away, he reported lastly. The picture "appears a little exaggerated – doesn't it", noted Ambassador Jarring in Washington drily, when he sent the press cutting to the Ministry of Foreign Affairs.

A few days later, both the Swedish and American press had been read in Moscow. On 3 March the Sovyetskaya Rossiya newspaper reproduced some of the imaginative stories. The articles closed by expressing fears that the NATO powers would, through their representatives in ESRO and "against the good intentions of the Swedish government and the Swedish people", exploit "the rocket range in Lapland kindly made available by the Swedes" for their own purposes.

If one takes into consideration that eight NATO member countries are in ESRO and that a ninth country is Franco's Spain, the balance of power within the organisation is obviously not in the favour of the non-aligned countries. How can we know whether or not those aggressive powers will attempt to upset Sweden's non-aligned position – in recent years many "technical" means to undermine that position have been attempted. Is the idea of a European Cape Canaveral in neutral Sweden, close to the borders with its neighbouring states, possibly another such means?

In his briefing paper, Edenstam stressed that there must be two guiding principles to direct the Ministry in assessing all forms of Swedish participation in international space cooperation. On the one hand, it must not have any military connection. On the other, it

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must be fully open on all levels – the data processed must be open and made available internationally. ELDO could represent a problem in this respect. If ESRO required its own launch vehicles, it was “particularly important” that the organisation had “a fully independent position in relation to ELDO” and made its decisions on a commercial basis. “We believe that, if ESRO requires satellite launchers, tenders must be invited from all places they can be purchased” – including the United States.

It is apparent that the Swedes were not interested in the French ideas of European independence in space – if they were aware of them at all. The position described by Edelstam would serve as guidance for Swedish activities in ESRO throughout the 1960s.

Negotiations with COPERS

In his briefing paper, Axel Edelstam reiterated the points of principle put forward in the proposal that the ESRANGE rocket base be built on Swedish soil.

The most important condition for the establishment of the launching range, as far as the Swedish government is concerned, is that restrictions on sovereignty must not be allowed and that there must be no restrictions on individual personal freedom which conflict with or are contrary to Swedish legislation or legal practice. Furthermore, the Swedish government must reserve the right, if national interests so require, to have a satisfactory control of activities and be able to review the lease, if significant changes in circumstances occur, for example as regards the extent of activities.

The Swedish side in the negotiations with COPERS on ESRANGE was represented by the Ministry of Foreign Affairs. Karl Sidenbladh, a court of appeal judge, was appointed as head of the delegation for the negotiations. After some time, however, he had to stand down on account of new responsibilities – he had become president of the Court of Appeal for Upper Norrland. He was then replaced by another future Court of Appeal president, Sture Petrén, head of the Legal Division at the Ministry of Foreign Affairs. The other members of the delegation were Carl Bergensträhle, Axel Edelstam and Bo Kålfors from the Ministry of Foreign Affairs, Rune Fremlin and Jöran Mueller from the Ministry of Education and Lamek Hulthén from the Space Committee. In addition, Bengt Hultqvist was attached to the delegation as adviser.

Before Sidenbladh stood down, he had time to visit the COPERS secretariat in Paris and hold discussions with a few of the officials there for two days in April 1962. The meeting was to take stock of the issues. Sidenbladh explained Swedish law as regards lease of land, building on non-freehold property, right of access to private land, differences between public and private roads etc.

Sidenbladh's report gives the impression that the problems were not particularly great and that it should be possible to resolve them without great difficulty. On his return he produced a first draft agreement. After being scrutinised by the ministries and authorities concerned, and subsequently by COPERS, the proposal was able to be used as a basis for the negotiations.

However, things did not go so easily. On 22-23 October 1962, a negotiating delegation came from COPERS to Stockholm and met at the Ministry of Foreign Affairs with the Swedish delegation, now chaired by Petrén. The head of the COPERS delegation was the future technical director Lines and his colleagues included Vandenkerckhove and the lawyer Hans Kaltenecker. Lines was known for his arrogance and Kaltenecker for his stubbornness. Not even Sture Petrén's great personal charm and brilliant diplomatic and

legal skill could prevent the negotiations from becoming stuck in detail. It would be nearly two years before the agreement could be signed. It should be added, for the sake of fairness, that it was not only COPERS that was being awkward. The Swedish delegation also had concerns over the Lapps and land owners, who tended gradually to increase the amount of compensation they demanded. Ultimately it was ESRO that would be responsible for the compensation and there was a widespread notion that the organisation's coffers were inexhaustible.

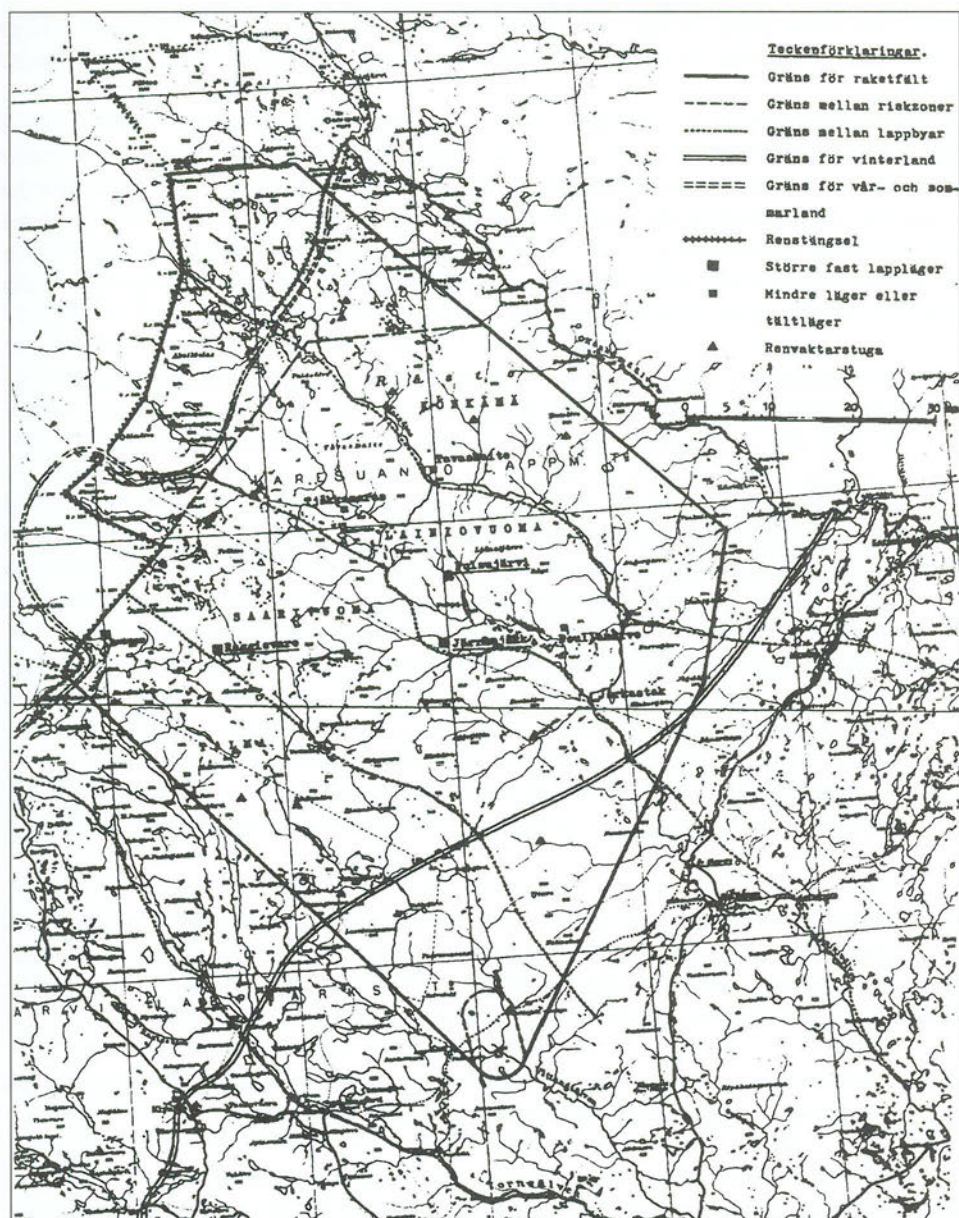
The Swedish demands for control and retained sovereignty were met with understanding and could be included in the agreement without any great difficulty. On the other hand, there were other points which were more difficult and which were dealt with time and again at a series of formal and informal discussions between the two delegations. The term of the agreement was one such stumbling block, as were the maximum number of launches each year, safety measures and compensation for the Lapps and land owners.

The Swedes took the view that the agreement could not run longer than ESRO's first eight-year period, which was guaranteed financially through the signature of the convention. During those eight years, the member states did not have the right to leave the organisation. After that period had expired, in theory, anything could happen and Sweden did not want itself left with responsibility for the facility. The COPERS delegation agreed that anything could happen after the eight years, but drew the converse conclusion – what if Sweden no longer wanted to have the rocket base in its territory and decided to throw ESRO out? The organisation would feel more safe with a fifty-year term of agreement.

The Swedish delegation got what it wanted. For a period of eight years and for an annual charge of one Swedish crown, Sweden leased the base area itself and land for receiver and transmitter stations. In addition, Sweden permitted the "safety area", the precisely defined zones A, B and C, to be used as the impact area for rockets, payloads or balloons which were launched from the base area. After the first eight years, the agreement would be automatically extended for further three year periods, unless one of the parties gave notice of termination. The Swedish delegation also stated in a separate letter to ESRO that it was prepared to guarantee that the government had no intention of limiting the term of lease to eight years.

As regards the annual number of launchings, COPERS maintained that it was a matter that the organisation, and not the Swedish government, should decide. The Swedes pointed out that the Parliament had been informed that there would be a maximum of 50 launches per year and that had also been the basis for the negotiations with the Lapps and land owners – because of the involvement of the Parliament, they could not give ground on this point. The COPERS delegation took the view that 50 rockets per year was a much too low figure which would seriously check the development of ESRO's programme. The entire scientific programme would be jeopardised because many satellite experiments would first be tested on board sounding rockets and in a few cases perhaps actually developed into sounding rocket experiments. However, the Swedish delegation did not give way and COPERS reluctantly had to accept the wording of 50 rockets "on average per calendar

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ESRANGE – map showing base and impact areas. Bill 1962:85

year”. It appears optimism was still high – with hindsight it can be observed that, in total, ESRO launched 152 sounding rockets during the six years in which it was responsible for the operation of ESRANGE. 50 rockets were never launched in any single year – the most was 40 in 1971. It should however be added for the sake of fairness that, as experience increased, so did the scientific requirement for payloads; they became heavier and

technically more sophisticated and required longer for preparation, which may have contributed to the total number of launches not being as great as had originally been thought.

Another contributory factor may have been a development which appears to have begun just as the ESRANGE agreement was being negotiated. Since 1961, Auger had gradually developed the prospective ESRO organisation – the various delegate committees and the secretariat. As it was beginning to find its feet, the planning of the scientific programme was intensified. In the spring of 1963 Fremlin complained that the secretariat's interest in the Kiruna project had cooled off. He thought that the main reason was that "there has been a shift in the entire scientific programme".

It is hoped to use ESRO for advanced space research and, with the developments which have taken place since the scientific programme was first drawn up, experiments with high-altitude rockets now tend to be regarded as a more marginal activity for ESRO, for which existing facilities can be hired. In addition, of the tests in the northern auroral areas which were planned, probably 9/10 are of the kind where it is not necessary to recover the nose cone. This means that, for example, the Andöya base could be used and it would thus perhaps not be necessary to set up a rocket base in the Kiruna area for around SEK 55 million. I believe that it is considerations of this kind which are the real reason why there has recently been a somewhat negative attitude on the part of the secretariat, one of the consequences of which is that Sweden is requested to provide specification as low as SEK 500 for estimated expenditure, while the organisation is prepared to find lump sums of 1.5-2 million for the base facilities in Sardinia with a view to the proposed rocket launches at the beginning of next year.

Fremlin's analysis is interesting. Back when the Blue Book was drawn up, a few voices were raised in favour of ESRO concentrating on satellites. Those voices had never really gone silent. There is much to suggest that the developments which eventually led to the discontinuation of the entire sounding rocket programme began at this time.

The atmosphere between the two delegations was not the best. Another bone of contention accompanied the negotiations and certainly did not improve the mood.

Both sides were keen to start building the base. Therefore it was agreed in November 1962 that the Swedish State would begin construction of access roads to the base area. The costs, estimated to be FF 470.000 at most, would be reimbursed by ESRO as soon as the Convention entered into force.

This did not present a problem. However, it was also important to set in motion the actual planning of buildings and other facilities at the base. On the instruction of COPERS, Hulthén and Hultqvist approached seven Swedish engineering firms in September 1962 and asked them to provide an estimate of the time and costs for that work, on the basis of the information regarding ESRANGE contained in the Blue Book. The results showed

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clearly that Orrje & Co, which the Space Research Committee had engaged for certain studies the previous year, was able to carry out the work in the shortest time.

It was therefore natural for Hulthén to recommend Orrje in October 1962. However, on 1 November Lines had taken over as technical director of COPERS. He was always very prestige-conscious and it evidently wounded his pride that such an important matter should be decided merely on the recommendation of the Swedish delegation. He rejected the information in the Blue Book and arranged for the production of a brochure with information on the requirements which should be laid down. On the basis of that brochure he initiated, from scratch, a standard tender procedure. When this was realised by Hulthén in January 1963, he wrote a critical letter to Lines and pointed out that if Orrje & Co had been commissioned to carry out the planning in November 1962, work could have been started in summer 1963. As a result of the secretariat's slow action, there was now the risk of losing a whole year.

Lines was furious at the criticism and, in a bitter letter, replied that it was unacceptable to decide the project contract on the basis of the Blue Book and that it was he and – implicitly – not the Swedish delegation that was responsible for the handling the matter. Eventually – but, as will be explained below, not for some time – he ensured that it was not Orrje, but Allmänna Ingenjörbyrå (AIB), which was awarded the contract. His pride was thus salvaged. But Hulthén was right; there was a delay of a whole year. Work could not begin until summer 1964.

On the whole, there was a distinct lack of understanding in COPERS of all the difficulties involved in planning ESRANGE. In a letter in spring 1962, Hulthén attempted – without great success – to explain this to Auger.

I am afraid you underestimate the scope of organising involved in placing 5600 square metres of Swedish territory at the disposal of an international organisation. ... There is a whole complex of questions concerning for example compensations asked for by the Lapps and safety measures for them as well as for tourists, fishermen, sportsmen and hikers; roads, telephone lines, shelters, radio and optical warning systems, liaison with local officers and authorities.... All these questions must be handled by a local responsible officer who knows what to do and whom to approach and this 'man on the spot' must have real responsibility and power to take decisions. He should not have to telephone to Paris every time a foreman asks him if he should lay a new culvert somewhere under the road or whether a telephone line should be drawn this way or that way.

When the secretariat finally came to appointing a director for ESRANGE, they did exactly the opposite of what Hulthén suggested. A local candidate was rejected; they wanted a technician and a French air major, Albert Le Bras, was proposed, "a NATO officer" as Fremlin put it with a shiver in his voice. Among his merits was the fact that, while serving in the Sahara, he had proved himself able to handle the fierce north African Tuaregs and, consequently, could be presumed to handle the similarly fierce Lapps. In March 1963

Le Bras was appointed, even though the Swedish delegation registered a reservation with regard to the decision. Formally, there were no objections, but it must nonetheless be regarded as quite without parallel to ride roughshod over the Swedish delegation in a matter which so closely concerned Sweden, as the host country. It also shows a lack of psychological awareness since the secretariat must have realised that the ESRANGE director would have his hands full dealing with the Swedish delegation.

Another cause of the cool attitude of the secretariat was the Swedish safety requirements, which were based on a maximum rocket altitude of 150 km with an average payload of 50 kg which would result in an impact risk of 0.7% outside the range (see page 83). Bert Bolin raised the alarm about the scientists' concerns over those requirements after a meeting in Paris in March 1963.

At the committee meeting there were further discussions of the restrictions on the scientific projects which would be faced if launches from a range such as Kiruna were limited to altitudes below 150 km. There was a large consensus that a very considerable proportion, even the majority, of the major scientific programme would be jeopardised and the committee made a resolution in which that view was clearly expressed. Questions were raised from several parties whether another launch range, such as Andöya, was preferable. In addition, in practice, all tests with instruments intended for satellites would be frustrated if launches could not be made to altitudes higher than 150 km and that fact eliminates one of the reasons for actually establishing a rocket base at Kiruna. In view of this, discussions are currently in progress concerning the possibility of using other bases for the 1964/65 period. The main options are Sardinia, the French base in the Sahara, Andöya in Norway, some temporary bases in Greenland and Fort Churchill in Canada. Talks will be held this month with Italy and Norway on rocket launches.

But, even at the COPERS plenary session in February 1963, Auger had complained about the "abnormal" Swedish requirements which, from a scientific point of view, were highly unsatisfactory – 150 km altitude was too low and meant that ESRO would not be able to implement the programme as planned. An analysis of the experiment proposals which had been received showed that the great majority required altitudes of 150-200 km, and in some cases up to 300 km.

Auger closed by asking whether, with these restrictions, it was even worth setting up the range. In addition, it was expensive, shelters and the special requirements resulting from reindeer herding – special roads, launch-free periods etc – were costly. A lengthy discussion followed. The result was that, for the time being, the secretariat was not authorised to begin the planning and, moreover, was instructed to present new studies of the technical capacity of the range, including the possibility of using other bases, for example Andöya.

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At the same time, the COPERS secretariat had begun a discussion regarding the possibility of beginning operational activity before the ESRO Convention had entered into force – the scientists were anxious to get started and the Convention had been delayed. At first, it was proposed to launch sounding rockets from Salto di Quirra in Sardinia, which Italy had offered once again as an ESRO facility. Fremlin suspected that Salto di Quirra might be a NATO base, which in itself made it doubtful as far as the Swedes were concerned. The secretariat thought that it could find the funds for the necessary investments on Sardinia in the ESRANGE budget, an attitude which understandably concerned and annoyed the Swedish delegation. The Swedes could, if absolutely necessary, contemplate some investment in Salto di Quirra, provided ESRANGE did not suffer. However, they fiercely opposed all operational activity before ESRO had been formally launched; the furthest they would go was operational preparations under the auspices of COPERS. Fremlin even went so far, in a rare critical statement, as suggesting that Sweden could not ratify the Convention if the operational activity had been set in motion.

It was in these circumstances that I attended my first ESRO meeting. During a meeting held in May 1963 with the Council of Europe Committee for Higher Education and Research in Strasbourg, I was called by Fremlin who asked me to step in for him at a meeting a few days later in The Hague of the COPERS Subgroup for Budget Matters. One of the main items on the agenda was the budget for ESRANGE. According to Fremlin, the secretariat would probably propose a transfer of money from ESRANGE to Salto di Quirra, which had to be opposed at any price.

I will never forget my feelings when I arrived. I was not unaccustomed to international work, but this was an entirely new world. The group was quite small and tightly knit. They spoke a language which was, to me, completely incomprehensible, a sort of “space lingo”, flaunting technical jargon which was impossible for a newcomer. The chairman was the Dutchman Hoogeveen, a kind and pleasant official from the Ministry of Education in The Hague. However, his gentlemanly benevolence was not adequate when the representatives of the secretariat, administrative director Crowley and technical director Lines, both Englishmen, came to speak. They were sure enough keen to make a deep cut in the ESRANGE budget in favour of investment in Salto di Quirra. There was a long discussion in which both men, in an extremely patronising tone, following an enormous lunch, informed the newcomer, quite unpleasantly, of the decision which had to be taken. My knowledge was not great, arguments deserted me, and eventually I could do nothing more than grasp the edge of the table and just say no, no, no. I remember that, in the end, the Italian delegate, Air Chief Marshal Cigerza, repeatedly hammered his head on the table in desperation at the idiotic Swede, who did not understand what was best for himself and the organisation, not to mention Italy. Of course, the discussion ended with the secretariat’s proposal being passed.

Back at home, I resolved never to have anything more to do with that unpleasant company. Fate would dictate otherwise, however. By September I was back, this time as chief delegate in the Administrative and Legal Affairs Committee.

The Swedish delegation took the view that the ESRANGE project was under threat and that something had to be done. Above all, it was important to formulate a new safety criterion. At first, the discussion still concentrated on the risk of impact outside the range. Hulthén was a good theoretician and in May 1963 he produced a timely proposal. He pointed out that, in the case of a rocket range which could neither be evacuated nor equipped with entirely safe shelters used at each launch, it was not logical to formulate the risk criterion on the basis of the chance of impact outside the range. It would be more accurate to "allow the assessment to be based on the risk that any person at all would be harmed, whether they are inside or outside the range". Weighing up the available information, such as population statistics, data on the normal frequency of tourists in the area and assuming a "hit area" of 10 square metres per person, there would be a risk level of lower than one in a million. Such a definition would enable rocket launches to an altitude of up to 300 km and thereby satisfy one of COPERS' chief concerns.

Hulthén's proposal was sent by Edelstam in an "aide-mémoire" to COPERS in June 1963. Now the matter was resolved and it was possible to agree on the following wording which would be included in an exchange of notes between the parties in connection with signature of the agreement.

... it is agreed between the Parties that in launching a single rocket, the risk of hurting any person, inside or outside the range, must not exceed one in a million, the cross section of a single person being 10 square metres. The risk calculation should be based on the latest population and tourist statistics available.

The safety measures themselves were seen by COPERS as excessive, but they had to give way. They were detailed and contained precise instructions regarding optical and acoustic warning signals, where and how notification should be given of imminent launches etc. The number of shelters –originally four, then six in Persson's report – was now up to "a maximum of 23", 19 of which should be built immediately. The shelters would offer "adequate" protection, which, for those who were used to read international texts, denoted that they were not safe against a direct hit. They usually consisted of a drum of galvanised plate-metal, half-buried in the ground and covered in earth or stones. In each shelter would be a stove, which would in due course make them popular as hunting lodges. In addition, in the protective shelters and at other sites in the impact area there would be no less than 250 light, portable radio receivers. It was typical of the way in which the young engineers in COPERS and ESRO worked – over-ambitious, very theoretical and very inexperienced and, in this case, with an excessive respect for the climate of Lapland, which was exotic to them – that when the receivers were to be purchased, specifications were drawn up to ensure that they would be able to operate at -40 °C and survive beneath 10 metres of snow. For that purpose a battery was required which was so large and heavy that the units were no longer portable. The simplest solution proved to be to buy normal radio equipment on the open market.

The Swedish demands for compensation were considered by Auger to be much too high. However, COPERS had to give way on that point too. They largely followed Lennart

Persson's proposal, albeit in somewhat revised form. The plan meant that ESRO would pay the Swedish State a certain amount which would then be passed on to the Lapps, land owners and others affected by the rocket range. Thus, a one-off sum of SEK 2.035.000 would be paid to fund the Pulsujärvi road to the Järämjokk Lapp camp, to erect some reindeer enclosures and to set up research into the life and culture of the reindeer herding people. In addition, an annual sum of SEK 80.000 would be paid to maintain the Pulsujärvi road, to compensate land owners for interference with hunting, fishing etc, to the village community of Soppero for their forest and to the Lapps for the reduction in hunting and fishing revenue, encroachment on the right of reindeer pasture and for theoretical reindeer deaths (see page 84). In the following years the Swedish delegation would regularly hear ESRO officials claim that Sweden had been greedy and that it should have been responsible for the compensation, if any compensation was actually necessary, which they very much doubted.

However, after the new safety criteria had been presented, things began to loosen up between the negotiation delegations in summer 1963. In October it was possible to reach full agreement. However, it was soon clear that the matter was far from resolved. Now it was the turn of the member countries to sink their teeth into the agreement.

And this they did with a vengeance. The agreement was not exactly transparent and the COPERS secretariat also failed to provide information regarding the discussions underlying the various wordings. Consequently, when it came to be analysed by the COPERS Legal Group, the poor Swedish delegate, Jöran Mueller from the Ministry of Education and Culture, became embroiled in a real ordeal of questions and arguments. The Lapps and lives, rights and customs of their reindeer were the subject of many questions. All the points which had been scrutinised by the two negotiation delegations for more than a year were given a fresh airing by the Working Groups' legal delegates, analysed down to the last detail and the last comma. In addition, the COPERS secretariat adopted a passive attitude during the discussions and was sometimes not even present. Two long meetings were needed – in total almost four days including evening sessions – before the lawyers had chewed their way through the agreement.

The British, headed by the administrative delegate Jim Hosie from the Ministry of Science, were particularly difficult. It was necessary for Mueller and Fremlin to travel to London in November specially to run through the agreement with Hosie and his colleagues at the Ministry.

Jim Hosie was a small, dark-eyed Scot who represented his country with great energy and even greater persistence. His was a sharp analyst and a skilful debater, something of a dialectician, who pushed his case as far as it would go, and, even when he could not, he still ensured that he at least had the final word. He was not unreasonable, however, and he had a characteristic which is not entirely common in international meetings – he was a very good listener. This meant that it was easy for him to tear empty arguments to pieces. But it also meant that – since he was a gentleman – he was not afraid to listen when he saw that there could be something in his opponent's reasoning. He was also a "friend to his friends" and a pleasure to be with at meal times or for a drink outside the sessions.

It is clear from the notes from the London meeting that both sides had to give and take, but Hosie undoubtedly had to give the most. After running through the agreement in London, things progressed somewhat more easily. The planning could be begun and, as has already been mentioned, the order was given to AIB.

The final version of the ESRANGE agreement differed only slightly from the text agreed by the two negotiation delegations. Sweden approved the agreement on 7 March 1964. ESRO's Council approved it at its first meeting at the end of the same month. It was signed in July in Paris – for ESRO by Auger and for Sweden by Olof Bjurström, counsellor at the embassy.

Now work could be started.

Kronogård 1962-64

The Plutnik launch in 1961 had shown that Sweden had the capacity and means to perform experiments in space. Now it was important to go further. The Arcas rocket which was launched from Nausta had been supplied by NASA. In the early autumn of 1961, Bolin was able to report to the Space Research Committee that there was interest on the part of the Americans in developing cooperation with a view to a rocket campaign in summer 1962. He had held discussions with Dr Robert Soberman at the Geophysics Research Directorate of the US Air Force regarding a series of experiments from the Vidsel range in which MISU research on noctilucent cloud would be coordinated with similar research conducted in Soberman's group. Kiruna Geophysical Observatory (KGO) was suggested as a third cooperation partner, more specifically for the experiment to investigate "polar cap absorption" for which Hultqvist had applied for funding (see page 73).

A plan had been agreed which consisted in carrying out experiments using four Nike-Cajun rockets – a two-stage solid propellant rocket which had a surplus anti-aircraft rocket stage as its first stage and which could reach an altitude of around 150 km with a load capacity of 40 kg. Two of the rockets would be launched when noctilucent cloud appeared, but the polar cap absorption phenomenon must not be present at the launch. The other two would be launched when conditions were the reverse. It would thus be possible to compare disturbed and undisturbed conditions.

On this occasion, the launches would take place not at Nausta, but at a civilian test range, made available by the National Board of Forests. They would also remain there for the following two summers. The pay loads would come down at an abandoned state forest rangers' residence, Kronogård, idyllically located deep in the forest on a small, bright lake close to the missile launch range. Because it lay outside the range, it was possible to avoid some of the military restrictions which had caused difficulties the previous year. The area was crown land and could be closed off for the course of the campaign with the help of the county administrative board. A road which could bear relatively heavy traffic led to Kronogård. There were also farm buildings which could be used as offices, stores etc. Telephone communications could be established to Kåbdalis, 14 km away, where there was a boarding school in which personnel could be accommodated. The Renkronan Inn at Vidsel, about 60 km from Kronogård, could also house a number of people.

In a special memorandum to the Ministry of Foreign Affairs, Bolin touched on the political aspects of the project. It would be implemented entirely under Swedish auspices, while the American support would be primarily in terms of equipment and instruments – NASA would supply inter-alia rockets and ground measurement equipment for tracking and telemetry. The experiments would have no military significance at all, he promised. All results would be openly available. Russian researchers had been invited to be present during the campaign. The tone of the memorandum is typical of the fear which existed at

the time that people would read military aspects into the project or that it would be seen to infringe the policy of non-alignment in some other way.

The Space Research Committee gave the all-clear in February 1962. The Institute of Physics in Lund was now also involved in the collaboration (Professor Sten von Friesen and Dr K Kristiansson). The costs of the whole campaign were estimated to be SEK 400.000, including personnel training in the USA, although the final bill came to SEK 459.000. In addition to Soberman's group, NASA's Goddard Space Flight Center also participated. The cooperation was regulated in a memorandum of understanding between NASA and the Space Research Committee. To be safe, the Ministry of Foreign Affairs had checked that it did not contain anything that was politically objectionable.

The MISU experiment (Bert Bolin and Georg Witt) consisted in passing rockets through visible noctilucent cloud. On reaching an altitude of 75-90 km, containers in the nose cone fitted with filters and sample collectors would be opened to sample particles from the cloud. After separation, the nose cone would come down in the missile launch range. The descent would be aided by spoilers and a parachute, while radar-reflecting aluminium strips would be released and signals would be triggered from a radio transmitter – SARAH (Search and Rescue and Homing), actually an emergency transmitter. The air force would carry out radar surveillance. Recovery of the load would be done by helicopter.



Kronogård – an old croft deep in the forests of Norrland. Photo: RTG

12. KRONOGÅRD 1962-64

The other experiments were intended to measure the flow and energy distribution of fast electrons in connection with the aurora borealis and magnetic storms (KGO – Bengt Hultqvist and Johannes Ortner) and to investigate the intensity and particle energy of cosmic radiation through exposure of photographic emulsions (Lund group). Using telemetry systems, the results of the measurements would be transmitted to the ground where they would be recorded by a tape recorder or printer.

Technology was largely the responsibility of the same space technology group within MISU as the previous year, albeit temporarily reinforced – the number of staff during the campaign rose to almost 50. Project leader was Lars Rey. Lennart Lübeck, who was granted leave of absence from national service by the air force administration, was responsible for the recovery operations. One 16-year-old trainee in the FOA rocket preparation group was Sven Grahn, who, with his wide knowledge and fine instructional skills in presenting the most complex problems in a comprehensible way, would become one of our country's foremost space technology experts.

The leap from the single Arcas launch in 1961 to the complicated experiments of 1962 was large and placed great demands on the group. However, they were enthusiastic and took pleasure in their work and it was a young and passionately interested group which came together in Kronogård in 1962. They felt that they really were pioneers in the true sense of the word and no problem existed which could not be resolved. Many of them had still not completed their college studies and, to them, the Kronogård campaign was an unusual, but ideal summer training practice.

Because there had been no earlier sounding rocket tests in the country, the group faced the task of borrowing or purchasing a considerable amount of equipment. During the campaigns of the following years – 1963 and 1964 – the degree of difficulty of the tests increased, which in turn created a greater need for new equipment. From the very beginning, it was consistently attempted to attain the greatest possible flexibility. It was possible before the 1964 campaign for example to find a caravan manufacturer who built six telemetry vans according to the group's specifications, in which all the telemetry instruments were fitted. They were also designed in such a way that they could be lifted by helicopter. Kronogård was a temporary arrangement and it would be simple to move the equipment from one site to another. The investments which had now been made were seen as a first stage towards a prospective Swedish launch site connected to ESRANGE.

The first Nike-Cajun went up on the morning of 7 August. The main objective of the launch was to take measurements of the aurora borealis – at the same time the equipment for studying noctilucent cloud could be tested. The rocket behaved as it should, separation took place when it should, but the parachute was not released. It was however possible to recover the fairly battered payload. The measurement results from the aurora borealis could be received without difficulty.

In the evening of that same day it was time for the Arcas rocket which should actually have been launched the year before. This time everything went to plan, the artificial cloud was released and could be observed for half an hour.



Home-made rocket trailer. Kronogård 1964. Photo: RTG

The task for the next Nike-Cajun which went up on 11 August was to sample particles from noctilucent cloud. On the whole, the launch went well, apart from certain problems with the measuring equipment and with the ground receivers for the SARAH signals. The particle sampling was a success. The next launch took place on 19 August and its purpose was also to sample cloud particles. However, this time things did not go so well. The nose cone did not separate from the rocket. The point of impact could nevertheless be located and the payload was recovered in a very disfigured state.

The final launch took place on 31 August. The primary aim this time was to study the aurora borealis and to test particle sampling equipment. Once again the nose cone refused to separate from the rocket. As a result of electronic problems, it was not possible to receive any data concerning the aurora borealis either.

The 1962 campaign was thus completed. Despite the problems – which were to some extent characteristic of rocket experiments during those pioneering years – it could be described as successful. The researchers travelled home with a large amount of data to process. The space technicians had now had their baptism of fire – they took home important experience which would serve them during the next two years.

In the summer of 1962 the commission of inquiry on space – or the Space Committee as it was called – had just been set up, but it had not yet begun its work. The Kronogård campaign therefore still ran under the aegis of MISU even though it was partially funded

by the Space Committee. However, the Space Committee had also been instructed to act as an interim research council. It was natural that it continued to be involved in the experiments and that it then had access to its own technical expertise. In autumn 1963 the technical group was therefore transferred to the Committee. The Space Committee Technical Group (RTG) became its official designation. It was headed by Lars Rey with Lennart Lübeck as his deputy. The group was gradually enlarged up to 1964 when it comprised, apart from Rey and Lübeck, the following permanent appointments – Anders Björkman, Robert Eide, Eva-Lisa Ljungblad, Johan Martin-Löf, Erik Söderdahl and Klas Änggård. During 1963-64, temporary appointments had also included Fredrik Engström.

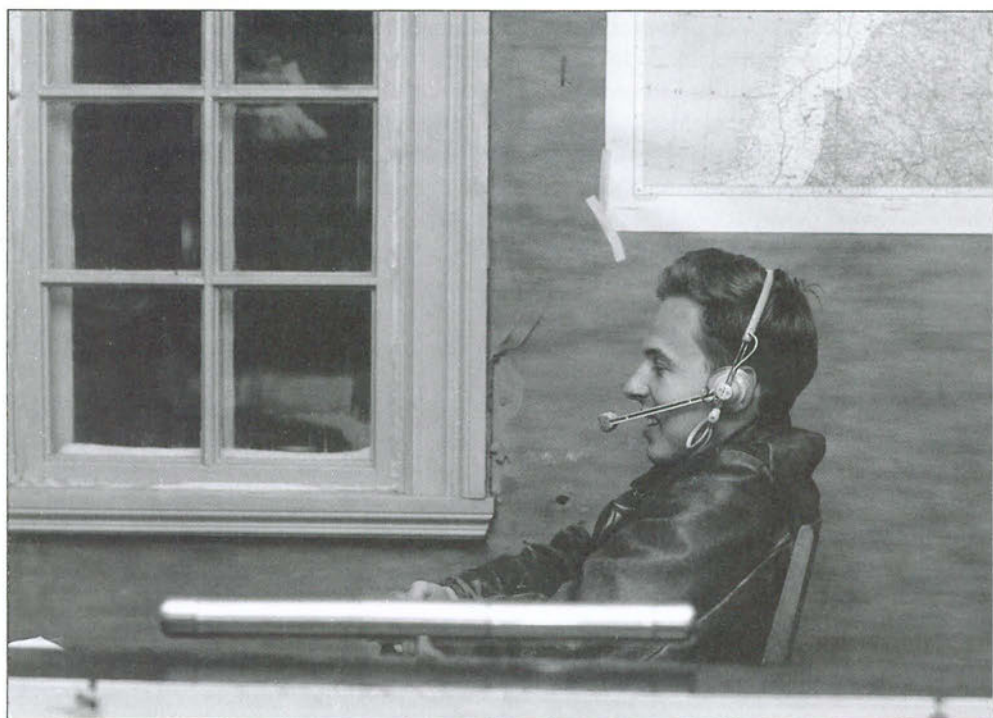
The campaign of 1963 was a success. The Space Committee was now responsible and had signed a new cooperation agreement with NASA. Only MISU conducted experiments that year and the aim was to determine the distribution of temperature and wind in the atmosphere at altitudes of 40-100 km with particular regard to the presence of noctilucent cloud. In the course of the period from 27 July to 7 August, four Nike-Cajun rockets were launched, two when noctilucent cloud could be observed and two when such cloud was not present.

Conditions that summer were favourable as there appears to have been a great deal of noctilucent cloud.

In the tests a new technique was used, the “sound grenade method”. A number of grenades developed by NASA and weighing 0.5 or 1 kg were discharged from a rocket at a certain altitude. The sound waves from the explosions were recorded by sensitive microphones on the ground. Using data regarding the time and position of the different explosions, it was possible to determine the propagation velocity and direction of movement of the sound waves in the altitude layer between two consecutive grenades. Since the sound velocity is dependent on temperature, it was possible to obtain the average temperature and wind strength in the altitude layer.



Lars Rey, project leader at Kronogård and head of the Space Technology Group during the 1960s. Photo: RTG.

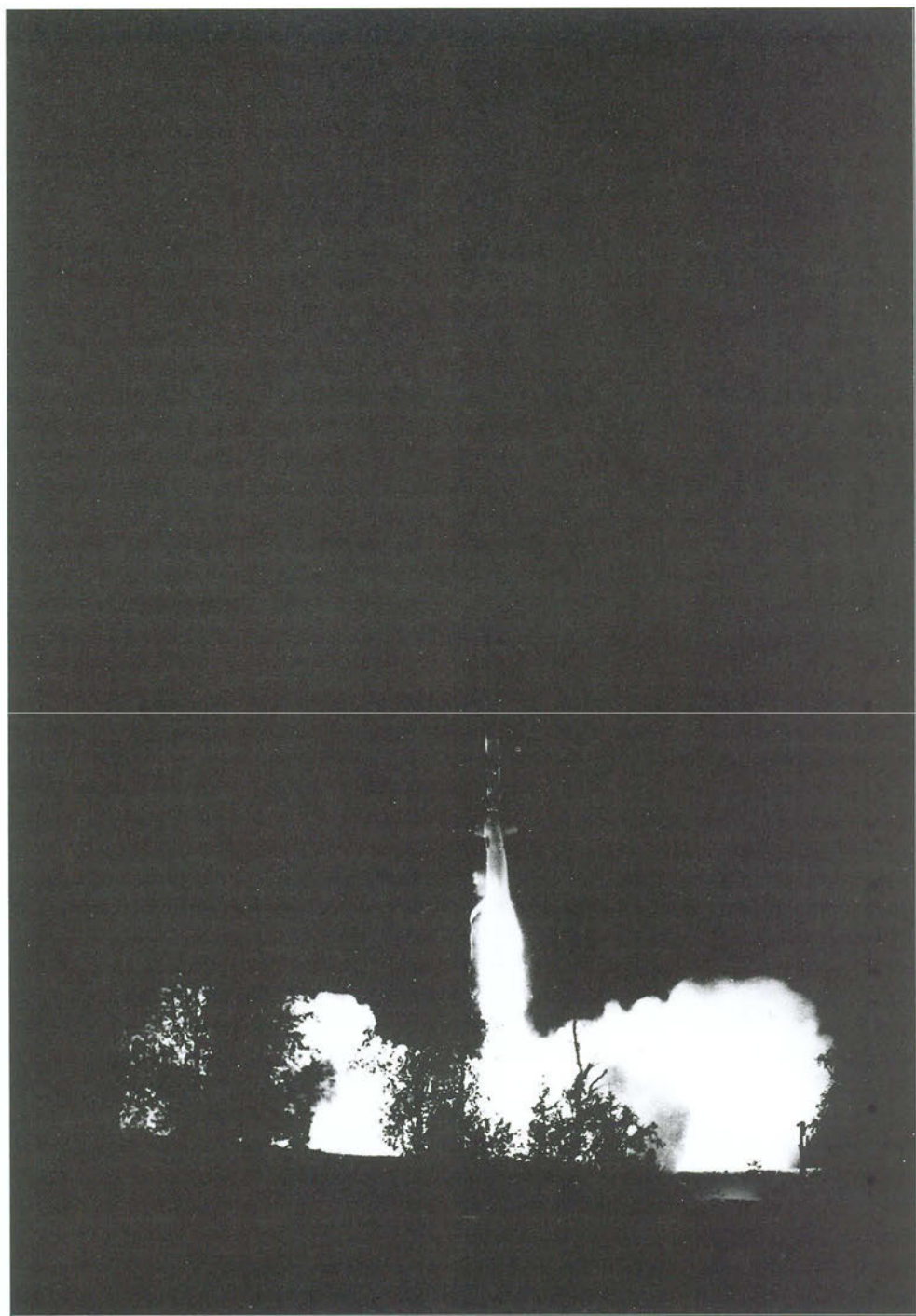


Lennart Lööbeck was there in 1961 when "Plutnik" was sent up. He later became director of the Swedish Space Corporation. Here he is listening intently during the Kronogård campaign in 1964. Photo: RTG

Wind velocity was also determined by photogrammetric measurement of the movement of clouds of smoke after the explosions. The experiments were conducted at dusk, but the smoke clouds were still lit by the Sun and could be observed more than one hour after the launch. In the case of one of the launches, they could be observed as far south as the Stockholm archipelago.

The results of the experiments showed inter-alia very extreme variations in wind strength – on one occasion 200 m/s was measured at 82 km altitude while, just 2-3 km higher, it was almost completely calm. In addition, extremely low temperatures could be observed where there was noctilucent cloud, on one occasion -143°C , which supported one of the findings of the particle sampling from 1962 – that the cloud particles were surrounded by a layer of ice. The temperature of -143°C was, according to the Guinness book of records, the lowest temperature which had been measured on Earth or in its atmosphere.

The summer of 1964 was the last at Kronogård. Administrative and economic problems were caused by the dissolution of the Space Committee on 1 July. They were resolved when the Natural Science Research Council and the Council for Technical Research agreed to cover the costs of the campaign, a total of SEK 1.5 million. MISU was once



Night launch at Kronogård in 1964. Photo: RTG

again able to take overall responsibility for the campaign and posts in the Space Technology Group were temporarily transferred back there. MISU and Soberman's group were responsible for the experiments.

The campaign was far more sophisticated than previous ones. The methods from 1962 and 1963 were combined. Four Nike-Apache and four Nike-Cajun rockets were launched in pairs during August to sample particles and to measure wind and temperature. The launches were coordinated with similar NASA launches from Fort Churchill, Wallops Station and Ascension Island. The four Nike-Apache rockets were provided free of charge by NASA, while this time Sweden paid for the Nike-Cajun rockets. The Nike-Apache was also a two-stage solid propellant rocket – it could take 22 kg to an altitude of 210 km.

When the experiments were conducted, the Nike-Apache rockets were equipped with nose cones which exposed special particle collectors at an altitude of roughly 70 km. Following separation, the nose cone was slowed down by a parachute. In order to be able to interpret the results correctly, it was necessary to know about the course and trajectory of the rockets. These were measured using the DOVAP (Doppler Velocity and Position) system developed by the Space Technology Group for the 1963 tests. For sound grenade tests, Nike-Cajun rockets equipped with a nose cone containing twelve grenades were used. All the rockets went up as planned, but the parachutes once again displayed a tendency to jam, which meant that one of the nose cones could not be recovered. It was not found until the following year.

Nevertheless, the campaign was a success both scientifically and technically. With the last launch on 17 August 1964, the Kronogård era of Swedish space activity was at an end. For a very low cost, in international terms, but with a great deal of effectiveness and enthusiasm, Sweden had developed a space technology capability in four years. The question was now whether and how it could be maintained. Against the background of the government's decision on space activity that same spring, the future looked gloomy.

The Space Committee of 1962

In May 1962 – one week after the Parliament took its decision on the space bill – the government appointed the Committee – see page 90 above – which would conduct an inquiry into the future of Swedish space research. As already mentioned, Gustav Cedervall became the chairman and Alfvén, Brising, Funke, Hulthén (vice-chairman), Jacobaeus, Lindblad and Sterky were appointed as members. Brunberg became the secretary. Fremlin was appointed as an expert with the unofficial task of keeping an eye on the Committee on behalf of the Ministry. Later, Bolin and Hultqvist were also called in as experts.

The instructions were concise – to investigate which organisational form the supervision of Swedish space research should take, either through attachment to one of the existing research councils or through the establishment of a separate research council. The forms of cooperation between Swedish space research and the ESRO programme should also be examined. In its proposals, the Committee should have regard to the interests of Swedish industry in the sector. In addition, the Committee should also act as an interim research council – SEK 1 million had been appropriated for that purpose under the bill for the 1962/63 financial year. SEK 2 million was allocated for 1963/64.

The first meeting was held on 1 June 1962 and it was primarily used for a survey of the sector. It was observed *inter-alia* that there were already two space bodies. The first was the Scandinavian Communications Satellite Committee which was formed in December 1961 by the telecommunications administrations of Denmark, Norway and Sweden. The second was the Working Group on Space Technology of the Swedish Association for Metalworking, which was formed in March 1962. The members were the telephone company LM Ericsson, SAAB, AB Flygmotor, Aga, Asea, AB Bofors, Sandvikens Jernverk, Standard Radio & Telefon AB, Svenska AB Philips, Svenska Accumulator, AB Jungner and the Axel Johnson Institute for Industrial Research. The list illustrates industry's attitude to space activity at the time – it was best, to be safe, to be at the fore in case something of interest developed. In the end, only three of the companies would develop in the space sector – SAAB, Ericsson and Flygmotor. The Working Group on Space Technology was a member of the Western European industrial association EUROSPACE, which acted as a point of contact with ESRO and ELDO.

There was also a description of the preparations for Kronogård 62. It was obviously easiest, from a formal point of view, to allow the Space Research Committee to continue during the campaign – the personal union was almost one hundred per cent. It was not until the turn of the year from 1962 to 1963 that the Space Research Committee was dissolved and its activities were transferred to the Space Committee. It soon emerged that the research council function required a number of decisions to be regularly taken and, consequently, a working party was formed within the Committee in May 1963 (Hulthén, Funke, Brunberg), which had the right to grant research and travel allowances to a maximum of SEK 5000. One of the first tasks of the working party was to grant Kerstin

Fredga SEK 900 to participate in the COPERS Summer School in Space Physics in 1963. It can be seen from the account which was eventually duly submitted that the grant was exceeded by SEK 35, a sum which the recipient presumably had to pay herself.

The Committee worked in direct contact with researchers and representatives of industry. In January 1963 a two-day conference was organised in Stockholm, at which research institutions and industrial companies described their plans and proposals. A report was completed in September 1963. It had been drawn up under the chairmanship of Hulthén – Cedervall had been unable to act as chairman since 19 February 1963 since he had been assigned to other duties.

The report began with an attempt to clarify terminology. As has already been mentioned, the words "space research" had often been used as a catch-all term for various types of space activity. The Committee now considered that the words "space activity" should now be used as a general term, covering "space research", the investigation of various scientific and medical phenomena in space, "space technology", the technology connected with sending up experiments and collecting data, and "space exploitation", the utilisation of space for public or commercial purposes.

Developments in the field, including fundamental research, and future applications in meteorology and telecommunications were referred to, as well as descriptions of civil space activity in various countries and the international cooperation organisations. The findings were summarised in the following table:

Annual cost of national activity					Contributions to ESRO and/or ELDO in million SEK	Total annual cost in million SEK
Nation	BNP in billion SEK	Million SEK	% of BNP	SEK per capita		
USA	2550	27000	1.06	150	-	27000
France	300	100	0.033	2.30	80	180
Italy	180	12	0.007	0.24	40	52
UK	320	70	0.022	1.38	130	200
West Germany	335	40	0.012	0.74	90	130
Belgium	62	1.8	0.003	0.20	13	15
Denmark	30	0.6	0.002	0.13	1.8	2.4
Netherlands	54	2.9	0.005	0.24	13	16
Norway	22	1.8	0.008	0.50	-	1.8
Sweden	81	2.0	0.002	0.27	4.4	6.4

The budget figures had been estimated using information for the 1963/64 financial year and the 1964 calendar year. The fees for ESRO/ELDO had been calculated on the assumption that ESRO's budget for 1964 would rise to SEK 90 million and ELDO's budget would increase to SEK 300 million. The BNP values were estimates for 1963.

13. THE SPACE COMMITTEE OF 1962

Comparisons of this kind should of course always be viewed with a certain caution and that applies in this case too. However, it still demonstrated something of the proportions of each country's space investment. It also illustrated in an alarming way the size of the American effort compared to that of Europe.

There was then a description of the results of a survey of current and planned space research in Sweden. It pointed to a great interest on the part of a number of university institutions.

Within the fields of astronomy and astrophysics, the Swedish National Committee for Astronomy had formed a working group which believed that, in view of its excellent traditions in stereo-radioscopy, Sweden should make an effort in that area. A fraction of the electro-magnetic radiation from different objects in the universe reaches the Earth, but now space technology had opened up new possibilities to obtain information through wavelengths which could not be utilised from the ground. The Uppsala physicist Arne Eld Sandström, together with the Stockholm astronomer, Professor Yngve Öhman, who was also director of the Swedish solar research station on Capri, had submitted to COPERS a proposal for a spectroscopic satellite investigation of X-radiation within the 1-10 Å region. Öhman had also submitted a sounding rocket proposal for the study of certain phenomena on the Sun's surface.

The working group stated that the following institutions were suitable candidates for future cooperative astrophysical research directed by and in close cooperation with the astronomical institutions in Stockholm, Uppsala and Lund.

There was optimism and there was even a dream in the longer term of a joint research centre with laboratories etc, perhaps in cooperation with geophysicists. The list of suitable areas of research which was drawn up was not detailed, but rather indicated guidelines for achieving a reasonably harmonious balance between theoretical research, practical experiments and instrument development. As regards the Swedish projects in

Institution	Field
Institute of Physics, Uppsala	Stereo-radioscopy etc
Uppsala Ionospheric Observatory	Self-recording spectrometry
Stockholm Institute of Technology, specifically the Optical Institute and the Institutes for Plasma Physics, Electron Physics and Microwave Technology	Detectors of various kinds (also infra-red), optical designs, measurement technology
Institute of Physics, Stockholm University	Gamma radiation, X-ray, lattice spectrographs etc
Institute of Physics, Lund and its Electronics Department	Gamma radiation, ultra-violet spectroscopy, measurement technology etc
Institute for Electronics, Physics and Telecommunications at Chalmers University of Technology	Measurement technology, X-ray analysis, image intensifiers for X-rays etc

COPERS/ESRO, there was a interesting comment which displays an openness to using the organisation as a forum for discussion and criticism.

It is now important to put forward new Swedish projects, so we should not be overcautious and wait until the instruments are almost operational, since the criticism often levelled at those putting forward proposals when the project is being considered can be very significant for its future shape. The most important thing is that the basic idea must represent a valuable and more or less original concept, and the project will perhaps then be given a better position on the waiting list.

Within the field of *radio astronomy*, the Råö Observatory concentrated *inter-alia* on solar radiology and meteoradiology. Institutions which were active in *cosmic physics*, which deals with conditions in space, such as particle density, electrical and magnetic fields, included the Institutes for Plasma Physics and Electron Physics at KTH, the Institute of Physics in Lund, the Research Group for Cosmic Radiation in Uppsala and Kiruna Geophysical Observatory (KGO). All had plans, which had been developed to varying degrees, to utilise data available from international projects or – particularly in the case of KGO – to conduct their own experiments on board balloons, rockets or satellites. KGO's primary area of research was in *ionosphere physics*, a field in which Uppsala Ionospheric Observatory also had a number of projects in progress. The Committee pointed out in particular that, during its short existence, KGO had already attracted international attention.

In the field of *meteorology*, the Meteorological Institute at Stockholm University (MISU) was intending to continue the studies of atmospheric temperature and wind conditions which had been begun at Kronogård. It was also planned to assimilate mapping of meteorological data by American satellites round the Earth, but at the same time it was observed that the use of satellites for weather forecasts had still not passed the experimental stage. The Institute emphasised – and one suspects the Space Technology Group here – that for “continuous experiments in meteorology or other areas of geophysics, there is nevertheless the need for permanent facilities connected to the Kiruna range”. Scandinavian cooperation should be embarked upon with the aim of launching around 60 small sounding rockets each year.

It was pointed out that *geodesy*, which studies the Earth's form, dimensions, mass distribution, gravitational field etc, was in itself a precondition for the execution of certain space projects, at the same time as it could utilise the technology itself. Both the geodetic institutes at Uppsala and at KTH and the Swedish Geographical Survey Office were planning experiments to examine methods for estimating distance and to study the Earth's form on the basis of stellar triangulation principles.

In the field of *space medicine*, the Aeromedical Department at the Karolinska Institute considered it important to study the physiological effect of accelerative force on performance. The interest of *space biology* lay in the study of the possible existence of living organisms in space and the micro-biological problems which might arise in

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connection with space travel. The interested institutions in this field were the Institute for Medical Cell Research at the Karolinska Institute and the Institute for Zymology at KTH.

It was primarily astronomers, meteorologists and geophysicists who envisaged a national experiment programme, including involvement with experiments in ESRO satellites and rockets, while other groups largely planned to utilise and process data collected from various international projects.

The list of interested institutions was relatively long, but to a certain extent the same considerations applied as to the industrial undertakings. A state committee was formulating guidelines for a future Swedish space programme. Fresh money would perhaps be available, since in the 1960s it was not like today that reforms have to be funded within the scope of the available budget. Obviously, in those circumstances, institutions wanted to push themselves forward and find out how they could join in and take a slice of the cake. When it later became apparent that there was no cake, interest waned on many sides.

The Space Committee itself pointed out that resources in Sweden should never be extended further than selective measures in certain areas where they were particularly good opportunities for Sweden to assert its position. In particular it highlighted astronomy, cosmic physics and geophysics as areas where there had been long traditions and rich experience on which to build.

In summary, the Committee recommended concentrating on the development of existing experimental and theoretical research in the above-mentioned institutions and also the initiation of new research which could be judged to be of scientific, technical or commercial value.

Ideas and wishes with regard to the *industrial aspects* of space activity had been put forward by the Working Group on Space Technology of the Swedish Association for Metalworking. The member companies' specialities were described and attention was drawn to the good reputation of Swedish industry for reliability and quality as manufacturers of precision instruments in many fields which could be expected to become relevant in the context of space (precision mechanics, electronics, optics). Naturally, there was a willingness to act as a supplier of equipment and apparatus. Swedish industry had also developed advanced propulsion systems suitable for low and medium-altitude sounding rockets, it was pointed out. AB Flygmotor had a liquid-propellant rocket engine and was in the process of developing a small ram-rocket engine. For its part, the Space Committee recommended continuing along the path taken and also ensuring utilisation of the by-products and spin-offs to which space activity could be expected to give rise.

In that connection, the Committee also recommended Swedish participation in future international telecommunications and weather satellite systems.

On that basis, the Committee submitted its *organisational proposal*. The shifting direction of space activity, touching on many fields of science and technology, required a central

authority to serve as the focus for all fields of interest, it was stated. The authority's "most important" tasks were summarised as follows. It should

1. follow developments in the space sector through contacts with both research and industry and other affected authorities at home and abroad;
2. assess future developments in the space sector and, on that basis, draw up guidelines for Swedish activity. In that connection, initiate research and technical development in new areas and support it in various ways;
3. be a service organisation offering space technology expertise, field test resources, a central laboratory, a department for data processing and documentation;
4. be the point of contact for ESRO and other international organisations;
5. be responsible for information exchange;
6. initiate training

When the subject moved on to how the authority should look, it was stated that by far the most important two tasks were the research council function and the technical services. By their nature, they were very different. It was therefore decided to divide the tasks into two and a proposal was made for the research council, the *National Council for Space Activity*, and a separate service body, a national *Space Institute*, to be set up on 1 July 1964.

The fact that the name Council for Space Activity and not Space Research was chosen shows that it was not only basic research that was considered to lie within the Council's remit. This is also clear from the proposal for its terms of reference, which stated that "the Council will promote research and technical development and associated activity for the exploitation of space".

The task laid down in the instructions for the inquiry of examining the alternatives of a merger with an existing research council or the establishment of a joint committee for several research councils was passed over fairly briefly. It was thought that the combination of research, technology and applications could not be found in any of the existing research councils and, therefore, that alternative was not appropriate.

It is of course conceivable that the allocation of appropriations for actual space research could be handled by the National Natural Science Research Council and that the Institute for Space could be subordinate to that research council as a service body for rocket experiments. There are, however, other important aspects of space activity for which such an organisation is less well suited: space technology research and development, the influence of industry and government, the interests of the administration, in general the commercial and public elements of space activity, the importance of which is likely to increase considerably over the next ten years.

As far as practical cooperation was concerned, the furthest it would go was a recommendation that the Council be based at the Wenner-Gren Centre in Stockholm, which was home to the other research councils and where they could be coordinated as

regards financial activity and the telephone exchange. Obviously, the Council would also be represented on the joint delegation of the research councils.

The Council's responsibilities were exactly the same as those set out in the organisational proposal, with the exception of the service functions. The Council would consist of a chairman and a maximum of twelve members appointed by the government, which would also appoint a secretary. It was assumed that a further four people would work at the chancery. A working group was considered to be necessary, together with a number of delegations to prepare matters within different areas of research. The annual cost for staffing and other administrative expenditure was estimated to be SEK 230.000.

It was assumed that the Space Institute would be subordinate to the Council, which would appoint its board and propose to the government the holders of posts such as director. There would be five different divisions within the Institute, for field work, for instrumentation, for aeronautical technology, for data processing and documentation, and for administration and purchasing. In addition, there would be a laboratory as well as a workshop and design offices. The personnel of the Space Technology Group would be transferred to the Institute. In total, it was assumed that the personnel would be 41 people, of whom 15 would have advanced training. A large sum – SEK 30.000 – was proposed to be earmarked for additional operational assistance. In keeping with the practice of commissions of inquiry at that time, the organisational proposal is extremely detailed, stating the grade of each official.

The Committee proposed that "connected premises", preferably a separate building, should be obtained for the Institute. The building should be connected to an existing institute of technology or university, or alternatively the Aeronautical Research Institute (FFA). An area of 1500 square metres would be required and building costs were estimated to be SEK 1.5 million at 1963 prices. The Council and the Institute would not share premises, which may appear remarkable, but was on account of the need for coordination with the other research councils.

The total annual costs of personnel, the institute building, equipment, travel etc, when fully developed, were estimated to be SEK 4.300.000.

An important objective for the activity was to launch a number of medium-sized sounding rockets each year to investigate the upper atmosphere and the ionosphere, cosmic radiation, solar and auroral phenomena etc. The Committee proposed that a Swedish launch site be built outside the area of ESRANGE, but using the base's impact area. Arrangements to that effect had been made with COPERS in the ESRANGE negotiations. The initial costs for the three-year period 1964-67 were put at slightly more than SEK 900.000.

The final chapter of the report dealt with the total costs. This issue was discussed against the background of the investments made by other countries on space activity. The Committee pointed out that an investment which was, in relation to gross national product, as large as that of the Americans would mean an annual budget of SEK 800-900

million, but added that unfortunately "there is no possibility in the foreseeable future of such a large space budget". A similar comparison with the United Kingdom and France suggested that a Swedish investment comparable with those countries would mean a budget of SEK 40-50 million.

For its part, the Space Committee found that it was "justified for an investment of that order to be made by Sweden on account of the need described in the report for active participation in the scientific, technical and industrial developments within this field of activity". However, it was stated, a development had to take place gradually and for the next three years from 1964/65, the appropriation requirement for national space research, including administrative costs, was estimated to be SEK 6, 11 and 15 million per year. In addition to those sums, ESRO contributions had to be paid for the same years which were calculated to be SEK 6.5, 8.8 and 11 million.

If the proposal were implemented, the total space budget for each of the next three years would therefore be SEK 12.5, 19.8 and 26 million.

Thumbs Down for the Space Committee

Looking back to the period from 1959 to 1964 in Swedish space research, it can be observed that it was a successful time. The research councils had not delayed in forming the Space Research Committee, and Sweden arrived on the scene early from an international point of view. The Committee played its cards well and they took one step at a time. The councils had contributed the initial funding for a national effort – naturally not enough, that was always the way, just one of the facts of life – but at least a start had been made. Space research was considered to be an area for the future and Swedish scientists could quickly assert their position internationally on the basis of their strong background tradition. In Europe, they were planning to pool their resources in ESRO and the Swedish government was prepared to join. They had asked for a committee to conduct an inquiry into the future organisation of space research, and they had got it. All appeared to be going well.

Yet, it still all went wrong. Why? There are many explanations. One was the composition of the Committee. Of the eight members, seven were in some way interested or established in space activity. Only the chairman, Gustav Cedervall, could be regarded as an outsider and he participated in the work only during the first six months, which was given over primarily to the collection of information and views. Cedervall also provided chancery experience which might probably have had a restraining effect in the final phase, but which was now lacking – there was total agreement. Fremlin certainly participated in the work, but he was not a member and I remember how he complained in the Ministry of Education about Hannes Alfvén who, in his view, was pushing hard the demand for annual costs of SEK 50 million for space activity. The arrangement which was arrived at and which is referred to in the previous chapter was certainly a little vague, but still sufficiently tangible to infuriate a research community in which there was almost universal consensus. I myself remember from internal discussions within the Ministry how astonishingly unrealistic the 50 million target was considered to be.

And it was, if consideration is given to the fact that the total appropriations to the research councils, including administrative costs, in that financial year – 1963/63 – amounted to SEK 46.2 million.

Medical Research Council	9.805.000
Council for Research in the Humanities	2.125.000
Social Science Research Council	2.091.000
Natural Science Research Council	9.159.000
Atomic Research Council, including contribution to CERN	12.575.000
Agricultural Research Council	2.100.000
Council for Technical Research	8.344.000
Total in SEK	46.199.000

The appropriations recommended by the Space Committee for the following three years – SEK 12.5, 19.8 and 26 million – also appeared to be excessively high in the light of the above figures, even if the first year's appropriation was at least at the same level as for atomic research.

Another reason for things turning out as they did was probably the Committee's surprisingly thin argumentation in its proposal. It was a time of mammoth reports filled with statistics and gradually developed arguments. It might possibly be thought that the space report, which was just 120 pages long, would then be something of a relief. But that was not the case. Instead, it was thought that the Committee had taken it easy. I remember comments that the reader got the impression that the Committee had first decided what they wanted and then stuck in the arguments. Perhaps there was something in that criticism.

The Space Committee's report was delivered to the Minister on 1 October 1963. Within the Undersecretary's Department at that time, I was the new head of the group which was responsible for the university and research budget and which was therefore responsible for handling the matter. The report was circulated for consideration immediately. At the end of November, answers began to come in; the consultation period was short because the decision was planned to be taken as part of the research bill which the government was preparing for spring 1964.

In the Ministry of Education and Culture we were not unaccustomed to reading ill-tempered statements from the bodies to which reports had been circulated for consideration – the school and university reforms of the 1960s used to trigger many such responses. However, often there would be a certain balance between negative and positive comments – it is within the framework of such balance that the government usually acquires its scope for action. But rarely have I read such almost unanimously negative opinions expressed by scientists in university faculties as were reflected in the statements on the Space Committee's proposal. Certainly, there was no desire to undermine space research as such – there was a loyalty among colleagues – but the organisational proposals were seen as a threat to the balance within the Swedish research budget. Space research would eat into the other areas. The allocation of funding therefore had to be done within existing research councils, it was claimed.

The *Medical Faculty in Gothenburg*, which did not mince its words, is representative of that opinion.

Research which concerns the conquest of space was obviously begun for military reasons and is still motivated by such reasons, even though the great powers' national and international political prestige has also become a very important driving force in later years. The Faculty cannot find any reason at all, for military reasons or on account of the need for prestige, for Sweden to be involved in such research. If the proposal is implemented, it can be expected that the overall research investment in Sweden would, to very considerable extent, be moved from humanities, natural science and

medical research to space research. ... The social, scientific and medical problems which are associated with the life of our own planet are still so enormous and therefore require such considerable research resources that a prioritisation of space research seems absurd.

The Faculty also warned that a concentration on space would further aggravate the already existing personnel shortage and claimed that this had already occurred in the United States – “an indication is the large American research grant to our country”. Lastly, the government was criticised for the fact that the proposal regarding Swedish membership of ESRO had never been circulated for consideration. All the proposals made by the Space Committee were dismissed, although it was not possible to reject pure basic research; the appropriation for “space research not linked to the conquest of space”, for example in astronomy and astrophysics through the Natural Science Research Council, was therefore supported.

The teaching staff at the Karolinska Institute advocated “an expansion of space research”, but took the view that this could be done through support from existing research councils.

The science faculties in Stockholm and Gothenburg criticised the government for the fact that the ESRO question had not been referred for consideration, but observed that Sweden still had full freedom of action because the Convention had not yet entered into force. The comments made by the Stockholm faculty included the following:

Against the background of the above comments regarding the strained personnel and economic resources at Swedish universities and colleges, against the background of the lack of teaching staff and the lack of technicians in industry and colleges, and against the background of the limited interest in space activity among Swedish scientists, with certain exceptions, strong arguments must be put forward if there are to be investments in space activity of the nature and scale recommended by the Committee.

In the report, the Space Committee had referred to an American Congress Report which had highlighted a number of indirect positive effects of the space effort, including a stimulating effect on the economy. The Stockholm faculty could now point out, with a note of triumph, that there were those in the United States who thought otherwise.

A large number of critical voices have been raised in recent years against the current organisation of the US space programme and that opposition has found an influential and representative spokesman in Senator J.W. Fulbright. Undoubtedly there has been a distortion of American research. The fact that the appropriation requirement of SEK 26 million estimated by the Space Committee – more than two and a half times the appropriation granted to the Natural Science Research Council – represents only slightly more than 2% of the research investment which is made at present in the USA, having regard to the differences in population size, shows in striking

fashion how neglected research in the natural sciences has become in Sweden today. *Considerably larger appropriations must be granted to other research councils at the same time as there is an expansion of space research.*

The proposal was rejected, but it was instead suggested that a joint board for space activity be set up for the research councils – in other words the Space Research Committee would be resurrected.

On the other hand, *the science faculties in Uppsala and Lund* supported the proposal with very brief comments, but with the usual reservation that space activity must not mean “a reduced rate of increase in appropriations to other fields of science”.

The National Board of Universities attempted to summarise the collected views of the universities on the proposals, it dismissed them and followed the line taken by the Stockholm faculty, suggesting a joint board for the research councils. Space research was too expensive.

The magnitude of the proposed sums means that they cannot be viewed in isolation, but consideration must be given to the collective resources which can be made available to research and higher education. Major development plans for universities and colleges are currently on the table. Existing research councils describe the need for increased funding for their requirements. Against that background, it is necessary to make a significant readjustment to the proposed sums for space research in Sweden.

One might think that there was a more positive view among the institutes of technology. But that was not the case. When the report was discussed by the staff board at the Royal Institute of Technology (KTH) in Stockholm, they failed to reach agreement. *The majority of the staff board* (Professors Erdtman, von Hamos, Hillert, Ingelstam, Lindholm, Reinius and Stelling) rejected the proposals contained in the report. They presented a strikingly static view.

The scientific sphere is now expanding like never before It is therefore more important than ever that appropriations for research be greatly increased, but also that research investments are planned so that economic and personnel resources are utilised as effectively as possible within the framework which can be determined for scientific activity. We believe that the most healthy development is to begin by utilising the existing resources In that way Sweden has been able to assert its position and contribute to the increase in knowledge.

There was also a concern that approval of the Space Committee's proposal would mean a commitment of considerable personnel resources.

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It is well known that one of the reasons for the very limited appropriations to our research councils is the fear that an enlarged activity would increase the difficulties experienced by industry in satisfying its demand for technicians and there has also been an effort to limit the number of teaching posts at universities and colleges so as to deter those who have just passed their examinations from remaining there.

Participation in ESRO was rejected on the basis of an argument which undeniably displayed an certain insight into the demands that were imposed by membership, an insight that was however used to attempt to frighten the government. It was claimed that in order to gain scientific profit from participation, a sizeable national contribution was required and they did not hold back as regards the size of that contribution.

There should be required, as a minimum in order to continue, a simultaneous national activity with a budget the size of which lies between Sweden's future annual contribution to ESRO and double that amount. It can be expected that there will be fierce competition between national projects which can be considered for ESRO launches and the large countries have a large amount to invest in that competition. The Minister was evidently not aware of this consequence when Bill 1962:85 was drafted, since he advocated restraint in the amount of national expenditure, inter-alia because the contribution to ESRO was large.

Professors Agdur, Hallert, Herlofson, Luthander and Odqvist expressed reservations *vis-à-vis* the majority opinion. They supported the Space Committee's proposal except for one point, probably a concession to the negative opinion. The Council was rejected, instead taking the line of resurrecting the Space Research Committee under the name of the Board for Space Activity of the Swedish Research Councils. It was also pointed out that the Space Committee's proposal should not be seen in isolation, but that appropriations to research councils must be increased.

We take the view that Sweden should commit itself to ... experimental space research, and join ESRO, having due regard to a rational balance between appropriations to national activity and contributions to ESRO. Swedish rocket launches appear to be a last stage, where activity has already been initiated on account of generous American gifts, but in which we should not make too great a commitment for the longer term....

We take the view that Swedish researchers should as far as possible concentrate on having their instruments put in rockets or satellites which belong to ESRO, or where appropriate other international and foreign organisations such as NASA. Activity geared to *the construction of Swedish instruments and launchings under international auspices* provide the necessary flexibility in the Swedish organisation during the forthcoming development period.....

KTH's powerful and influential Vice Chancellor, Ragnar Woxén, largely took the minority view. He found no fundamental reason to support a Council and he believed that the Institute required further examination. However, he pointed out, compelling reasons – the country's geographical position, importance in terms of communications etc – were arguments in favour of Sweden committing itself to space research "on a reasonable scale". The appropriation should, however, be adjusted in proportion to other funding allocated for research and "thus not be given a priority position".

The opinion from the *staff board at Chalmers University of Technology (CTH)* displays strong similarities with the minority opinion from KTH.

At that time the institutes of technology had not yet been placed under the National Board of Universities, but answered to the *National Board of the Institutes of Technology*. In its opinion, the Board largely concurred with the minority view at KTH. However, doubts were expressed over the consequences of ESRO membership.

It has been claimed that for genuine benefit to be drawn from participation in that organisation sizeable national investments will be required ... The Board wishes to point out that when the matter of Sweden's accession to ESRO was brought before the Parliament in 1962, it was assumed that accession ... would result in lower expenditure for the national activity in the field of space research. The economic and practical consequences of Sweden's accession to ESRO should be clarified before the Convention is ratified.

Of the other bodies, the *Royal Academy of Sciences (KVA)*, the *Academy of Engineering Sciences (IVA)* and the *Council for Technical Research (TFR)* were doubtful over some of the conclusions drawn by the commission of inquiry. Participation in ESRO cannot happen without development of the base organisation, it was asserted, at the same time as opposing the proposed space council. It was also thought that the conclusion that space activity would have a stimulating effect on industry was questionable, since it was a "circuitous route" to go via space. The *Natural Science Research Council* and the *Atomic Research Council* were supportive, and it can be suspected that Funke was behind this. The *Medical Research Council* complained that the list of medical space projects was incomplete. The *Defence Research Institute (FOA)* took the view that "insufficient knowledge" of the degree of difficulty of space activity gave rise to "an excessively positive assessment of the possibilities offered by space technology at its present stage of development".

The widespread and understandable pioneering spirit of joy is also reflected in the present report to some considerable extent ... It can be noted, as far as the scientific side is concerned, that there is a risk of overestimating current space science, since a positive opinion is given of that science – or scientific technology – *per se*, whilst there are generally no comparisons, either between the value of the results achieved and costs incurred, or between the

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importance of those research results and the importance of other research activity.

The FOA nevertheless supported many of the proposals, but not the space council. It is was also thought that the space institute should be co-located with the *Aeronautical Research Institute (FFA)*. That idea was further developed with great enthusiasm in the FFA's own comments. *The Agency for Administrative Development* also adopted that line.

Not everyone was so negative or doubtful, however. There were some who saw space not as a competitor, but as a future. The applications sector believed that it was time to act quickly, as did the representatives for Lapland. *The Board of Telecommunications* realised that communications satellites were not far off and had nothing against a space council.

The development work on the international satellite telecommunications system must be viewed as a pressing task and that work could be pushed forward more quickly if there were a separate body for space activity than if such a body was attached to one of the existing organisations which are conceivable in this connection.

The Swedish Meteorological and Hydrological Institute (SMHI) was also enthusiastic.

Access to satellites will mean a revolution in meteorology. It is of the utmost importance that Sweden has the opportunity to take an active part in the development work in that field. If Sweden were to fall behind at the very beginning, there would be very serious consequences for Swedish meteorology and the Swedish meteorological service.

The *International Institute of Meteorology in Stockholm* displayed equally great enthusiasm – not entirely surprising, even though its director Bert Bolin, for obvious reasons, did not participate in the discussions. "Sweden as a technically and economically highly developed country" must obviously be part of the development of "a new and dynamic area of research". However, the costs were deemed rather high, but were supported on the condition that the increase would not be greater than for the other research councils. The Institute expressed doubts over the Council for Space Activity and recommended further investigations. On the other hand the proposals for an institute for space research and a Swedish launch site were supported even more strongly. One might suspect the influence of the Space Technology Group, since it was at MISU, the sister body to the International Institute of Meteorology, that the Group's personnel had been employed.

The Geographical Survey Office, the National Board of Civil Aviation and the National Board of Shipping and Navigation were interested in utilising the new technology from their own positions and therefore supported most of the proposals.

The Swedish Association for Metalworking responded after consulting the Working Group on Space Technology for the industrial aspects. The proposals were supported.

Reservations were expressed only in one respect – it was “fundamentally wrong” for a research council to have its own technical organisation at its disposal. A corporation overseen by industry would be preferable. The statement points ahead, to some extent, to the organisation which would be established in 1972.

We wish to express our firm conviction that such a service must be performed by industry. Industry generally has the construction and manufacturing capacity which is required Industry should be involved at an early stage in the research, development and component construction work, particularly as regards equipment which can be subject to serial production. Otherwise there is the risk that the result of the construction work will be equipment which contains specially manufactured components, where far cheaper and more reliable standard components can be used. ...

It is likely that a service organisation which utilises the material and personnel resources available within industry would mean a more rational utilisation of the country's assets and will be less of a burden on the public. Industry is interested in discussing with the authorities forms of organisation for the space service work within the framework of an industrial corporation, assuming that satisfactory agreements can be reached with the contracting authorities.

The Swedish Association of Engineers and Architects also adopted the same line and advocated the form of a limited liability company with representatives of industry and the State among the founders.

The only entirely enthusiastic support which was unreservedly positive on all points came from *the Swedish Interplanetary Society*, which expressed its “pleasure and gratitude at the production of the present report”, and from the *County Administrative Board for Lapland* and *the town of Kiruna*.

How would the Ministry of Education and Culture now treat this document which arrived on its desk towards Christmas 1963?

In December 1962, the Consultative Committee on Research had been formed with Prime Minister Tage Erlander as chairman and Professor Bror Rexed as secretary. Its primary function was to act as a forum for consultation on long-term research policy. At same time, a working group on research policy had also been set up within the Cabinet Office, chaired by Erlander and with Rexed as secretary. The members of the group were Hannes Alfvén, Professor Sven Brohult, director of the Academy of Engineering Sciences (IVA), Professor Ingvar Svennilson, an economist, and Professor Arne Tiselius, a biochemist, as well as Sven Moberg, head of department at the Ministry of Education and Culture and Hans Håkansson, head of department at the Ministry of Trade. Håkansson was head of the unit within the Ministry of Trade which was responsible *inter-alia* for technical

development and research and which would eventually be developed into the Ministry of Industry.

In its first year, the Consultative Committee on Research was used primarily for discussing research policy and for compiling statistics and other documents. At the same time, the more tangible issues relating to prioritisation were handled in working groups within the various ministries.

When the budget proposals for 1964 were presented, the research appropriations were not included within all the affected ministries. Instead they would be presented in a separate bill in the spring of 1964 which was intended to be the great demonstration of the work of the Consultative Committee, principally through substantial increases in the appropriations to the research councils. The bill thus became the first of the research policy bills which later became commonplace, above all as planning instruments. It was in that bill that a decision would be given on the Space Committee's proposals.

The discussions began in January. The response to the report circulated for consideration could be simply summarised as follows. No one within the research community had rejected space research *per se*, but it had to be done without any organisational modifications and funded within the framework of the existing research councils. Applications primarily within the field of telecommunications were regarded as an area for the future. Industry expressed an interest, but was not prepared to contribute money.

Certain personnel changes took place in the Ministry of Education and Culture in spring 1964. Hans Löwbeer moved over to the National Board of Education as its director-general. He was replaced as Undersecretary of State by Sven Moberg, who had previously shown himself to hold a fairly negative attitude to space research. The preparatory meetings now took place in his presence and his position appears to have been clear from the outset – it was thumbs down for the Space Committee's proposals across the board. This position was of course one which presented itself readily in the light of the opinions of the bodies consulted and was not difficult to defend. It is impossible to say whether the outcome would have been different if Löwbeer, who was interested in space activities, had remained as Undersecretary of State. It would have presumably been difficult to go against the opinions of the bodies consulted, but it may have been possible to envisage compromises, for example by rejecting the space council but accepting the institute for space. I myself made an attempt to salvage the council, claiming that it should be solely a council for fundamental research, but Moberg dismissed this immediately. The preparatory meetings before Minister Edenman passed quickly; there was little to decide, particularly not since the Consultative Committee on Research and the working group had been called in.

The long-term research priorities had been discussed at length in both bodies. Arne Tiselius pleaded the cause for the life sciences and Hannes Alfvén did the same for the physical sciences, particularly space research. The debate was fierce, but it was Tiselius whose views met with sympathy. One of the results was the establishment of the Centre for Chemistry in Lund and the Centre for Biomedicine in Uppsala. In the first annual

report of the Consultative Committee, it was stated that "there is general emphasis on the need for expanded biological research in view of its importance as fundamental research and its practical applications in, for example, medicine, agriculture and technology."

In his recollection of the 1960s – printed in the form of conversations with journalist Arvid Lagercrantz – Prime Minister Erlander touched on the discussions on space research in the Consultative Committee on Research:

AL: Was there any type of research that you put an end to?

TE: We did not end anything, but we were critical of a excessively costly investment in space research. In the committee meetings it was pointed out that if Sweden invested in space research, it would mean such enormous sums that there would be nothing left for anything else. We had to concentrate on areas where we had natural opportunities: steel, hydro-electric power, electricity. But we also had to concentrate of those areas where we were fortunate to have outstanding researchers who could gather a group of other researchers around them. We had biochemistry with Arne Tiselius. None of these areas required such enormous economic and personnel investments as space research would have done. Alfvén therefore became a lone figure both in the Consultative Committee and in the working group. That may possibly explain why he became so annoyed with us.

In the research bill, medical researchers and natural scientists therefore received the largest increases – 34% and 40%. However, the natural scientists were at the same time given guidance on how their appropriation should be used in the following statement from the Minister:

In another connection, I have stressed in particular that biological research is in a very dynamic phase of development. With reference to the Natural Science Research Council's own statement and proposals in this regard, I would therefore like to emphasise the importance of the need to pay special attention to biological research in the Council's continued activities.

Alfvén's defeat in the debate on prioritisation naturally did not mean that the physical sciences were left to fend for themselves. However, there was barely any scope for investment in space research. Alfvén fought hard, but the battle was lost from the very beginning, especially since Moberg was among its opponents. The proposals were rejected across the board – no council, no institute, no launching field, and space researchers had to be satisfied with obtaining grants from research councils in competition with other research, a position which was in keeping with research policy doctrine at that time, according to which appropriations should not be specifically earmarked, but there should be competition as far as possible. According to Hans Håkansson, Erlander was reported to have said at the preparatory meetings in the working group that logic actually dictated that Sweden did not join ESRO either, but that such a move would be unwise, and

a concession had to be made to the space researchers. Even greater reasons for not taking such a drastic step were of course ESRANGE and general considerations relating to European policy. The ESRO Convention was thus ratified on 7 March 1964.

When the decision was then to be set out in the minister's statement in Bill 1964:69 "concerning *inter-alia* appropriations for the 1964/65 financial year to certain research councils", there were at first no problems. The bill thus recommended that the Kiruna agreement be approved and that funds should be allocated for participation in ESRO for the next year (SEK 3.7 million) and to the National Labour Market Board for the construction of the Pulsujärvi road (SEK 1.75 million), and that the agreements with land owners and the Lapps should be approved. So far so good – but then the problems started. On the one hand, both the Committee and several bodies to which the matter was referred for consideration had asserted that ESRO membership required a base organisation in Sweden. And, to make matters worse, the Minister had stated in the 1962 bill that "possibilities for utilising experiences and results of cooperation in ESRO will be greater if a national investment is made in space research". Now there was not to be any base organisation or any earmarked national investment, but Sweden would be joining ESRO, at the same time as it was claimed that Swedish space research would have to be satisfied with that. This led to some sweeping formulations.

The Minister began by recalling his statement in the bill of 1962 – in determining the size of appropriations to space research, regard must be had to the costs of ESRO participation. On the other hand, he was careful not to refer to the above-mentioned statement regarding the need for a national investment. Instead, he made the following point:

Furthermore, I wish to point out that a study of, on the one hand, the preparations for the operational plans for ESRO's technical laboratories, and on the other, the organisation's Convention, clearly show that ESRO's research institutes and laboratories will to a great extent be able to be used by national researchers.

These words were dictated by Moberg, who believed that they would take the sting out of any possible criticism of the imbalance which would occur if Sweden on the one hand joined ESRO, but on the other rejected the proposal for a national programme. By that time, I had participated in ESRO work for almost one year and was certain that this claim was not true – the scientific coordination would of course take place in ESRO, but that was all, broadly speaking. On the contrary, it was clear from the preparatory work that ESRO would be responsible for technology in the form of rockets and satellites, while the experiments would be developed and built at national level. I protested, but to no avail. Instead, my protests gave rise to the following addition:

In my opinion, the Swedish delegates in ESRO should therefore work towards developing the organisation in such a way that national research institutes or groups of researchers can work closely together in the on-going work within the framework of the organisation. If such a development occurred, it appears to me that the investment of material and personnel

resources in Sweden could be considerably less than proposed by the Space Committee.

It also appears that, in terms of technology too, space research groups working in Sweden will be able to rely on close cooperation with ESRO institutions.

It was self-evident that research groups would cooperate within ESRO, but my protests at the wording regarding the preparatory work made Moberg uncertain. According to him, the instructions to the Swedish delegates would therefore be interpreted to the effect that the delegates should work to ensure that experiments could also be financed by ESRO. As a delegate, I reluctantly but loyally attempted on several occasions, against my better judgment, to argue this line. The result was scornful and sarcastic comments from the technical director Lines and his administrative colleague Crowley. I cannot say that I pushed the matter with any great enthusiasm after that.

The Minister closed his statement by remarking that, with regard to the increases in the appropriations to the Natural Science, Technical and Medical Research Councils, he was reckoning on a higher sum for space research during 1964/65 than the 2 million which was made available to the Space Committee in 1963/64.

Here I have reckoned on a total of SEK 2.25 million. Contributions to space research should nevertheless not be tied at that amount, but the research councils concerned must analyse applications concerning space research projects in the same way as the councils examine other research projects. This means that next year's actual contribution to Swedish space research may be more or less than I have reckoned on in balancing the appropriations.

Thus the critics had got their way, while the space researcher had been given a bone on which to chew. Certainly, the 2.25 million could not be regarded as having been earmarked, but this was done all the same and that was the ministry's implicit intention. They were able to retain their two million and gain an additional SEK 250.000 – a small comfort in comparison with the 50 million of which they had dreamt.

The government's decision must have come as a shock to the Space Committee and the space researchers. In the Committee's archive at the NFR there is a gloomy document. It is a notice to Hulthén and Brunberg to attend a meeting on 14 March 1964 at the Ministry of Education for "information concerning Swedish space activity with reference to the forthcoming bill". On the notice are the following telling pencilled notes from the meeting in Brunberg's handwriting:

20/3/64 bill
no council
no inst
no launch pad at Kiruna
Future of Sw space res:

14. THUMBS DOWN FOR THE SPACE COMMITTEE

Committee ends 30/6/64

Priority TFR, NFR, MFR, SEK 2.25 million in actual funding but it must be examined by the council in question, may be more or less

Tech cooperation with ESRO?

Proposal a mess

I was at the meeting, which was chaired by Moberg. Spirits were low, to say the least. The only person who was unconcerned was the MFR's secretary, Bengt Gustafsson, but, for him and his council, space research was evidently a peripheral and unimportant activity, to which a modest sum was given mainly out of loyalty to the other councils.

At the meeting, someone – if I remember correctly it was Hulthén – asked how ESRO matters would be handled after the Space Committee was dissolved on 30 June. Someone must coordinate them, be responsible for instructions to delegates etc. We in the Ministry had not contemplated this at all, probably because we had subconsciously drawn a parallel with Swedish participation in CERN, which was handled almost entirely by the Atomic Research Council. Moberg cast a reproachful glance in my direction and explained that he would give some thought to the matter. It may be necessary to set up a committee for the purpose, he added. Thus, the idea for the Swedish ESRO Committee was born.

The members of the Space Committee cannot have been entirely unprepared, however. The fact that the Ministry took as long as until 14 March to respond was in itself a bad sign. The uncertainty had created problems for the planned Kronogård campaign in summer 1964. Consequently, the Liberal Birger Lundström had been prompted to put a question to the Minister for Education in the upper chamber on 14 February, requesting information on the future of space research. Irrespective of the way in which Swedish space research was organised, it had to be ensured that the projects which had been started by the Space Committee could be continued, he insisted. Cooperation with NASA was likely to break down, the summer campaign at Kronogård would possibly have to be suspended and the future of the Space Technology Group was uncertain because, despite reminders, there was no response from the government. The interpellation ended with two questions.

1. Does the Minister intend to take steps to ensure that the Swedish-American cooperation planned by the Space Committee for this coming summer is not jeopardised?
2. Does the Minister intend to implement measures in the future as a result of which continued Swedish work in the field of space research will not risk being hampered or delayed?

Minister Edenman replied on 18 March – two days before the bill was tabled in Parliament. As was usual, it was a very formal answer and it cannot have instilled any great hopes in the listeners to the subsequent debate.

Edenman announced that on 28 February, at the request of the NFR, the government had approved the council's decision to guarantee, up to a maximum of SEK 350.000, certain

material orders which the Space Committee had to make by 20 March. Birger Lundström answered by pointing out that the problem was that there was a lack of clarity over the allocation of appropriations and information on the amounts that could be expected had been refused. It was incomprehensible for a state research committee to be treated in such a way, he stated. Edenman replied that the Space Committee was not unaware that the appropriations to the national research councils would in total increase by 56.5 million. If space research could not then argue its case for an appropriation of SEK 400.000, it did not deserve to obtain any appropriation at all. The debate was thus concluded.

The government had laid down the conditions for space activity in Sweden. They were not particularly good. Time and again, the Space Committee had pointed out that the precondition for a successful programme was a balance between international and national commitments. It was precisely that balance that was lacking as Sweden was now entering the space age in earnest.

The ESRO Committee and the Space Board

When, in spring 1964, the Parliament approved the bill concerning *inter-alia* space activity in Sweden, a large part of the work done by first the Space Research Committee and then the Space Committee had come to nothing. But, not entirely. Membership of ESRO was assured, there had been three years of successful space campaigns at Vidsel and, despite all the criticisms, no one had called into question space research *per se*. There was a base on which to build and now it was important to make the best of a bad situation.

Because the Space Committee was to be dissolved on 1 July 1964, the research councils had to provide further guarantees for the summer rocket campaign. They did so, and the most pressing problem was thus resolved. The next problem was the form taken by the future work. Space research concerned primarily the Natural Science Research Council and the Council for Technical Research and, to some extent, the Medical Research Council. Many projects within the field were inter-disciplinary and many could also be expected to be linked to the ESRO programme. It was therefore important that the assessment and administration procedure should be conducted within a coherent organisation. It was then very obvious for the research councils to bring back the Space Research Committee of 1959, which had been a joint body for the research councils. There was of course also support in this regard from many of the bodies to which the matter had been referred for consideration and which had been critical of the proposed space council.

From 1 July 1964, under an agreement between the Natural Science, Technical and Medical Research Councils, a joint board was formed, the *Space Board of the Swedish Research Councils*. The purpose of the Board was stated as being "to promote Swedish space research, which means natural science, medical and technical investigations which are conducted using high-altitude rockets, satellites or space probes".

As was the case previously, Lamek Hulthén became chairman and Ernst-Åke Brunberg became secretary. The NFR and the TFR were represented by their chairmen, Bertil Lindblad and Martin Fehrm, and their chief secretaries, Gösta Funke and Gösta Lagermalm. The MFR was represented by its chief secretary Bengt Gustafsson and by the space medicine expert, Professor Carl-Johan Clemedson. The Working Group on Space Technology was represented by Curt Mileikowsky, sales director at Asea. He was succeeded after a few years by Tore Gullstrand from SAAB. Other members were old acquaintances – Hannes Alfvén, Bert Bolin, Bengt Hultqvist, Håkan Sterky and Yngve Öhman. After a short time a working party was set up.

In the course of the year up to 1972, certain changes took place in the composition of the Board. The FOA was represented by B. Grabe, a head of division. In 1967, Hulthén was replaced as chairman by Bolin. He was then replaced by Hultqvist in 1971.

At the chancery, Brunberg was assisted by Britt-Marie Holmlin who would subsequently serve for many years in the Board for Space Activities.

The Board was given its own funds, which were made available by the research councils. This actually ran counter to the principle set out in the bill, but the research councils were autonomous and no one was more eager than the government to safeguard that autonomy. The government therefore remained wisely silent. The 2.25 million specified in the bill formed the basis, but this was increased by the NFR and TFR to around 2.7 million. On top of that, there was a symbolic contribution of SEK 6000 from MFR and contributions of SEK 115.000 from the FOA and SEK 250.000 from industry. In that way, it was possible to scrape together a total of slightly more than SEK 3 million, which was one million more than the Space Committee had enjoyed for 1963/64. However, according to the Space Committee, around 6 million had been needed, an estimate which was not unrealistic if consideration was given to the expectations and plans in the field and the fact that many institutions were interested in participating in the ESRO programme. In reality, the Space Board therefore went to work with a shortfall which, when it came to light after a few years, would become very difficult to overcome.

The Space Board was not the only body. In May 1964, at a meeting at Uppsala Ionospheric Observatory between representatives of various research institutes, the Joint Group for Swedish Space Research was formed. It would act as a forum where space researchers could discuss matters of prioritisation among themselves and options and forms of coordination for various projects.

However, the question still remained how ESRO participation would be handled and by whom. As was seen in the previous chapter, the position set out in the bill had overlooked that need. When the matter was then discussed within the Ministry, it was envisaged that, as was the case with CERN, the research council, to be specific the Natural Science Research Council, would be allowed to handle ESRO matters. An even more readily available alternative was to delegate such business to the Space Board, the creation of which was announced during the spring of 1964 – the Ministry was aware of the Board. But Moberg, the Undersecretary of State, opposed all ideas along such lines. He distrusted the Space Board, since he believed that it would include too many space enthusiasts and he feared that in ESRO it might commit Sweden to participation in expensive undertakings. Responsibility was therefore conferred on a committee in the Ministry of Education and Culture, the Swedish ESRO Committee, which was formed in May 1964.

Moberg himself became the chairman and the head of the Ministry's international secretariat, Ilmar Bekeris, was appointed as secretary; he had replaced Fremlin, who returned to the Ministry of Foreign Affairs in spring 1964. Bo Holmberg was recruited as assistant secretary, having experience of data companies and foreign service. The members were Professor Bert Bolin and Professor Lamek Hulthén, Axel Edelstam from the Ministry of Foreign Affairs, Hans Håkansson from the Ministry of Trade, Christian Jacobaeus a director from LM Ericsson, Bengt Resare from the Ministry of Finance, Professor Bror Rexed from the Consultative Committee on Research and Jan Stiernstedt from the Ministry of Education and Culture. As is apparent, the ministries were well

15. THE ESRO COMMITTEE AND THE SPACE BOARD

represented, since, according to Moberg, it was important to keep a careful check on both the ESRO secretariat and its Swedish users. Contact with researchers was dealt with by Hulthén and Bolin who were both also on the Space Board.

Moberg, Rexed and Hulthén were appointed as delegates on the ESRO Council. They had already attended the first Council meeting of the organisation in March when the Convention finally entered into force. Håkansson, Resare and Stiernstedt were appointed as delegates to the Administrative and Finance Committee (AFC).

The first Council meeting (March 1964) was to be the only time that Moberg visited ESRO. As Undersecretary of State he had an enormous workload and he quite simply did not have the time that was required by the ESRO Committee. There were many ESRO issues to be tackled and in the first six months alone, the ESRO Committee met 12 times, or almost every other week. Bekeris also found it difficult to make time for his functions as chief secretary. Responsibility gradually shifted to Jan Stiernstedt and Bo Holmberg. In spring 1965, Moberg stood down as chairman of the ESRO Committee and it was transferred to Stiernstedt as of 1 July. Bekeris handed over the responsibilities of secretary to Holmberg.

At the same time – 1 July 1965 – the ministries were restructured. The departments of the Undersecretary of State and the Permanent Undersecretary were abolished and replaced by coherent specialist units. Senior management at permanent representative level was exercised by three senior officials, the Undersecretary of State, together with the Permanent Undersecretary and the Undersecretary for Legal Affairs. In the Ministry of Education and Culture, Stiernstedt became Assistant Undersecretary and head of the department for higher education and research. In practice, the ESRO Committee and its secretariat therefore came to act as a part of the department, at least until 1969 when Stiernstedt became Permanent Undersecretary, though he remained as chairman of the ESRO Committee. The Committee secretariat then became more independent again, even though all the cabinet decisions concerning ESRO were formally still handled by the higher education department. From the summer of 1964, Stiernstedt had also been chief delegate on the ESRO Council – a function which he would also perform in ESA, for 25 years in total. During the first few years he was also a delegate on the AFC. Hulthén also sat on the ESRO Council, whilst Rexed's participation in the Council was restricted to the first meeting. When the Ministry of Trade and later the Ministry of Industry subsequently began to take an interest in space matters, Hans Håkansson also participated as a delegate at Council meetings.

One of the first matters which the ESRO Committee had to tackle was an issue which had also been neglected in the bill, the future of the Space Committee's technical service group. Would it be dissolved, thereby throwing away the technical know-how which had been developed in the country over the previous three years? It had been used not only during rocket campaigns but also in monitoring various ESRO matters, in particular the important issue of safety at ESRANGE. The issue was raised by Bolin and Hulthén at the Committee's third meeting in Älvsbyn in August 1964. Bolin preferred a technical/scientific secretariat funded by the Ministry to be attached to the Space Board,

while the technical service group would be responsible to the Space Board but be organised as an independent branch institute within the Aeronautical Research Institute (FFA). Bengt Resare from the Ministry of Finance thought that the proposal appeared awkward and suggested that the simplest approach would be to transform the service group into a corporation, which Moberg also thought a good idea. On the other hand, Moberg rejected – though privately – all ideas of a technical/scientific secretariat, since this would be a way of implementing the proposal for a space council by the back door.

Anyway there was consensus that the service group should exist. During the autumn of 1964, the matter was raised once again. Jacobaeus presented an offer when had been discussed in the Working Group on Space Technology and which meant that industry would finance the group which would then be formally established in SAAB. Researchers would then be able to purchase services in connection with launches and other services from that group. Hulthén fiercely opposed the offer, since he took the view that it safeguarded the interests of industry while ignoring those of researchers. He was supported by Resare. The Swedish researchers, industry and the ESRO Committee all shared a common need for a technical service which could be adapted flexibly to different interests and provide an information and documentation service, he pointed out. There were three alternatives – a state space institute, a branch institute or a company solely financed by industry. Moberg summarised the discussion – a core of 2-3 people should be retained and be afforded financial guarantees. He then instructed a group consisting of Hulthén, Jacobaeus and Resare to draft a proposal for a guarantee contract between industry and the State. Later, during the autumn, Hulthén was able to report that the matter had been temporarily resolved until 1 July 1965 because industry – in the form of the Working Group on Space Technology and the Council for Technical Research – had jointly guaranteed a sum of SEK 230.000.

At around the same time in autumn 1964, a proposal was also tabled for a tripartite agreement between industry (ASEA, LM Ericsson and SAAB), the Space Board as the representative of the NFR, MFR and TFR, and the ESRO Committee. Resare had played a major role in the emergence of the agreement – he also ensured that funding was taken into account in the 1965 budget proposals for the ESRO Committee's undertakings under the agreement. Among the alternatives considered was attaching the group to the Aeronautical Research Institute. Another alternative, a company called AB Svensk Rymdteknik, can be seen as a precursor to today's Swedish Space Corporation, which would supply space technology services to Swedish industrial companies, State and municipal authorities, research institutions, scientific academies and ESRO.

In the end, however, a simpler solution was settled on and, in autumn 1965, the tripartite agreement could be signed, after great difficulty. It meant that, in the financial year 1965/66, the group was guaranteed an annual budget of SEK 500.000. A proportion of the guarantee undertaking would in principle be offset against orders with the group and, as a result, be gradually reduced.

The group's steering body became the Space Board's working party, enlarged to include a representative of the ESRO Committee (Holmberg). It was assumed that the steering body

would formally confirm an agreement which had already been concluded with the private company Teleutredningar AB (TUAB) for its offices and organisation to be located at the company. The official name of the group became the Space Technology Group, the Technical Organisation for the Space Board of the Swedish Research Councils (RTG). TUAB's premises were in Solna and that is where the RTG went. This would also determine the geographical location of both the future Board for Space Activities and the Swedish Space Corporation in this area.

Lars Rey became head of the RTG. He was succeeded in 1970 by Fredrik Engström. The group became slightly larger than the 2-3 people envisaged by Moberg, and strictly speaking the original core – in addition to Rey – consisted of eight people. They were Anders Björkman, Robert Eide, Eva Lisa Ljungblad, Lennart Lübeck, Johan Martin-Löf, the brothers Erik and Sven Söderdahl, and Klas Änggård.

During the period after 1965 the group's activities were greatly affected by a lack of funding, although in 1968 it was possible to carry out the first national sounding rocket campaign after Kronogård, now, finally, from ESRANGE (see Chapter 18). Almost all the above-mentioned people would continue to work in space activity. Björkman, the Söderdahl brothers and Änggård remained faithful and continued later in the Swedish Space Corporation. Lübeck was recruited to the Ministry of Industry in 1969. Rey went there in 1970 – he was succeeded as head of the RTG by Fredrik Engström. Martin-Löf also ended up at the Ministry (1976). Of those three, Lübeck returned to the space world, first on the board of the Swedish Space Corporation, then in 1986 as managing director of the Swedish Space Corporation. Martin-Löf also maintained contact with space matters, eventually also as a member of the Board for Space Activities.

Another body was established. Under Article 23 of the ESRANGE agreement, a joint ESRO/Swedish consultative committee would be set up to facilitate the application of the agreement. The Swedish government would appoint, in addition to the chairman, representatives of the authorities and municipalities affected, the reindeer-herding population, the local residents, nature conservation bodies and tourist organisations. ESRO's representatives would be appointed by the organisation. The committee was launched in September 1964. It was large – 25 members from Sweden, led by the county governor of Lapland. The constituent meeting was not held until April 1965 under the chairmanship by county governor Manfred Näslund and attended from ESRO by, among others, Auger and his closest colleague and constant shadow, the Swiss Jean Mussard. Business discussed included the issue of tours of the base in connection with launches. The tourist representatives exerted pressure, but Auger declared that it was out of the question – a concentration of people and vehicles in the area was not possible for safety reasons. However, he could contemplate organised tours for educational purposes, though not in connection with launches. The issue was then dropped.

I will never forget a meeting in September 1968 chaired by Näslund's successor, Ragnar Lassnanti, and attended by ESRO's then director-general Hermann Bondi. Both were known for their loquacity. It began with Lassnanti delivering a very long oration in Swedish on the history, nature and population of Tornedalen from the stone age onwards

– he thought that Bondi needed to be informed about the features of Lapland. Despairing amateur interpreters attempted to interrupt him in order to be able to translate, but to no avail. When he had finished and a confused summary had been given in English, Bondi started to speak and gave an address which was, if possible, even longer on the past, present and future programmes of ESRO, its dream, finances and crises. This was followed by the actual talks where a considerable proportion of the time was taken up with discussions regarding an axe which should have hung on the wall of one of the shelters, but which one of the Lapp representatives present had taken home for a while, since he claimed he did not have a good axe at home.

By chance, Sture Petré, a member of the International Court of Justice and former court of appeal president, happened to be in Kiruna and, because he had led the negotiations on the agreement a few years earlier, he was interested in listening to the discussions. I remember his friendly, ironic smile and his ambiguous comment after the meeting, typical of a man from the University of Lund: “Yes, I see that this committee is *really* necessary”.

And he was right, after all. The committee would actually serve its purpose well as a forum where problems great and small were discussed and even sometimes resolved.

It thus was a multi-faceted organisation which would be responsible for Swedish space activity from 1964. At the top was the ESRO Committee, holding responsibility for the Swedish ESRO policy, but with no responsibility for national activities. Since it was rooted in the Ministry, the Committee did hold some power outside its mandate, however. Furthermore, the Space Board had no responsibility for the Swedish ESRO policy, but was responsible for national activities. Between these floated the RTG, the local ESRO committee and the researchers’ joint group. Within industry there was the Working Group on Space Technology and in Kiruna there was the local ESRANGE committee. The various bodies certainly kept each other informed of their decisions and positions, but it could nevertheless not be helped if there was sometimes a lack of coordination. The ESRO Committee made every effort to protect the interests of Swedish researchers in ESRO, partly by allowing the Space Board to nominate and, in practice, appoint representatives on the organisation’s scientific committees. However, it could not for example finance Swedish experiments on board ESRO vehicles – that was for the Space Board and it had a much too small budget at its disposal for that. All the ESRO Committee could do to support the researchers was to finance their trips to ESTEC in connection with experiments and, even there, they overstepped the rules, though with the consent of the chairman.

ESRANGE Finally Ready

It is a quiet period in Swedish space history which began in 1964. The organisational and financial conditions had become clear – not in the best way, but at least people knew where they stood.

As can be seen from Chapter 12, the fourth Vidsel campaign took place at Kronogård that summer. It was clear that it would be the last. On a proposal from Bert Bolin who was in charge of the campaign, the ESRO Committee decided to visit Kiruna and Kronogård in order to be able to familiarise themselves with the activities, to witness a launch and study the preparations for ESRANGE. All the members apart from Rexed, plus the two secretaries Bekeris and Holmberg, took part in the visit which took place at the end of July/beginning of August 1964 and was led by Sven Moberg.

The journey began in Kiruna. The town held a luncheon in the town hall where the Committee was able to meet the social-democrat municipal administration and the town commissioner Folke Granström – a man whom they would work with a great deal, in particular with regard to contacts with the Lapps. The municipal politicians were enthusiastic and more than willing to support ESRO in any way and resolve any problems which might conceivably arise. We then travelled via Jukkasjärvi to the site for ESRANGE. The local road there was still being built over the remains of an old forest road. The bus almost got stuck on several occasions. Eventually we arrived at an opening in the forest, not far from the Vittangi river, where AB Grävmaskiner from Stockholm, which had been awarded the contract by ESRO for site preparation, had managed hurriedly to transport several excavators which looked very lonely, but had nonetheless scraped out a few small hollows.

The rain came steadily down from the gloomy sky. Beside the excavators stood a small helicopter which had been sent there for the Committee. One by one, the members were thus able to take an aerial tour of the area with ESRO's works manager, a Norwegian, who explained where in the spruce forest the various facilities would be positioned. A few elks stood under a spruce tree and melancholically gazed up, not even afraid of the helicopter. A lonely reindeer which had wandered astray was startled and scampered away; the Lapps had talked about large herds of reindeer, but there did not appear to be any. It all made for a gloomy impression and the members did not get a very good picture of how it would all look.

The next day, there was a visit to Kiruna Geophysical Observatory (KGO). Bengt Hultqvist was on holiday, but the facility and its activities were demonstrated by one of his scientific colleagues, the Austrian Willi Riedler, who is now a professor at the Technical University in Graz. It was of course not very easy for Riedler, as a foreigner, to receive a large delegation from the government headed by a stern Undersecretary of State and with members who did not even make an effort to look like they understood his

presentation of the institute's research, but merely asked questions regarding the budget and administration which he found difficult to answer. I remember that my impression of the activities of KGO was fairly foggy when we headed south towards Älvsbyn.

It was there that the Committee had to learn about the perception of distance in northern Sweden. A colleague at the Ministry of Education and Culture had told me that Kronogård was next door to Älvsbyn, which I understood to mean a few, perhaps ten kilometres. It proved to be a bus journey of slightly more than 100 kilometres on monotonous, straight Norrland roads to Kåbdalis, and then further along a little forest road.

While the Kiruna visit was of little benefit, the Kronogård visit was much more rewarding. The Committee were taken care of by the enthusiastic Bolin who gave an informative and fascinating insight into the aims of the campaign and, together with the members of the Space Technology Group, demonstrated the various phases in the countdown to the launch which would take place that evening.

That evening, I was able to learn, for the first but certainly not the last time, that a rocket launch is nine-tenths waiting, waiting and more waiting. After visiting the different technical stations and being informed of their functions during the countdown and launch, we settled down by the small Kronogård lake. The summer night was bright and still, the lake was sparkling and beautiful. Gnats buzzed around hungrily. Time passed. Nothing happened. At 2.00 am we were informed that the launch had been suspended until further notice. I do not remember the reason – perhaps it was because some noctilucent cloud had decided not to make an appearance. There then followed a few hours' bumpy and sleepy return trip to Älvsbyn.

The visit was rewarding nevertheless. The Space Technology Group made a strong impression. They were efficient, united and enjoyed their work – it was an unusually close-knit group of young engineers and technicians. It was here that for the first time I met people with whom I would later work closely – Lars Rey, Lennart Lübeck, Fredrik Engström, Klas Änggård, Sven Grahm, Per Zetterqvist, Johan Martin-Löf and others. Their enthusiasm was unmistakable and would continue – as has already been mentioned, most of them would remain faithful to space activity. When the matter of the group's future was raised the next day, it was good to have seen its members in full stride – we realised that the group really was worth keeping together.

The next day, a somewhat tired ESRO Committee met in the village of Älvsbyn. A systematic survey of the situation of Swedish space research in domestic and international terms was on the agenda. In this connection the issue of Scandinavian space cooperation was also raised. Moberg and Stiernstedt promised to take up the matter at government level. This was done, though without any great success. Only Denmark was a member of ESRO and Norway saw Sweden as a competitor in terms of launches in the northern auroral zone. The NATO facility at Andöya had been put forward in ESRO, but had not gained support because Norway was not joining the organisation.



The Chancery visits Kronogård. From the left: Hans Håkansson, Jan Stiernstedt, unknown, Bengt Resare, Bo Holmberg, Lamek Hulthén, Bert Bolin, Axel Edelstam, Lars Rey, unknown, unknown, Cecilia and Sven Moberg, Ilmar Bekeris. Photo: RTG

In autumn 1966 came the inauguration of ESRANGE. There was certainly still much to do before the base was fully ready, but because the first launch was expected to be possible some time in autumn 1966, it was thought best to inaugurate the base before the Lapland winter set in in earnest. The inauguration, which was set for 24 September 1966, was naturally seen as a golden opportunity to create good publicity for space.

An aeroplane was filled with invited guests – delegates on the ESRO Council, representatives of the relevant embassies in Stockholm, journalists from near and far, Swedish director-generals, directors and ministerial officials, headed by the Minister for Education, Ragnar Edenman, and Sven-Eric Nilsson, Minister without Portfolio. From ESRO there was the Council's chairman, the German Alexander Hocker, and the newly appointed scientific director Bert Bolin – Auger had been prevented from attending. There had been a miscalculation on the matter of the Lapland winter, however. On the morning of 24 September, there was a snowstorm in Kiruna. The plane circled aimlessly above the airfield. It was not the easiest thing to push the inauguration back a day. Of course the base could still be opened by the county governor and the municipal officials, but it would all have a slight air of comedy about it if all the distinguished guests from outside had to be sent back to Stockholm. In the end, the pilot took a chance and landed. It went well, even though some of the guests sat with their hearts in their mouths. I remember the relief when the landing strip appeared through the haze of snow.

In Kiruna most guests were placed in the Standard Hotell, a typical Swedish provincial hotel, where generations of business travellers have slept and drunk – the Hotell Ferrum was still on the drawing board. More than the snow storms, mountains and forests, the Standard Hotell, with its heavy air and old, sagging beds, gave the guests the feeling that they were at the edge of the world – civilisation's last, albeit slightly decaying outpost. I remember a romantic ESRO delegate who, for years later, fondly spoke of "the hardships in primitive Kiruna". It was some time before I understood that it was not an igloo, but the Standard Hotell, he was talking about.

The festivities began with a reception in Kiruna's beautiful town hall. The guests were then taken by bus to ESRANGE. The inauguration itself took place in one of the assembly halls. Hocker gave a welcome and explained ESRO's origin and its role. Then Edenman spoke.

His speech was awaited with interest in the light of Sweden's ambivalent attitude to space research. I had written the draft and had come to the conclusion that it must show pleasure and enthusiasm over the establishment of the space base without giving the audience the impression that the Swedish attitude to space research had changed. It was a balancing act which was not all that easy to perform. Edenman accepted the outline and approved the draft.

He began by pointing out how science had gradually become internationalised. That applied in particular to "big science" where international cooperation was a necessity – for example in high-energy physics, space research, molecular biology.

It is therefore most satisfactory to be able to say that international cooperation within the field of research in Europe has expanded rapidly during the last few years. In Sweden, for instance, state grants to international research work are today more than ten times larger than ten years ago.

This is the right development. It makes a united contribution possible and it does not exclude the smaller countries from research work which otherwise – at least partly – would perhaps be out of reach. At least, as far as Sweden is concerned, participation in the work of ESRO does not mean that we have especially selected and given priority to space research. Our participation in ESRO activities should simply be seen as an expression of a firm conviction that, when occasion arises and when we have possibilities, we do not hesitate to take part in international research cooperation, with all that this implies of giving and taking, sharing experiences and knowledge, and getting new experiences and new knowledge.

He then moved on to ESRANGE. He stressed that, for the local people, ESRANGE would mean something new and stimulating and also took the opportunity to thank the local authorities for their enthusiastic cooperation. He believed that it was significant in every



ESRANGE finally ready. Photo: Swedish Space Corporation

respect that it was Kiruna that would be host for the first *European* rocket base. Edenman, who avoided the hardships of the Standard Hotell and stayed at the mining company LKAB's excellent hotel, emphasised that Kiruna was located culturally and technically at the heart of Europe, even though its geographical location was at the outer limits of Europe. Cultural traditions and cultural awareness were strong and alive in these areas, which were characterised to an unusually high degree by old and new, by the meeting of wilderness and highly modern technology and culture, he stated, becoming extremely lyrical.

The members of the international staff of ESRO who will live and work up here will not feel that they have been banished into the outskirts of civilisation but at the same time – and that is possibly unique – they will, while working on the base, be in the centre of the wilderness of Lapland, among reindeer pastures and mountains. It is difficult to imagine more inspiring surroundings for a working place. Through their presence here they will add new and enriching features to an environment already full of excitement ...

I will finish by expressing the good wishes of the Swedish Government to ESRO and the hope that many successful rocket experiments under the auspices of the organisation will be made from this base, the inauguration of which we today have the honour and pleasure to attend.

The speech was well received. Some of the researchers would be disappointed, however, since they appear to have imagined that gold and green forests would await them as soon as ESRANGE was opened.

The next speaker was Bolin, who, in his capacity as scientific director of ESRO, was the most senior representative of the organisation's secretariat who was present. He stressed the importance of complementing ESRO's research with a vital national space programme – the Swedes who were present had no doubts that his sometimes extremely strong words were directed primarily to Edenman. He finished by inviting Bengt Hultqvist to perform the inauguration. Hultqvist took a champagne bottle, solemnly pronounced the words "*I name thee ESRANGE*" and smashed the bottle against a rocket carrier with such force that fragments of glass and champagne sprayed all around. ESRANGE was inaugurated.

There were toasts and cheers. Tours of the main building and the rocket pads followed. On the trip back to the hotel, there was a stop-off at Kiruna sports centre where the artist Olle Bonniér had organised a exhibition in connection with the inauguration, which was sponsored by the government, the town of Kiruna, LKAB and ASEA. It was called "The Palace of Minos" and was an electronic multi-media installation with sound and pictures. The music had been composed by Karl-Erik Welin. In the form of myths, four sides of human nature in the struggle with forces of nature were depicted. They were represented by Ariadne, Theseus, the Minotaur and Icarus. Ariadne, who rescued Theseus from King Minos' labyrinth represented purity, Theseus, who killed the Minotaur, represented man's unknown self, while the Minotaur stood for humanity's hidden side and Icarus, who flew from Crete but fell from the sky, symbolised the death of an old culture and the birth of a new culture. In Kiruna that day, a new era was opened.

The day ended with a great banquet for more than 400 guests who were able to enjoy the same classic Lapland meal that would be served to many visiting space dignitaries from abroad in the years to come – raw pickled char, roasted grouse and ice cream with warm cloudberry. Only reindeer steak was missing. The speeches which were delivered, in their drowsy enthusiasm for a new technology, recalled those reproduced by Strindberg from the opening of the railways in the Sweden of King Oscar II in the satire "The New Kingdom".

The newspapers on Sunday 25 September contained exhaustive and positive coverage of the inauguration. ESRANGE and space research now had the publicity it desperately needed. Edenman's statement about space research as a non-priority area was mentioned, but there were no comments on it. Two months later – on 20 November 1966 – the first sounding rocket was launched from ESRANGE. It was a Centaure 1 and contained scientific payloads from the universities of Utrecht and Liège.

The journey had been a long one and there was still much to do. For the ESRO Committee, the establishment of ESRANGE meant an interminable series of administrative questions to be decided both before and after the inauguration. The ESRANGE agreement was to a large extent an agreement on principles and there were literally hundreds of issues of varying complexity which the local and central authorities

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had to tackle before the base could operate independently. Only a few of the more important issues will be described below. It could actually have been possible to decide many of them quite simply at senior official level. It was on account of the provincialism

and unfamiliarity with international matters which was still characteristic of Swedish authorities at that time that they now required extensive consideration in the ESRO Committee and by the government, as well as at the highest level in the ESRO secretariat in Paris. Also, ESRO was a highly centralised organisation – no matter could be decided in Kiruna, everything had to be decided in Paris – culture clash is a weak word to describe the environment in which ESRANGE was planned and came into being.

The implementing regulations concerning safety during launches, the allocation of radio frequencies, privileges and immunities and exemption from taxes and customs duties for both ESRO as an organisation and its staff, social security agreements, liability issues, the thickness of the ceiling of the shelters and so forth are examples of some of the items which were more or less constantly on the agenda of the ESRO Committee and which were eventually resolved after extensive discussions. A telemetry station with antenna masts at the Sekujärvi lake 26 km from ESRANGE, which had not been envisaged when planning started, now needed a separate agreement between Sweden and ESRO. It meant new negotiations, both locally with the Lapps, who would be compensated for “encroachment”, and between the two parties.

The safety measures at ESRANGE proved particularly difficult. They would actually become an on-going serial, which, in the form of negotiations with ESRO over various launches and also over the conditions for Swedish use of the base, ran until the hand-over to Sweden in 1972. As early as the spring of 1966, the Space Technology Group had realised that certain rocket types which ESRO wished to use – Skylark, Boosted Skylark, Belier, Centaure and Dragon – were likely to come down outside the range, thereby infringing the agreed safety criteria which specified that the risk that a person would be hit should not exceed one in a million. On a proposal from the Space Technology Group, the ESRO Committee decided that permission to launch rockets of this type – with the exception of Dragon – would be given for periods of one year at a time, on the condition that the nominal impact points could be said to lie within safety zones B and C. Furthermore, ESRO should declare that it was prepared to afford the Swedish authorities a full right of inspection during launches. The possibility that rockets could come down in Norwegian or Finnish territory could not be ruled out and the proposal was therefore submitted to the Norwegian and Finnish governments. They had no objections and the government was therefore able to approve the proposal. In practice, the government’s permission came to apply primarily to various time-limited campaigns.

However, the Dragon rocket could not be launched from ESRANGE. This was because it would come down in the North Atlantic after passing over Norwegian territory. The Norwegian government did not wish to grant permission for overflights – the Norwegians obviously hoped thereby to necessitate launches from Andöya. The matter of overflights of Norway was raised once more during the 1970s after Sweden took over ESRANGE. On that occasion, I led the negotiations with Norway and I still remember the amused

astonishment which spread through the Swedish delegation when one of the Norwegian officials claimed in all seriousness that Norwegian territory – unlike Swedish territory – extended through the infinity of the universe and that no overflights could therefore be permitted in the light of the Norwegian citizens' legitimate claim for safety. I thought that a gentle breeze from the time of the union between Norway and Sweden before 1905 went through the Norwegian Ministry of Foreign Affairs negotiation room in Oslo.

Article 25 of the ESRANGE agreement stipulated that the various provisions of the agreement should be revised every three years. When the first three-year period came to an end in July 1967, there was a whole series of proposals for amendments which had been made by ESRO and in Sweden by the ESRO Committee, the Space Technology Group, the local ESRO committee and the county administrative board in Norrbotten, on the basis of the experience gained during the first period.

The negotiations on the revision of the agreement were opened in autumn 1967 and lasted for the length of the subsequent three-year period – they could not be concluded until autumn 1970. By then, the number of proposed amendments had been reduced greatly compared with the proposals made in summer 1967. They were mainly amendments or clarifications of the safety measures against the background of the experience thus far. While the negotiations were still on-going, the Lapps made their views known, declaring that having now seen a rocket impact, they realised that the shelters would not withstand a direct hit. In fact, the shelters had not been built to cope with a direct hit, but to improve the climate of cooperation, it was decided to reinforce the roofs at the expense of Sweden – the National Labour Market Board readily undertook the "public relief work". The reinforcement, which essentially consisted in throwing a pile of rocks and sand on the roof, probably had only symbolic importance. In reality, few people used the shelters during the campaigns, although they did become popular as fishing and hunting lodges.

Two issues proved to be particularly difficult during the negotiations.

The first concerned Swedish use of ESRANGE in accordance with the provision set out in Article 22 of the ESRANGE agreement. An agreement in that regard would certainly entail expenditure in the form of compensation to the Lapps and land owners, but would at the same time substantially improve the Space Board's options for long-term planning of its research programme. During the agreement negotiations with ESRO, the Swedish side (RTG) claimed that, with regard to such use, Sweden and not ESRO was entitled to be responsible for making the final decision regarding launches and safety measures. This was opposed by ESRO – the proposal was seen as a way to accord Sweden, as regards responsibility for activities, exclusive privileges which no other user could enjoy. The matter was never resolved.

The second issue concerned the extension of zone A, the area in which the first stage of the rocket was expected to impact. Certain types of rocket which ESRO and many national users, including Sweden, wished to use in certain campaigns – Nike Apache among them – required an extended zone A in order for the damage-risk criterion to be satisfied. Not surprisingly, the question immediately arose of compensation for land

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owners within the new area which would be brought into zone A as a result of the extension. After a number of *ad hoc* decisions had been taken in connection with Nike Apache campaigns, the question was raised whether it would not be more simple once and for all to extend zone A permanently. Negotiations were initiated, they lasted three years and resulted in the right for the local Swedish authorities to agree with ESRO on the extension of the zone and the enforcement of the safety measures.

Reference was made earlier to contacts with the Norwegian and Finnish governments. This was more far-sighted than was perhaps realised at the time. When activities commenced at ESRANGE safety left much to be desired. The ESRO rockets had a tendency to impact at completely different points to the designated zones, on one occasion not far from the town of Kiruna and several times in Norway and Finland.

It became impossible for me, being ultimately responsible at senior official level in the Ministry, to stand silently by. The two ministers in the Ministry of Education, Olof Palme and Sven Moberg, could get into trouble if someone or something came to harm. If nothing else, the press could become aware of the risks – it was always on the look-out, particularly where Palme was involved.

In summer 1968, I therefore asked the RTG informally to investigate the possibilities of developing a self-destruct system which could prevent impact outside the rocket range. In addition, at an ESRO meeting in Venice, I took up the matter with ESRO's new director-general, Hermann Bondi. The discussion was continued through correspondence during the autumn of 1968. But at the same time, the situation worsened. Using statistics from the RTG, I described, in a letter to Bondi in December, the results of the last ten launches, in which three types of rocket were used. Of the ten rockets, only three had ended up at their intended destination. Of the seven remaining rockets, four had come down in Sweden, but outside the area of the base, two in Finland and one in Norway. Three of the rockets were Boosted Arcas which resulted in ESRO prohibiting their use for the time being. As requested by the RTG, I now demanded on behalf of the Swedish government the temporary prohibition of Boosted Skylark rockets, pending the introduction of improved safety measures.

Bondi replied in January 1969. He was not happy, but accepted the Swedish position and even expressed understanding for it. He promised to seek to improve the performance of the rockets. However, his letter also contained a hidden threat with regard to the future of ESRANGE.

Despite the fact that the attitude taken by the Swedish Authorities is understandable, I should like to stress that it has a serious impact on the use of the range and the execution of our programme. We have to study the situation carefully, and I think we shall probably have to suppress launchings or transfer them to other ranges, or postpone them until the autumn, at which time we hope to be able to enter again into discussions, based on the results of the improved rockets, as referred to above.



*Hermann Bondi, the temperamental
but effective director-general of ESRO.
Photo: ESRO*

Furthermore I must underline that the decision of the Swedish Authorities may have a serious bearing on the use of ESRANGE in the long run, if we cannot come to an agreement in autumn 1969.

With hindsight it can be noted that at the time of Bondi's letter, ESRO was considering whether in future it should concentrate only on satellites and transfer sounding rockets to the national programmes. Bondi had probably realised that there would perhaps, in the not too distant future, be some truth behind his threat.

A far easier safety issue was the wish expressed by the town of Kiruna's tourist board for spectator galleries for tourists and other interested people during launches. The board was persuaded that the risks were too great and the interest in activities could instead be satisfied by specially arranged tours.

Other problems included the issue of a school for French children in Kiruna, which ran for a long time, but was never resolved.

One sensitive issue was the level of salaries at the base compared to both local wages in Kiruna and salaries at other ESRO facilities. There was a risk that KGO would become depleted of technical and scientific personnel. Hultqvist reported that one of his best technicians who went to ESRANGE received a larger net salary there than he had received in gross pay at KGO. After lengthy discussions, a compromise was eventually reached which meant that foreign nationals employed at ESRANGE would receive higher wages than Swedish nationals, in the form of special foreign or "hardship" allowances. Even though this did not resolve the problem entirely, it helped to improve the situation.

One slightly comical episode was the storm which arose when a Belgian and a German company which supplied equipment to ESRANGE was found to have attempted to smuggle in beer, whisky and cigarettes in its consignments, under the cover of customs

exemption, probably to be consumed by the company's own staff while the equipment was being installed. Formal correspondence was exchanged and director-general Bondi made a formal apology on behalf of ESRO for "this irrational and senseless deed".

An even more sensitive and significantly more awkward issue was the position of director at ESRANGE. As has already been mentioned, despite protests from the Swedish delegation, ESRO had appointed a French officer, Albert Le Bras, as director of the base, although – somewhat remarkably – he was based at the headquarters in Paris. The issue was once again taken up by the ESRO Committee. In February 1965 Moberg wrote a letter to Auger in which he went to great lengths to describe the Swedish government's dissatisfaction at the appointment. He even went so far as to say that the experiences of Le Bras in Kiruna had been negative, partly on account of his lack of experience in civil administration. Activities at ESRANGE took place in a sensitive part of Sweden, Moberg wrote. The post of director of the base required diplomacy and good management – wrong decisions could seriously damage ESRO and its programme. "M. Le Bras is in our opinion not the person suited to this difficult and – to us at least – important task".

It is unusual for government representatives to use such strong words with regard to staff at an international organisation. But the letter did the trick, Auger took the message seriously and carried out a reorganisation. Le Bras was pushed upwards and disappeared from the picture. The director's post was re-advertised, this time being based at ESRANGE, and Jan-Olof Lenman from SAAB in Linköping was appointed. Lenman remained for the rest of the ESRO period, until 1972. He was an effective and capable director who cleverly and diplomatically struck a balance between the ESRO bureaucracy and the Swedish authorities. Under Lenman, cooperation between ESRANGE and the local people, included the Lapps, became good. He also strove to achieve effective cooperation with the ESRO Committee, in particular by keeping the Committee informed of the outcome of the different campaigns.

Sweden in ESRO

Alongside all the ESRANGE business, the work of the ESRO Committee was dominated by monitoring the regular work of ESRO. It was important to gain the greatest possible benefit from membership. The fact that the Convention had entered into force (March 1964) did not mean that ESRO was fully organised and operated without a hitch. There was still much to do, above all in terms of administration, before all the internal rules were approved and before the organisation established its working methods.

Like most international cooperative organisations, ESRO developed, even during the COPERS period, into an unwieldy, bureaucratic colossus in which the member states protected their own interests using all conceivable permitted, and sometimes not permitted, means, at the same time as keeping a jealous eye on each other. In formulating ESRO's rules, certain member states often used their positions for blackmail or horse trading in order to secure benefits in other areas of the organisation's activity, above all with regard to industrial contracts. Meetings became very frequent – during the first three years, the Council met 17 times, while the Administrative and Financial Committee met 45 times. In addition there were countless meetings in subgroups and ad hoc working groups. This meant a great strain on personnel, in particular for the small countries, which had to send delegates to the headquarters in Paris literally every week.

Cooperation with the secretariat became much better after the administrative director Crowley and the technical director Lines left ESRO. When Auger also eventually departed and was replaced by the astrophysicist, Professor Hermann Bondi, the atmosphere improved greatly. Bondi, who originally came from Austria, was inventive, imaginative and constructive. He often became agitated – his hair would stand on end, his arms waved around like windmill sails and his voice rose to falsetto. He made a point of having good relationships with the delegates – under the previous regime, you sometimes were given the impression that it was the duty of the delegates to serve the secretariat, rather than the other way round. You were afraid even to ask the simplest question.

As the cooperation improved, relations between the delegations also became better, even though there was an evident gulf between the "Latin" block and the Northern Europeans. As far as the Swedes were concerned, this meant that we worked together mainly with the British, the Danes and the Dutch. I met the Danish delegate, Obling, from the Ministry of Education in Copenhagen at my first ESRO meeting in the Hague. He looked after me and tried to show me the ropes. In the name of Scandinavian cooperation we always supported each other. He was not any great support in more difficult questions however – he was not one to seek out confrontation. The Dutch were represented by Hoogeveen and his colleague Goedhart who later became the Council's expert on the Convention. He knew it back-to-front and became highly agitated when we did not follow it to the letter, which occurred extremely frequently when ESRO entered into the field of applications. The agitation was articulated in an Oxford English which was more Oxford than Oxford itself.

The British delegation, on the other hand, spoke with Scottish accents with a rolling "r" (Hosie), or with a New Zealand articulation (Atkinson).

The French delegation often went its own way. One of its members – Mangon – excelled at filibustering. Often when he asked to speak, the delegates would stand to their feet demonstratively and leave the room. Professor Denisse, chairman of the French space organisation CNES, his colleague Bignier and their colleague from the Quai d'Orsay, de Boisgelin, were more willing to cooperate, though with a certain distance. A character unto himself was the old Spanish air force general, Luis de Azcarraga. His contributions were long, sometimes obscure, he always raised objections, but always ended up on the side of the chairman or the secretariat. He was dreaded by all Council chairmen – when he asked to speak, you knew that the meeting would be delayed. However, you could not be angry with him, since he had a rare individual charm and humour. He was the Spanish chief delegate in ESRO/ESA for more than 25 years. Less than a year after he retired, at more than 80 years old, he was killed by a terrorist just as he was leaving church after Sunday mass. It has always comforted me that, according to his faith, he was in a state of grace, having attended mass minutes before.

When Moberg and Bekeris left the ESRO Committee in 1965, Stiernstedt and Holmberg had to bear the burden alone. There were many trips to Paris and a workload which became impossible in the long run. It did not help that the affected ministries and government offices assisted in matters within their own specialist areas – for example, the Ministry of Health and Social Affairs for social security benefits for ESRO officials, the Ministry of Public Administration for pensions and remuneration, the Ministry of Finance for the drafting of financial regulations, the Patent Office for drafting copyright regulations etc. An additional problem for me was that I had my normal duties as head of the department for higher education and research in the Ministry of Education to perform. My colleagues in the unit frowned on my frequent absences and had good reason to do so, as space activity undoubtedly encroached on my work more than was reasonable.

In view of the high frequency of ESRO meetings, a permanent Swedish representative in Paris appeared to be the only rational solution. A post of technical and scientific attaché for space and other matters was introduced in 1966. The attaché was formally employed at the Academy of Engineering Sciences, but was appointed by the government and based at both the Swedish OECD delegation and at the embassy. The role of the post was to monitor the technical, scientific, industrial and research policy developments within the OECD, ESRO and France. In reality, it was the work in ESRO which would dominate. Claes Pilo was appointed to fill the post. He was succeeded in 1972 by Thomas Eckered.

Pilo reported both to the Ministry of Industry and its predecessor and to the ESRO Committee. He established good contacts in the ESRO secretariat and was often able to pick up information there about current issues and events. In addition, he could represent Sweden on the working groups and ad hoc committees and assist the regular delegates in ESRO's permanent bodies and occasionally deputise for them. To have someone who was constantly following activities on the spot clearly made the Swedish monitoring of ESRO more effective.

It was not only a question of drawing up the rules. In general the Swedish delegation was loyal to the secretariat and tried to support it in its difficult work. But at the same time, it was of course important to safeguard Swedish interests. Space researchers asserted themselves effectively without the need for assistance from the ESRO Committee – research cooperation had the support of the international research community and worked excellently on its own without external interference.

An aspect which needed to be monitored constantly was Sweden's international non-alignment. The Swedish government still feared that ESRO would be tempted to become involved with NATO. When in 1964 ESRO launched rockets from a French military facility on Ile du Levant, the Ministry of Foreign Affairs was concerned. "From a Swedish point of view, it does not appear appropriate that ESRO, for its activities, enters into agreements to use member states' military facilities, as is now occurring", stated a memorandum. It was added that "we do understand, however, that the organisation, at least during the initial phase of its activity, must often have recourse to member states' facilities, which are in general operated under military auspices".

When I put forward this view point in ESRO's Council, I did not receive any understanding. The general reaction was that the Swedes were unnecessarily anxious over non-alignment.

A more difficult task was to push forward the interests of the Swedish electronic and aviation industries. Those industries had held a strong position internationally for a long time. It was natural that they became interested at an early stage in the growing European market in space equipment. However, the market was very closed and the national research organisations kept to the industrial undertakings of their own country. The ESRO market then became all the more important. A list drawn up in the ESRO Committee in 1966 covers a total of 21 companies. Some of these fell by the wayside at an early stage. In 1969 the Working Group on Space Technology of the Swedish Association for Metalworking had thirteen members: ASEA, AGA, Bofors, Axel Johnson Institute for Industrial Research, Philips Teleindustri, SAAB, Sandvikens Jernverk, Standard Radio och Telefon AB, Jungnerbolagen, Svenska Flygmotor, SRA, Svenska Philips and LM Ericsson. Most of these would gradually also find the space market to be more costly than lucrative. Ten years later, only three really remained – SAAB, LM Ericsson and Flygmotor (Volvo).

As was explained above, a brief resolution had been added to the ESRO Convention in which ESRO was recommended "to place purchase orders for equipment and industrial contracts as equitably as possible in the member states after taking account of scientific, technological, economic and geographical considerations". When that statement was actually applied, difficulties quickly arose. The resolution was vague and left much scope for discretionary interpretation. Furthermore, unlike the situation when the resolution was drafted, there was now a fierce interest in the member states to ensure that their industries won as many and as large contracts as possible.

The Swedish side advocated innocently, but as would soon transpire naively and unrealistically, that the purchasing rules should be drafted so that, after weighing up quality and price, the organisation was guaranteed the best possible goods and services. On that basis, it rejected all talk of a "fair return" in the form of a reimbursement based on quotas allocated among the member states. Each time the Swedish delegations raised the matter, there was a general silence. The general starting point for the large member states in particular was just such a quota-based "fair return", that is to say each country would be awarded industrial contracts in relation to what they had paid in membership contributions. Obviously, at the same time this precluded an examination of quality and cost.

It did not take long, however, before the innocence was lost and Sweden supported the reimbursement principle as keenly as the other countries. A majority of the member states pushed for a rule under which the principle of geographical reimbursement would always be observed. However, if the lowest bid came from an industrial undertaking in a country which had exceeded its quota, a higher bid from an industrial undertaking in a country which had still not filled its quota would be accepted – but the higher bid could not be more than 10 per cent higher than the lower bid. A contributory factor to Sweden abandoning its resistance was that the ESRO secretariat supported the principle – it thus became senseless for the Swedish delegation to swim against the tide. The secretariat feared, however, that the quota-based reimbursement could allow quality to suffer – it did not seem to matter that price would suffer. In order to safeguard quality, countless detailed contract rules were formulated with very stringent controls, where the slightest departure from the contract would be penalised by a price reduction or even cancellation.

In the Swedish delegation, the specialist in contractual matters was the Assistant Undersecretary, Bengt Resare from the Ministry of Finance. He believed that the secretariat's rules were excessively restrictive and would push up prices. He therefore recommended that the contract terms be simplified and based on the standard terms as drawn up by the UN Economic Commission for Europe. His words fell on deaf ears, however. Time would prove him right – it would soon transpire that ESRO's satellite contracts were significantly more expensive than had originally been expected. As has already been mentioned, it was clear at an early stage that the ambitious programme set out in the Blue Book had broken down.

Thus, the flagship of the ESRO programme, LAS, the Large Astronomical Satellite, eventually had to be discontinued on cost grounds. The costs were estimated to be almost SEK 1000 million and, if the project had been continued, there would have been no funds left for any other satellites. The TD project progressed almost as badly. Originally there had been plans for a series of six satellites which would be launched with the American Thor-Delta rocket, hence the name TD. The satellites were intended as a standard platform on which various scientific experiments could be installed. At an early stage the number was reduced to four, then to three and, when the contract was placed in 1967, the number was just two – it was no longer possible to talk about a series.

In actual fact, ESRO was in a permanent crisis. In those circumstances, it was not easy for a small country whose industry was lacking in experience of space manufacture to assert its position. ASEA, LM Ericsson and SAAB ambitiously formed a consortium which, with a greater amount of optimism than experience, submitted tenders for the first two ESRO satellites. They did win a study contract for the ESRO 1 satellite, but that was all. When manufacturing contracts were awarded, it was obvious that only consortia composed of industries from several member states stood a chance. It was not easy to speak on behalf of the Swedish consortium – I have painful memories of secretariat officials' smiles of pity when, in one statement after the other, I spoke of the rational organisation of Swedish industry and its great awareness of quality and cost. I pointed out that it was against that background that the Swedish consortium would offer a lower number of working hours and therefore lower prices than many other tenderers. I was usually sent packing with claims that wages were too high in Sweden and that they did not trust the estimates of the number of working hours.

The reimbursement to Swedish industry was not therefore in proportion to our membership contribution. Certainly, Sweden had, for obvious reasons, been favoured when the contracts for the construction and equipping of ESRANGE were awarded, but those contracts were of no interest as far as development and knowledge were concerned, since they went primarily to construction, transport and office equipment firms. When ESRANGE was opened in 1966, they were valued at SEK 11.8 million. Clearly they were valuable from an economic point of view, and consequently could not be excluded from the calculations of the Swedish quota altogether, but they were not development contracts their value was reduced by 75 per cent – their quota value was thus SEK 2.9 million. For purely development contracts, which counted 100 per cent towards the quota, Sweden could account for SEK 5 million at the same time.

This was not a good result and industry called into question the benefit of Swedish participation in ESRO in contacts with the government in autumn 1966. Thus far, it had agreed to the loss because the preparation of the tenders was expensive. The costs were calculated in September 1966 to be around SEK 4 million and the knowledge gained by industry was minimal. Would it not be better to concentrate on a purely Swedish research programme, where the development and manufacturing costs went to Swedish rather than foreign industry? The Norwegian withdrawal from COPERS was cited on several occasions as an example worth following.

However, at the same time Swedish industry had done its homework. It was realised that if Sweden was to remain in ESRO, cooperation partners would have to be found in other European countries. And found they were. ASEA joined the British-led EST consortium (European Satellite Team), while SAAB and LM Ericsson became members of the Franco-German-English MESH consortium (Matra (France), ERNO (West Germany), SAAB (Sweden), Hawker Siddeley Dynamics (England)). Standard Radio och Telefon AB joined forces with the French Sudaviation. There was much at stake in January 1967 when the contract for the twin satellites TD1 and TD2 was to be decided in the ESRO's Administrative and Legal Committee.

Both MESH and EST together with Sudaviation submitted tenders. MESH held the greatest interest from the Swedish point of view, because a larger proportion of the 16 per cent interest of Swedish industry was represented by SAAB. The government was eager for SAAB to be awarded a contract – any civil alternative to military aircraft manufacture was regarded as important in the endless discussion on the fighter planes Viggen, and later, JAS. If SAAB had dropped away, questions could have certainly been asked – as industry had done already – about Swedish participation in ESRO.

It was not hard to figure out in advance how the voting would go, though it was uncertain where the British delegation stood and it held the balance. Before the meeting I had a conversation with the British delegate Jim Hosie. I hinted cautiously that a contract to EST could mean a Swedish withdrawal in 1972 when the mandatory first eight-year period had expired. Hosie kept me on tenterhooks – he had strong interests in both EST and MESH, though strongest in EST.

The meeting began. Each person spoke for their favourite, and I spoke in favour of MESH. Hosie asked for the floor and spoke ardently in favour of EST. I realised that that things looked bad for Sweden and became absorbed in gloomy thoughts; it was small comfort that ASEA would get a fairly decent share of the EST contract and that a few not insubstantial parts would even go to SAAB and LM Ericsson. But I suddenly heard Hosie say, with a slightly hesitant intonation, that, because the British partners in EST had previously been awarded a very good contract, perhaps MESH should be favoured all the same. Yes, he added, I believe I will vote for MESH, that is what I will do.

I could not believe my ears. MESH was home and dry! Hosie loved to be dramatic. He later acknowledged that his instructions gave him a free hand. I will never know whether my conversation played a part in his decision. In his annual report, Claes Pilo noted with satisfaction that “the TD contract is not only the biggest industrial contract thus far in ESRO’s activity, it is also the first satellite contract in which Swedish industry has significant interests”. There was great celebration in the Swedish delegation that evening.

SAAB and LM Ericsson were now involved in European industrial cooperation. After a few years, ASEA, like many others who initially expressed an interest, bowed out of aerospace industry development and manufacture. It had cost a great deal and not produced any dividend. It is open to speculation whether SAAB and LM Ericsson would have done the same had they not been given a share of the cake.

Unfortunately, the TD contract was not as valuable as had been thought. Costs escalated as time went by. Eventually, Italy lashed out and threatened to withdraw if the TD project was continued, actually not so much on cost grounds as because Italy did not receive much from the project. After an interminable number of meetings filled with quarrelling and aggression, it all ended with the cancellation of TD2, while TD1 was formally taken out of the ESRO programme to emerge again as a “special project” in which all countries except Italy participated. The glorious TD programme had finally collapsed. However, the important point for Sweden was still that SAAB and LM Ericsson had got their foot in the door and been given the opportunity to work with Europe’s big boys.

Industrial matters remained a constant concern within ESRO, however. Above all, there was a lack of a proper industrial policy, a benchmark for the distribution of reimbursements among the member states. It became slightly better when, during the TD crisis, Bondi pushed through a proposal that each member country, after certain deductions for administration etc, would be guaranteed industrial orders to a value of at least 70 per cent of membership contributions expressed as the reimbursement coefficient 0.7. At the end of the first eight-year period Sweden was badly placed – at that time it was barely 0.6. Nevertheless, hopes for an improvement were high since, at that precise time, ESRO was embarking upon the big, new applications projects which were expected to give a good dividend. These hopes would also be realised in due course.

The ESRO Committee was very ably supported in the technical analysis of ESRO projects by the Space Technology Group, which also assisted with the examination of contract proposals and analyses of ESRO's industrial policy.

An issue which was important for the effectiveness of ESRO cooperation was that personnel in the organisation came from all the member states. As soon as a post became vacant, it was advertised in the leading daily and specialist press in the member states. Even though the positions were very well paid, interest among Swedish engineers was low. In the 1960s foreign service was still regarded as rather dangerous and there were also fears of being forgotten at home.

After a few years, it could thus be observed that the Swedes were clearly under represented among the personnel ranks. One compensation was that for a couple of years (1965-67) Bert Bolin held perhaps the most important post in ESRO, the post of scientific director. In addition, the director of ESDAC, Stig Com  t, was a Swede. Other Swedes to whom particular mention should be given were Per Schalin, Adam Dattner and Inga Elgerus. Schalin came from SAAB and held many important ESRO posts at senior level. Dattner, who was a PhD pupil of Hannes Alfv  n, also held many posts with important and influential responsibilities, including that of planning director for a period in the 1980s. Elgerus originally came from the IAEA, the atomic energy organisation, and dealt primarily with personnel matters in ESRO/ESA. For a time she worked at ESTEC. At the same time, Roy Gibson was working there – they met and married. When in 1975 Gibson became director-general of ESA, it was considered inappropriate for his wife to be working there and Inga Elgerus had to leave the organisation.

Adam Dattner remained in ESRO/ESA for more than 25 years. He and his French wife, Elisabeth, who completed some of her training in Sweden, demonstrated generous hospitality to the Swedish delegation. It became almost a tradition at each Council meeting to have a good meal at their house. I used to joke that meals at the Dattners' house were what Sweden got out of its Swedish personnel. This was in contrast to some other delegations who were very eager to place their countrymen in key posts. These delegations were therefore, unlike the Swedes, always remarkably well informed – even when it came to purchases and contracts that were secret. The Swedish delegation and the Swedish officials were above such things. It is probably typically Swedish that when Bolin became scientific director, he could sometimes – probably for fear of favouring his

own country and probably without noticing it himself – be harder on the Swedish delegation than on other delegations.

However, it was not only ESRO matters which the Committee was required to address. Space travel and space research were still seen as something new and exciting and there was great curiosity over what was happening. The ESRO Committee was thought to know everything about flying saucers and there were many inquisitive telephone calls and letters. One matter relating to flying saucers came from the Prime Minister himself. In November 1967 "His Excellency Tage Erlander, Prime Minister of Sweden, Stockholm, Sweden, Europe" received a letter from a organisation called ICUFON in New York – the "International UFO Research and Analytical Network, Originator of Project G/Globe/, the only Global Cooperation of all the Nations, for UFO Surveillance and Mutual Information". Erlander was invited to support the organisation's efforts to resolve "a vital world problem". The problem had been created by a number of unknown "organs", which continually devoted themselves to disinformation and suppression of the facts concerning the constant increase in reconnaissance of the Earth by identified (!) flying objects. His Excellency U Thant, UN Secretary-General, had been informed of the impending danger represented by these objects and warned to set up, for protection, a sovereign space territory (!), under UN jurisdiction, 80 km above the Earth's surface.

The Cabinet Office sent the letter to Sven Moberg, requesting a proposed reply. Moberg forwarded it to me with the question "Is it about flying saucers?" and I sent it on to the ESRO Committee secretariat, which passed it on again to the Space Technology Group – a textbook example of how a matter is handled when no one wants it. There, John Martin-Löf prepared an overview of the UFO issue which came back to my desk, together with a proposed answer for Erlander. It was not the most pressing task to write a reply, particularly since the US embassy had informed me, following an inquiry, that the organisation was completely unknown. The letter nestled further and further down in my pile of papers. Only when I left the Ministry in 1979 – ten years after Erlander's departure – did it appear again and was consigned to the archive. Neither ICUFON or Erlander had remembered about it.

Wilderness Years

In his scientific memoirs, Bengt Hultqvist talks about the years 1964-72 as Swedish space research's wilderness years. The proud plans of the 1962 Space Committee lay in ruins. The job taken on by the Space Board of the Swedish Research Councils in 1964 was really not an easy one. The budget available to the Board had been granted primarily by the research councils. It was less than half of the amount proposed by the Space Committee as the basis for a progressive increase in appropriations. Moreover, national space research was completely dependent for the future on the interest and benevolence of the councils.

Against the background of a budget which was wholly inadequate from the beginning, the Board would endeavour to push Swedish research within ESRO and it was more than apparent that Moberg's ideas that ESRO should also finance experiments on board satellites and sounding rockets were unrealistic. However, in order to be able to assert its position in ESRO, a national space research programme was also necessary. Consequently, it was important on the one hand to finance Swedish ESRO experiments and on the other to further build upon the foundation which had been laid at Kronogård. It can also be said, quite crucially, that the situation was not made any easier by the fact that, as it would emerge, Swedish space research, and in particular the Kiruna Geophysical Observatory (KGO), was regarded as standing at the forefront internationally and was managing very well in the competition for using ESRO satellites and rockets. However, as has been mentioned, having an experiment on board was not free of charge.

When the Space Board began, it had roughly SEK 3 million at its disposal. Based on the research requirement which had developed during the first few years of the 1960s, this meant that there was in reality a shortfall. During its eight years of operation, the Board succeeded with great difficulty in dragging the grants up to barely SEK 6.3 million in 1971/72. Funding would always be lacking and there are countless memoranda, minutes and letters with calls for help to the research councils and the government which bear witness to the economic difficulties. The space industry (the Working Group on Space Technology of the Swedish Association for Metalworking) also complained in numerous calls and letters – often in consultation with the Space Board – that the lack of funding and the fragmented national structure resulted in a poor industrial return.

There were also complaints in the media about the shortfall. "Crisis of confidence hits Swedish space research", wrote the Uppsala Nya Tidning on 4 June 1964 in a report on a meeting with the Joint Group for Swedish Space Research at Uppsala Ionospheric Observatory, shortly after the 1964 bill had been passed by the Parliament. There was great bitterness at the meeting. According to the Uppsala Nya Tidning, the researchers put their demands to the government in six points:

- Swedish delegates to ESRO had to be able to put forward Swedish projects with scientific authority. (This implied that Sweden should be represented on the ESRO Council not by bureaucrats, but by space scientists. It appears to have been overlooked that Hulthén was appointed as a delegate to the Council, although they were possibly looking for active space researchers. Hulthén was a theoretical physicist and did not conduct experiments in space.)
- The exchange of information between Swedish scientists and ESRO had to be promptly reorganised. (This was in fact done through the Space Board and the ESRO Committee.)
- A permanent technical/scientific secretariat had to be established to handle rocket projects. (This was achieved partially when the Space Technology Group was placed on a permanent footing.)
- Industrial and scientific centres had to be stimulated so that the large sums paid by Sweden to ESRO were put to good use.
- Swedish scientists had to be afforded the opportunity to conduct experiments at the Kiruna base, since ESRO considered that experiments should be financed nationally. (To a limited extent ESRANGE was also used for Swedish experiments through the Space Board).
- The ESRO Committee had to utilise contacts with NASA in particular. (This demand was outside the mandate of the ESRO Committee, since it was responsible only for contacts with ESRO, and therefore could not be met).

The major problem was and remained the lack of funding. "Sharp criticism from scientists over inadequate appropriation", reported Dagens Nyheter in February 1966. "We have to watch while others carry on research". "Slightly more than 200 million is needed for Swedish space research", wrote the scientific correspondent Arne Karsberg in Dagens Nyheter on 21 March 1969.

Of course, the objection could be raised that it is not unique for council appropriations not to be adequate to satisfy all those who have applied, which makes it necessary to make difficult priority decisions. However, in the case of space research there are undoubtedly some special circumstances. It is in itself extraordinarily costly, it requires very expensive technical facilities and considerable base resources which cannot to any large extent be supplied as part of the universities' normal basic support, but had to be built up during the 1960s using the Space Board's appropriations. It is also time-consuming – the turnaround time for a satellite experiment can be put at around 5-6 years from the beginning of detailed planning to the point when measurement data is available for analysis. Experiments are difficult to plan from an economic point of view, because they can be dependent on circumstances which are not related to the experiment itself, for example the launch time, which may be dictated by the needs of other payloads on board the same rocket. Delayed launches are countless in number and if the experiment is dependent on

the launch taking place during a specific period of time, the "launch window", it may have to wait for another launch. If the launch is unsuccessful, not only are the expected results lost, but also years of preparations. It is not difficult to imagine how it would feel for a doctoral candidate who is developing parts of his thesis around a space experiment if it then comes to nothing.

The Space Board certainly made difficult priority decisions and was forced to act as executioner vis-à-vis institutions which, according to the 1962 Space Committee, would have cooperated in the development of an extensive and effective Swedish space research programme, though this still did not protect it in the long run from unforeseen problems.

However, the Board adopted a wise policy. Rather than scattering its appropriations across the board to everyone who had some interest in space research, it concentrated on three areas and within the five research groups where high-quality space research had already been developed. Support to those groups was intended primarily to consolidate a basic activity whose long-term objective was experiments on board ESRO satellites or on sounding rockets, either within ESRO or as part of the national sounding rocket programme. The areas and institutions involved were the following:

Astronomy and astrophysics

Institute of Astronomy at the University of Lund

Geocosmophysics

Kiruna Geophysical Observatory (KGO)

Uppsala Ionospheric Observatory (UJO)

Institute for Plasma Physics at the Royal Institute of Technology (KTH)

Upper atmospheric physics

Meteorological Institute at Stockholm University (MISU)

In addition, the Board supported space-related fundamental research at for example the Institutes of Geodesy and Physics in Uppsala, the Stockholm Astronomical Observatory, the Institute for Electron Physics at Chalmers and various individual researchers, who received both research and travel grants. The list of those receiving grants included two young scientists whose life's work would be expanded to cover the entire spectrum of space activity and space policy, Kerstin Fredga and Fredrik Engström.

Kerstin Fredga originally came from Uppsala where she took her licentiate examination in astronomy, but she was now conducting further research with Alfvén at KTH. In the 1960s she spent several years in the United States as a holder of a NASA scholarship at Goddard Space Flight Center and in the Netherlands at the University of Utrecht. At Goddard she was responsible for the development and construction of rocket-borne instruments for conducting ultra-violet solar studies. Four rockets with her instruments were launched from White Sands Missile Range in New Mexico, USA. The results formed the basis of her doctoral thesis at Stockholm University in 1971. From the Space



Kerstin Fredga, future director-general of the Swedish National Space Board, with a rocket experiment for studies of the Sun in ultraviolet light. The rocket, an Aerobee 150, was successfully launched on 12 April 1965 from the White Sands Missile Range in New Mexico, USA.

Board she received a grant for certain instrument components for NASA cooperation as well as travel allowances in order to attend inter-alia ESRO's summer school in Alpbach, Austria, in 1963 and 1965.

Fredrik Engström, who took part in the Kronogård campaigns, was also an astronomer. He undertook his postgraduate studies at the Culham laboratory in England and at Stockholm Observatory and was awarded a grant for studies of the Sun's ultra-violet spectrum and travel allowances for various conferences.

However, the appropriations were not sufficient for any major experimental activity. Through cooperation with NASA, it was possible for some researchers to be involved in experiments in rocket launchings in the United States and Norway. But, it was of primary importance for the Space Board – as stated in the 1967 budget bill – to take advantage of ESRO membership. Experiments on board ESRO rockets or satellite therefore took priority. The five "base institutions" participated in ESRO's sounding rocket programme at ESRANGE with various experiments, including proton and particle measurements (KGO), studies of the aurora borealis (UJO), mesosphere, atmosphere, particle and ozone measurements (MISU), studies of micro-meteorites (Lund group), electronic field measurements (KTH group). Research groups used ESRO's sounding rocket programme to an extent which was proportionally greater than the Swedish contribution during that period.



*Fredrik Engström during the 1962 Kronogård campaign. He later became head of RTG and the Swedish Space Corporation. He is now director of ESA's launcher programme.
Photo: RTG*

The Space Board never failed to point out in its appropriation proposals that satellite experiments generally required preparatory tests on board a sounding rocket. The insufficient access to rocket launches in the national programme reduced the possibilities for Swedish researchers to use ESRO satellites. Despite this, the KGO, through Bengt Hultqvist, was very successful in the fierce competition to place experiments on board ESRO satellites.

On 17 May 1968, slightly more than ten years after Sputnik, ESRO's first satellite had been launched. This was ESRO II, or Iris as it was named after the launch. It was followed on 3 October the same year by ESRO I, or Auroræ, which was launched with a SCOUT rocket from the Western Test Range in California. The purpose of the satellite, which weighed around 85 kg, was to collect ionospheric data, having particular regard to investigation of the structure of the aurora borealis and the connection between various auroral phenomena. One of the eight experiments on board came from KGO and involved the measurement of electron and proton spectra using electron and ion spectrometers. The experiment worked well for the entire lifetime of Auroræ, that is to say until 26 June 1970, when the satellite re-entered the atmosphere and burnt up.

One year later – on 1 October 1969 – ESRO 1B, in actual fact the back-up for Auroræ, was launched from the Vandenberg base in the United States. Its task was to study the ionosphere's cold electrons and ions in a very low orbit – it was therefore called Boreas. On this occasion too, there was a KGO experiment on board, which was essentially the

same as the one on *Auroræ*, though with some different apparatus. *Boreas* re-entered the atmosphere after only seven weeks, but during that brief period it was possible to carry out measurements using instruments in both *Auroræ* and *Boreas*.

Bengt Hultqvist has pointed out that while *Auroræ* was in space, KGO had access to a database whose importance cannot be underestimated and which generated new scientific results for an entire decade. He has also eloquently described the feelings of a space scientist at a launch:

On the whole, KGO's first satellite experiment was definitely successful and it paved the way for a future for the group in satellite experiments. If it had been unsuccessful for any reason, whether or not it was on account of ourselves, then not only would the group's future opportunities to compete for space on later satellites have become fewer, but also the individuals in the group would have fallen into difficulties. After five years of intensive work, we would have stood there empty-handed if for example the launch had been unsuccessful or if a significant part of our own experiment had failed. There was enormous tension before the launch. When it had gone well, we still had to see how the experiment had worked, which we could not ultimately know until we had studied large quantities of data. We found all the problems which were connected to the long execution period for satellite experiments to be very trying.

All went well, however, and successes followed. Reference has been made above (page 160) to ESRO's TD project where, as a result of inescapable circumstances, the number of satellites was reduced from six to one. For a long time, however, the organisation believed that it could launch two TD satellites. TD1 would measure ultra-violet radiation, X-radiation and gamma radiation while TD2 would be an ionospheric/magnetospheric satellite. One of the experiments came from KGO and concerned particle measurements and directional distribution of electrons and ions in the 0.5-150 keV energy range. When TD2 also had to be cancelled, some of the experiments – including KGO's – were transferred to a smaller satellite, ESRO 4, which was successfully launched in autumn 1972. In the space of four years, KGO had sent three satellite experiments up in space, the only Swedish institution to do so.

The next ESRO project was important for KGO. It was GEOS, ESRO's first research satellite in geostationary orbit which would measure particles, plasma and lines of flux in the magnetosphere. The satellite was technically advanced and competition to be on-board was very fierce, but KGO once again succeeded. In advance, the rival groups had agreed that the winner would share with the others the incoming measurement data. This was done, which meant that KGO also had to bear the entire burden of responsibility for developing its particle measurement experiment and for reducing the raw data to physical numerical values which were then sent to the other groups in Denmark, France and West Germany – a good example of loyalty among scientists.

GEOS was approved by the ESRO Council in 1969 and was launched – two years late – in spring 1977. The project was significant for KGO and, as a result, it would play some part in Sweden's decision to remain in ESRO after the end of the first eight-year period in 1972, as we will see. In October 1970 a call was made on Sven Moberg, now Minister without Portfolio with responsibility for higher education and research, by Bengt Hultqvist. The discussion chiefly concerned the implications of a Swedish withdrawal from ESRO, in which case KGO would miss out on the GEOS experiment. Hultqvist asserted that KGO was unique in its combination of ground-based and space-based research – many similar institutions in other countries concentrated on obtaining data either from the ground or in space. However, it was precisely this combination that was KGO's strength and a condition for the observatory being able to remain on the front line. A withdrawal from ESRO would mean that it would be seriously weakened from a scientific point of view, since the loss of the GEOS experiment would mean that almost all the satellite-based research planning for the 1970s would come to nothing. It would also mean that Sweden would lose out on important European, and to some extent global, research cooperation.

Hultqvist's arguments made an obvious impression on Moberg and I remember that he later referred to it sullenly as one of the reasons for Sweden remaining in ESRO.

However, it was also important for the Space Board to set in motion a national experiment programme. Summer 1964 had been the last year at Kronogård. ESRANGE had opened in 1966. Under the agreement with ESRO, Sweden had access to the base for its own launchings. With the difficult situation created by the space decision in 1964, however, it took a long time to get started. In 1967 the Board drew up guidelines for a progressive sounding rocket programme with two rocket campaigns each year as from the 1968/69 financial year. The plans were approved by the research councils, but they were not able to allocate the money that was required. Consequently, some of the plans were shelved. The Board was forced to undertake a reduced programme of launchings. From autumn 1968, however, it was possible – in collaboration with NASA – to arrange one campaign a year at ESRANGE, including occasional launches from Andöya in Norway. The participants were the "base institutions" – support for them had now produced a dividend. The projects included the "Twilight Probe" in 1970 in cooperation with ESRO and NASA. The objective of that campaign was to investigate, through launchings of seven rockets, the chemical and physical processes which determine the structure of the Arctic mesosphere. During the last year of the period, the "Aurora Borealis Probe" project was carried out – the name shows the aim of the project – with KGO, UJO and the Lund group as participants.

For a few years the space researchers' joint group rented from the National Board of Public Building a former school for nomads in Jukkasjärvi, and also for a time the home for elderly Lapp people. They used to accommodate Swedish and sometimes foreign research groups in connection with rocket campaigns at ESRANGE. Not far from the buildings an observation area was set up to enable optical observations during campaigns. The activities were funded mainly with the help of an annual grant of SEK 20.000 from the Space Board.

As part of the Space Board's modest administration budget, funds were also set aside for its own conferences and meetings, forward studies etc. Thus, in February 1966, a symposium was arranged to inform researchers, technicians and studies of developments in Europe. Leading figures from European space research gave papers – Robert Boyd from University College, London, Reimar Lüst from the Max Planck Institute for Physics in Munich, C. de Jager from the University of Utrecht and, amongst others, Hannes Alfvén and Håkan Sterky from Sweden.

The expenditure incurred by the Space Board also included the agreed contribution to the Space Technology Group (RTG). It now emerged how wise the decision to keep the RTG together had been. In relation to its work of carrying out technical analysis of proposals in the slimmed-down research programme and helping with the ESRO Committee's monitoring of the ESRO programme and safety at ESRANGE, the Group was, at least initially, somewhat oversized, particularly in the light of the very limited number of national launchings. On the other hand, this meant that the RTG could devote a relatively large amount of time to the type of activity which is often neglected due to lack of time: studies, investigations, surveys of space activity in other countries, forward planning etc. It set to work with optimism and faith in the future – despite everything, the RTG had not let itself be defeated by the breakdown of 1964; minutes and memoranda bear witness to a belief in better times and that reason would win through. When this finally came about at the beginning of the 1970s and Swedish space activity was placed on a permanent footing within a coherent organisational framework, there had therefore been, from the early stages, a very good knowledge base on which to fall back and a willingness to develop a carefully devised and rational programme.

There really had to be optimism when it came to setting in motion a Swedish satellite project. The project, sometimes called SATAN, was born in spring 1967 during discussions on the future between RTG and industry (ASEA, LM Ericsson, SAAB). In October 1967 a first plan had been formulated within RTG. Under the plan, satellites would be the key element of an introductory phase of a balanced Swedish space programme. RTG had received some encouragement from the reorganised Ministry of Industry which was now beginning to take an interest in the possibilities offered by space – this will be examined further in the next chapter. The Space Board provided assistance in the form of a small grant.

The most important factor for the project was that NASA was responsible for the launch using a SCOUT rocket. The European options were deemed to be too uncertain and risky – even ESRO was using American rockets at this time. The project was to provide as much technical know-how as possible to the Swedish space programme and to Swedish industry. With a view to the future development of communication and observation satellites, particular attention was to be paid to advanced telecommunications, data processing and data reduction, attitude and orbit control and power supply. SAAB was judged to have good facilities, on the basis of its computer equipment in the Viggen aircraft, to be able to develop an on-board computer for satellites – in due course such a computer would become one of the company's most important space products.

Furthermore, it was thought that LM Ericsson could develop equipment for satellite communications in the microwave band.

An experiment proposal from Bengt Hultqvist at KGO would determine the shape of the project. It consisted in the systematic measurement of particle radiation which fell into the ionosphere under the influence of the Earth's magnetic field and, amongst other things, gave rise to the aurora borealis. The energy spectrum of the particle flux would be measured using a large number of detectors of various kinds – channeltrons, semiconductor detectors and Geiger-Müller tubes. KTH would also supply a magnetometer on board.

The experiment imposed precisely the technical requirements which were seen, from the point of view of industry, as particularly important to develop with a view to the future applications satellites – an on-board computer was required, as well as a ground station for transmission of primary telemetry data using a microwave link.

Contacts with NASA turned out to be positive. At first, the American experts believed that the project was too ambitious to be a suitable first project. Questions were raised in particular over the possibility of using a satellite-borne computer after a single stage of development. However, when certain complementary studies were presented and the level of ambition was slightly reduced, NASA's doubts disappeared. Interest in establishing cooperation even became so great that, contrary to the customary practice, the Americans declared that they were prepared to allow Sweden to take advantage of performance improvements to the SCOUT rocket which still had not been formally decided, in order to help to resolve certain problems over power supply and weight. As a condition for the cooperation, the hope was expressed that space on board would be given to at least one, and preferably two American scientific experiments.

The satellite was expected to weigh 100 kg and would be launched in November 1971 in an elliptical polar orbit with a minimum altitude of around 400 km and a maximum altitude of around 1800 km. The costs were initially estimated to be around SEK 50 million, but subsequently rose to approximately SEK 70 million.

As has already been mentioned, the project was informally encouraged by the Ministry of Industry and it was also presented in one of the Ministry's committees of inquiry on space. All in all, almost SEK 1 million was allocated by the Space Board, the National Board for Technical Development (STU) and industry for studies of the project. Nevertheless, it was never executed – it was not yet the right time. When money was requested from STU in order to progress from the initial study phase, it was refused. It would be 1986 before the first Swedish satellite – VIKING – was launched. However, studying the documents concerning the project, it is interesting to see how clearly it points the way forward – there is a straight line from the satellite proposal of the 1960s to VIKING in the 1980s and FREJA in the 1990s.

There was not only a focus on satellites, however. It was also an obvious option to take an interest in sounding rockets. A collaboration between FOA, the Space Board and RTG

was initiated. The results were described in a report from FOA in February 1968. It first observed that there were many sounding rockets on the international market – no less than 26 different types were listed in an annex. A new rocket therefore had to be able to demonstrate some considerable advantage over existing types. A major reduction in impact dispersion – the risk factor which limited the use of ESRANGE – would be one such advantage and make a new rocket interesting for all users of the rocket range.

The proposal was to develop a Swedish two-stage rocket with a stabilised first stage equipped with a newly developed guidance system. A solid propellant rocket with around 800-1000 kg of solid fuel was proposed for the first stage and the second stage would be a tried and tested rocket motor using either solid or liquid propellant. The project would be executed by Swedish industry. The rocket was expected to be about 8 m in length with a launch weight of 1.5 tonnes and a load capacity of 100 kg up to an altitude of 300 km. The development work would take four years and cost around SEK 8 million. Unfortunately the project did not even make it as far as the drawing board.

At the same time, another project was in progress at the aircraft company Svenska Flygmotor AB. Since 1962 it had worked on the development of "hybrid" rocket motors. On the basis of that work, a proposal was now made for a sounding rocket motor called SR-1. It had considerably lower performance than the FOA rocket and would be able to lift only 10-20 kg to an altitude of 150 km, which was still sufficient for experiments in areas such as ionosphere physics. There were preliminary discussions on a compromise between the two projects. Uncertainty over the market meant that Flygmotor did not regard the development costs as a normal investment, but considered that it could continue only with assistance from STU. No such assistance was ever granted.

For seven years the Space Board fought for an existence marked by difficult priority decisions, constant compromises and even more disappointments at the lack of understanding shown by the government for its work. When, in the spring of 1971, the Board learnt that the research councils could not increase the appropriation for the 1971/72 financial year, patience ran out. It was decided to suspend the sounding rocket programme – in the long term space research could not reasonably be conducted if there was no money for experiments. RTG exerted pressure – the possibility of a Swedish ESRANGE could not exist at the current programme level. At the same time all the members of the Space Board vacated their positions. The activity in 1971/72 was carried out by a steering group whose responsibilities included conducting the last campaign, the Aurora Borealis Probe project.

The resignation of the Space Board attracted attention. "We are no longer needed", members told Dagens Nyheter. The decision caused consternation among the research councils and there was a move to persuade the Board to continue. But the Board stood firm. According to its chairman, Bengt Hultqvist, it was not "possible to continue to work, because funds are sufficient only to pay for the minimum possible infrastructure, but not for the use of the infrastructure for conducting research".

The reaction in the Ministry of Education was quite different. Moberg saw the members' resignation as attempted blackmail and this reinforced his determination to hold firm to the decision of 1964. As far as I was concerned, as an official I of course had to observe a certain loyalty, but after eight years' involvement in space activities I really did not feel any inner loyalty to the decision. I therefore asked RTG to work out the minimum costs for maintaining a national sounding rocket programme. The calculation indicated SEK 12.5 million or roughly a doubling of the Space Board's appropriation. If ESRO were to discontinue its sounding rocket programme, which was then being discussed, there would be an additional 4 million, plus a further million for the development of a Swedish sounding rocket. In total there would therefore be around SEK 17.5 million.

That was a large amount of money at that time. There was no money available and it could not be conjured up by magic. My view was confirmed that we had reached a point where it was necessary to decide whether we wanted to have Swedish space activity or not. With the current organisation and resources it would not be possible in the long term. The Space Board had had an impossible task and when it emerged that the task was impossible, it took the consequences. The ESRO Committee's task was also impossible. Its mandate was only administrative and budgetary, but because it did not have responsibility for the substance of the activity, it found that it was very short of air to breathe. If there was a desire to maintain a Swedish space activity, two things were necessary in my opinion – a coherent organisation and more money for a national programme which comprised not only fundamental research but also applications.

Now I had to convince the government of that. I could not do it alone. My hope lay with the Ministry of Industry.

ESC and ESRO's First Package Deal

It did not take long after ESRO and ELDO had actually set to work before voices were raised calling into question the way activities were structured. Things had not gone according to plan. ESRO's satellites and sounding rocket programme proved to be many times more expensive than had been thought. As has already been mentioned, the proud flagship, LAS (the Large Astronomical Satellite), had been discontinued after painful discussions. In addition, the other satellite programmes and sounding rocket programme had to be slimmed down. In ELDO the test launches were going badly and the financial calculations suggested major overspending.

The international arena was dominated by the United States and the Soviet Union, which pursued successful programmes on a large economic scale. The United States was preparing the Moon landing of 1969 and had already begun to work out what would follow – the post-Apollo programme (space shuttles etc), in which Europe was invited to participate. In 1967 alone, the USA launched 77 satellites into orbit around the Earth and 10 space probes into escape orbit into space. The corresponding figures for the Soviet Union were 66 and 1. In the same year ESRO launched one satellite – its first. ELDO carried out two test launches. Both failed. While the first stage – Blue Streak – worked, the second stage did not ignite.

At the same time, a revolutionary, rapid development occurred in the field of telecommunications. Here too, the Americans were the first to arrive. They began experiments with communications satellites at the end of the 1950s. In July 1962 they launched Telstar, which could convey telephone conversations and television pictures across the Atlantic; just a few days later, the world's major television companies, in cooperation with the European Broadcasting Union (EBU), transmitted the first television programme via satellite. One year later, Syncom was sent up – the first communications satellite in geostationary orbit at an altitude of 36.000 km above the equator. In 1965, Early Bird arrived – the first commercial communications satellite. Intelsat (International Telecommunications Satellite Consortium) had already been formed on an American initiative in 1964. Early Bird, renamed Intelsat 1, became its first operational satellite. Many western European telecommunications authorities joined Intelsat. However, the initiative and influence in the organisation lay with the Americans; as usual, Europe was in danger of falling behind. This was undoubtedly partly the result of conservatism among the telecommunications authorities which had long viewed space technology with suspicion and, deep down, preferred to continue to bury themselves in the Earth.

However, they were not too foolish to realise that it was important to keep an eye on the new technology and maintain a readiness in case it caught on in earnest. The Swedish, Danish and Norwegian telecommunications administrations therefore formed a joint committee for space communications, the Scandinavian Communications Satellite Committee, as early as 1961. In cooperation with NASA, it conducted reception

experiments using a large aerial which was erected at Råö, in connection with the radio-astronomical observatory run there by Chalmers professor Olof Rydbeck. The cooperation led to the establishment in 1971 of the Scandinavian Communications Satellite Station in Tanum.

A new player had also arrived on the European scene. It was CETS (Conférence Européenne des Télécommunications par Satellites - European Conference on Satellite Communications) which was formed in 1963 in order to coordinate the positions of the western European states on the developments in the field of communications satellites and to study possibilities for developing a European experimental communications satellite. The joint organisation of the European telecommunications administrations, CEPT (European Conference of Postal and Telecommunications Administrations) was behind the plan – ultimately the formation of the organisation went back to an initiative by Håkan Sterky, Director General of the Swedish telecommunications administration, who, unlike many of his colleagues, realised at an early stage the future importance of space communications. Sweden participated in the CEPT and CETS through the Ministry of Transport and Communications. After Sterky retired, however, the suspicion of satellites shown by the administration appears to have grown. In *Dagens Nyheter* on 20 September 1967, for example, it was reported that the telecommunications administration had doubts over a European communications satellite – “the Board of Telecommunications doubts the value a long-term concentration on satellite technology can have”, it was reported.

In the mid-1960s there were therefore no less than three European space organisations – ESRO, ELDO and CETS. ESRO's field was fundamental research, ELDO's was rocket launchers and in the longer term – if it succeeded in launching its rockets – possibly also applications. CETS was responsible for cooperation between telecommunications administrations on communications satellites.

Criticisms of European space activity highlighted the fragmented organisation and pointed out that not all areas of space technology, such as meteorology and other long-range analysis, were covered by the three organisations. As early as 1962, the Western European Union (WEU) expressed concerns that a single space organisation had not been formed. In a resolution in 1965, the WEU recommended that a ministerial conference be called in order to define a coordinated European space programme. In a report from the Council of Europe's Economic Committee, which was produced in 1966 by the Swedish member MP Sven Gustafson, there were calls, in strong words, for an improved coordination of European space activity. Furthermore, the Consultative Assembly of the Council of Europe recommended in resolutions of May 1966 and January 1967 that ESRO, ELDO and CETS be merged into a single organisation. The 1966 resolution also proposed that an intergovernmental conference be called to resolve the problem.

And so it came to pass. In the spring and summer of 1966, ELDO held three council meetings at ministerial level, primarily to seek to resolve a crisis which had been caused when the United Kingdom threatened to leave the organisation. According to the British, ELDO was spending far too great sums on a rocket which would shortly be outmoded. Europe could obtain better and cheaper rockets if they were developed in collaboration

with the United States, or even purchased from the USA. The British position represented a new policy launched by the Minister for Technology, Anthony Wedgwood Benn. It claimed that expensive high technology should be imported from the United States and that the large savings which could then be expected should be used to develop neglected areas of research, particularly social research. The 1966 ELDO crisis was temporarily resolved by a reduction of the British contribution at the expense of the other Member States.

The crisis had shown, however, that dangers lurked beneath the surface and there was no great unity. This applied not only to ELDO, but also ESRO, where the member states had made every effort in the course of interminable council meetings to reject or reduce the budget and programme proposals made by the secretariat. Against this background of crises, ELDO's Council of Ministers readily addressed the wishes of the WEU and the Council of Europe for a high-level conference to resolve the problems. In summer 1966, the ELDO ministers decided to take the initiative for a European space conference at ministerial level.

The first space conference (European Space Conference, ESC) took place in Paris in December 1966 and had been formally convened by France. All the ELDO and ESRO states participated, together with CETS states, although some were merely observers. Sweden hesitated up to the last minute over whether it should attend. The conference was seen as being too greatly inspired by ELDO. After France had privately exerted pressure, Sweden did attend, as an observer. Pilo represented the Swedish government.

The results of the first ESC conference were meagre – the delegates all complained of the lack of coordination between the space organisations and formed a committee of deputies to review European space programmes internationally and nationally. It was the beginning of a long and difficult journey and over the next nine years the Paris conference would be followed by a further seven ministerial conferences and countless meetings in countless committees and working groups. "Space fiasco for Europe. Chaos threatens", wrote Dagens Nyheter on 24 January 1967.

The issues on which it was so difficult to reach agreement over the next few years can be summarised in the following points:

1. A single space agency rather than three could be accepted in principle fairly easily. However, it was much more difficult to agree on the agency's programme and priorities. In plain English, should the scientific programme be cut back in favour of an applications programme? Would participation in the various programmes and projects be voluntary or be based on an *à-la-carte* principle? How extensive would a mandatory minimum programme need to be in order to ensure survival and continuity for the organisation? One thing was clear – for many of the small countries to be able to accept a mandatory minimum programme, it could not include development of ELDO rockets.

2. Should Europe accept the United States' offer to participate in the "post-Apollo" programme which encompassed space laboratories, space shuttles etc. How much of its technology could the Americans be expected to share with Europe?
3. Should the ELDO programme be continued or should Europe, as the British claimed, abandon the development of its own launchers and instead purchase launches using American rockets and in the long term the prospective US space shuttle?
4. Should the new agency develop applications satellites for telecommunications, navigation, meteorology, surveillance? On the basis of what criteria? Or should the responsibility for development be transferred to the future users?
5. What rules should apply to the agency's industrial policy? Should the principle of fair return be pursued to the ultimate limit, even if that meant higher costs?
6. What should be the structure of the new agency? What decision-making procedures and voting rules? What budget regulations?

The issues were difficult, particularly as the delegates often proceeded from entirely different premises and diametrically opposed points of view. The most difficult issues were participation in the post-Apollo programme and whether the organisation should have its own rocket development programme – both also had significant direct consequences for large areas of the other activities.

It therefore took a long time before agreement could be reached. My own recollections of the years 1966-70 are an endless series of meetings in ESC's committee of deputies, in its senior officials committee and in one working group after another. The common ground between all these meetings was that they generally closed without any results having been achieved – after each meeting, you returned home with increasing pessimism and frustration.

When ESRO was formed, the planning of activities had been monitored not only by the Ministry of Education and Culture, but also by the Ministry of Trade, where Hans Håkansson was responsible *inter-alia* for matters of technical development and research. As has already been explained, Håkansson was also a member of the ESRO Committee and, together with Stiernstedt, attended meetings of ESRO's administrative committee (AFC) and Council at an early stage.

In the mid-1960s there were discussions within the Swedish Social Democratic Party and the government as to whether the government should pursue a more active industrial policy. "The new Ministry of Technology should conduct industrial research", said Ragnar Edenman in an interview in *Handelstidningen*. The driving force in the debate was Krister Wickman, then still Undersecretary of State in the Ministry of Finance. The government settled the matter in 1967, when Wickman was appointed Minister without

portfolio and responsible for the "economic and industrial affairs units" in the Ministry of Finance, including technical development and research. By 1969 the units were reorganised into a ministry, the Ministry of Industry, headed by Wickman. Håkansson had also come from the Ministry of Trade in 1967 and now worked in the new ministry as an adviser. He still had contact with space matters and participated in ESRO work.

When the Ministry of Industry was being set up, Håkansson cast his eye over the Space Technology Group (RTG). The members of the group were unconventional and committed and their knowledge and intelligence could be put to good use in a new and enthusiastic ministry. Lennart Lübeck had gone there himself in spring 1969 and was working as an expert in European research cooperation, although formally not space activity. The following year, Håkansson also recruited the group's head, Lars Rey, to the Ministry. As has already been mentioned, Rey was replaced as head of the RTG by Fredrik Engström.

But something else was already happening. When the economic and industrial affairs units were formed, hopes were also raised in the space industry, which had perhaps not always thought that its problems were properly understood by Moberg in the Ministry of Education and Culture. The Working Group on Space Technology of the Swedish Association for Metalworking made a call on Wickman and put forward its concerns for the future of space in Sweden. This resulted in the formation of an informal government "working party for space technology" in June 1967. The group's role was "to compile the material necessary to enable an overall judgement of the efforts which should be made by Sweden on the one hand within European space cooperation, and on the other with respect to domestic space technology". Space research was included in the survey.

All affected ministries were represented in the working party – from the Ministry of Industry came Håkansson, as chairman, and Bo Aler, from the Ministry of Education Stiernstedt, from the Ministry of Foreign Affairs, Lennart Eckerberg, a senior officer, and from the Ministry of Transport and Communications, deputy assistant undersecretary Bertil Voss. The interests of users and industry were represented by Arne Rohdin from the Telecommunications Administration, Henry Scheffe from LM Ericsson and Bengt Schmidt from SAAB. Lars Rey was the group's secretary.

The working party's report was delivered in 1969. It was an excellent description of the space activity being pursued in Europe and in Sweden; it recommended increased Swedish participation and outlined the consequences of investment at various economic levels.

At the same time, another group was working at the Ministry of Education. Since autumn 1967, Olof Palme had been head of the Ministry. He had previously been Minister for Communications and, in that capacity, had responsibility for Sveriges Radio (Swedish Broadcasting Corporation). When Palme moved over to the Ministry of Education, he took broadcasting responsibilities with him. He was clearly interested in media issues and it was rightly thought that broadcasting belonged in the ministry which also had responsibility for cultural matters.

The director-general of the Swedish Broadcasting Corporation was Olof Rydbeck. The company was constantly being remodelled during the 1960s. Rydbeck and his closest co-worker for international business, Edward (Eddi) Ploman, director of Sveriges Radio's international secretariat, had realised that, within the not too distant future, programmes could be distributed via satellite. There was strong interest in the European Broadcasting Union (EBU). Already sound and pictures were being received via space – "an astronaut's heartbeat can boom out of our loudspeakers and pictures of man's first slow movements in space flicker on the television screen", wrote the space enthusiast Ploman in his book *Jord, rymd, kommunikationer* ("Earth, space, communications") in 1969. Rydbeck and Ploman received little response from the agency responsible for the distribution of radio and television programmes, the Telecommunications Administration. However, they did get a response from the new Minister of Education. Olof Palme understood that a development of importance to media policy had been initiated by the space age. He wished to be kept informed. At irregular intervals a small, informal group, consisting of Rydbeck, Ploman, Stiernstedt, and often an official from the Ministry of Foreign Affairs, met in his office. During the meetings, the latest developments in the space field were presented with particular attention to the distribution of radio and television programmes. Palme was particularly interested in developments in Europe – the Europeans could not be dependent on the United States for their media distribution, he stressed.

The Palme group did not take any decisions and it existed only during Palme's time as Minister for Education (1967-69). Its purpose was to keep the Minister informed. Palme also made a point of keeping himself informed about developments in Minister Moberg's area of responsibility, higher education and research, which covered ESRO matters. In practice he also reserved the right as the senior minister – if necessary – to take final decisions within that field. As far as I can remember, however, he never altered decisions made by Moberg. I can now confess many years later that, when it came to space research and Swedish positions in ESRO, I used Palme's positions to present and get the green light for action in European space matters which were sometimes more bold and went further in a positive direction than the cautious Moberg wished. Moberg was probably not unaware of what I was doing and, to his credit, it must be said that he accepted my actions without protest.

In summary, it can be observed that the climate with regard to the government's attitude to space activity radically improved in 1967 when Palme became Minister for Education with responsibility for broadcasting and Wickman became Minister for Industry. It also made it easier to handle complicated European cooperation issues.

The European picture was still confused and inconsistent. The second ESC conference took place in Rome in July 1967. Its only results were the formation of a committee headed by the Frenchman J-P. Causse to formulate a European space programme and instructions to ESRO to design a communications satellite which served the needs of the EBU; as has already been explained, radio and television companies had a much greater interest in space technology than the telecommunications administrations.

The next ESC conference was held in Bad Godesberg in November 1968. At that conference, the Causse committee's proposal for a European space programme was delivered and was immediately dismissed, particularly by the British. It had already been possible to remodel Causse's organisational proposals in a new committee chaired by the Dutchman J.H. Bannier. Now, in Bad Godesberg, a decision in principle was actually taken to form a single space organisation – though it was uncertain when. Agreement could not be reached on a programme for the organisation. The launcher question was the great stumbling block. Agreement was reached, however, on the so-called "Bad Godesberg formula", which would play a large and important role within ESRO and ESA for many years – in principle it still applies today, as it was written into the ESA Convention, in modified form, in 1975. According to the formula, European launcher rockets would be used for launches of ESRO satellites provided that the price did not exceed by more than 25% the price for a launch using a non-European rocket. Lastly, another fact-finding committee was formed – the "senior officials" committee under the chairmanship of the Italian G.Puppi.

The Bad Godesberg formula did not resolve the differences on the matter of launchers. The central question remained: would Europe continue with its own rocket development or not? In spring 1968 the British had already declared that they could not participate in any new ELDO programmes and that they could support the programme in future only in the form to which the original commitment had been made. In practice, the British declaration was seen as an announcement of withdrawal. ELDO was now supported chiefly by France, Belgium, the Netherlands and West Germany; the Italians were having doubts. Just two weeks after the Bad Godesberg conference, another test launch failed – this time the third stage did not ignite. The countries which, like Sweden, never joined ELDO now finally felt, perhaps with a certain malicious delight, that they had done the right thing.

The next ESC conference took place in Brussels in July 1970. As regards the Swedes, since spring 1969 there had been a basis on which to take decisions in the form of the *Sweden and European Space Activity* report produced by the Ministry of Industry's working party. It proceeded from the assumption of participation in a prospective European collaboration and, as already stated, recommended an increased national space programme, including development of a Swedish satellite and a Swedish sounding rocket. When the report was published, Minister Wickman pointed out that for the time being the proposals should not give rise to any measures. The background to his statement was the continuing European disagreement. The report was circulated for consideration and largely met with a positive response.

Thus far, the Swedish ESC delegation had kept a very low profile in the negotiations – as long as the "big four", Italy, France, Britain and West Germany, could not agree, it was relatively unimportant what the small countries believed and thought. In an answer to a question in the Parliament in April 1970, Wickman asserted that the prospects for an agreement on the future organisation of European space cooperation were not particularly good. The total returns for Sweden's investments must be as good as possible and as long

as there was uncertainty over European cooperation, there could be no investment in a national programme either.

The tough European space negotiations were rarely mentioned in the press, but when they were, they were generally portrayed in an unfavourable light. "Space fiasco for Europe. Chaos threatens" (Dagens Nyheter (DN) 24/1/67). "Space rocket base in Kiruna threatened by cutback plan. Western European chaos" (DN 18/6/1968). The scientific correspondent at DN, Arne Karsberg, even managed to make it sound as if space cooperation stood or fell on Sweden's attitude, by claiming that the twelve other ESC participating states had delivered an "informal ultimatum" to Sweden, demanding that Sweden clarify its position on European space cooperation by 5 November 1970 (DN 14/9/70). Where Karsberg obtained this information remains a mystery – no ultimatum was ever issued by the ESC and the Swedish position was probably one of the lesser problems the conference was required to deal with. Only in summer 1971, when the threat of a cancellation of ESRANGE became really serious, did the Swedish attitude begin to be relevant in the eyes of the other countries.

Hopes were now set on the Brussels conference in summer 1970 to resolve the deadlock, but it failed to do so. It was agreed to form an organisation for fundamental research and for applications in the form of projects for telecommunications, meteorology and air traffic control. However, many reservations were made and the launcher situation remained unchanged. Sweden abstained from voting on the resolutions. The conference was adjourned until November 1970.

Up to this point, no Swedish cabinet minister had taken part in the ESC. In Rome, the Swedish delegation was led by the Swedish ambassador in Italy, Brynolf Eng, in Bad Godesberg by Håkansson and in Brussels by Stiernstedt. We were regularly asked impertinent questions as to the whereabouts of our ministers. It began to become awkward and Håkansson and I decided to persuade our respective ministers, Wickman and Moberg, to participate in the second session of the ESC conference in Brussels in November. We should not have done so. The conference was planned to last two days, but at the end of the first day it was established that the differences were so great that there was no point in continuing. The ministers returned home frustrated and declared with one voice that they had never encountered such a confused international forum and planned never to return. What they had seen and heard certainly had not done Swedish space activity any favours – all of Moberg's old suspicions were more than confirmed.

The situation was not made any better by the fact that the Swedish delegation had gone to Brussels well prepared. A new report, *Current perspectives on European space cooperation*, had been drawn up and circulated for consideration. There had been general support for continued Swedish space activity and participation in European cooperation. At an informal session of cabinet the government had decided that for the present Sweden would remain in ESRO and also participate in one of the proposed applications projects – the communications satellite. The decision was a compromise. The Ministry of Industry had given priority to participation in the applications programme and the post-Apollo programme, which would mean a withdrawal from the scientific programme, as the

Ministry of Finance refused to contribute any new money. The costs were estimated to be SEK 13-14 million per year for the scientific programme and SEK 7-8 million for the communications satellite from 1974/75.

Before the conference broke down, Krister Wickman made a statement in which he said that Sweden was generally favourably disposed to European cooperation in space research and space applications. Sweden was, he explained, prepared to join a possible new organisation and, within it, to support the scientific programme for another three-year period, until 1973. In debates, voices had been raised for a few years in support of discontinuing ESRO's sounding rocket programme in favour of concentration on satellites. Wickman opposed that view. The continued existence of ESRANGE as an international facility was a condition for Swedish involvement. Moreover, it was important to have as broad a scientific programme as possible. He also explained that space applications were of interest to Swedish industry, but that the first priority for the time being had to be the communications satellite project. Lastly, he declared that Sweden could not participate in the American post-Apollo cooperation for economic reasons. The launcher issue was not mentioned.

His statement was generally warmly received. Sweden, which had previously waited for the big four to show the way, had for the first time revealed where it stood.

The collapse of the Brussels conference marked the low-point of European space negotiations in the 1960s and 1970s. All the commissions of inquiry, committees, piles of documents, the complicated proposals and compromises lay in ruins. However, it was also the turning point. There was a strong reaction from the member states. When ESRO's Council met one month later (December 1970), France announced its withdrawal from the organisation from 1 January 1972 – the first eight-year period expired at the end of 1971. The French government was prepared to return, however, on the conditions that ESRO was reorganised, with the introduction of the "*à-la-carte* principle" for participation by the member countries in the different programmes and projects. Increased importance should be given to applications projects and the budget for the scientific programme should be reduced. Lastly, it called for better coordination between ESRO and the national programmes, with the possibility for the organisation to decentralise parts of its development work to national bodies.

Denmark also wished to withdraw, although there was no connection between the Danish and French decisions; the Danish decision was taken purely on financial grounds. Sweden and the United Kingdom reacted to the French blackmail by threatening to withdraw themselves.

In Stockholm we had already analysed the consequences of leaving ESRO; now we were also beginning to discuss it in earnest. Researchers and industry had for some time questioned whether it would not be best to leave ESRO and initiate a national space programme based on bilateral cooperation with other countries. Thus, I was visited in December 1969 by Stig Lindgren and Fredrik Engström, in their capacity as representatives of the Swedish space research community. They immediately addressed

the issue of whether there was not good reason to withdraw from ESRO and invest the money in a national programme. I replied by pointing out the general political reasons for membership: "Sweden has not, at least thus far, made a habit of pulling out of international organisations once it has joined". However, I added "it is a possibility which is open to us and may arise". Now – one year later – it had arisen. However, it was not as simple as Lindgren and Engström possibly thought. It was not merely a matter of raising your hat and going. Bengt Hultqvist was extremely dependent on his experiments on GEOS, as has already been explained. The government was well aware of that. In the event of a withdrawal it was therefore important to ensure that the baby was not thrown out with the bath water.

The risk of ESRO's disintegration at the end of the eight-year period was considerable. In those circumstances, the Council decided to set aside the activities within ESC – it had in fact broken down. Instead, it instructed its newly appointed chairman, the Italian Puppi, to negotiate with all the member countries over the future of ESRO. What would happen to ELDO was put to one side or at least had to wait for the moment. Puppi proved to be ideal for his task. He was easy-going and humorous, could display Italian gentleness, but behind the genial mask he could be as hard as stone. He began by travelling around all the member states in order to test the waters and to hold discussions, without commitments, to examine various proposals.

Because it was only the problem of ESRO, and not at the same time ELDO, which had to be resolved, it now progressed more easily. In March 1971, Puppi came to Stockholm. He was not received with any great understanding there, however. The Swedish delegation had certainly accepted the proposal for a single European space organisation, but it was suspicious of its ELDO content. The negative attitude was reinforced by the fact that Puppi was now strongly recommending the cancellation of the sounding rocket programme and with it ESRANGE. Sweden could envisage involvement in applications projects, but it did not want to participate in the post-Apollo project under any circumstances; it had too strong a flavour of the military and NATO. Deep down, it really wanted things to remain as they had been.

In the debriefing after the session with Puppi, I remember my own comments: the scientific programme will be eaten up by applications in the new organisation, so let us forget ESRO and set to work on a strong national research programme instead.

Puppi's proposals were delivered in spring 1971 after extensive discussions and negotiations in ESRO's bureau, of which I was a member in my capacity as vice-chairman from 1969. It had been made easier by the fact that the post-Apollo negotiations had completely broken down after many years of difficulties. Puppi could therefore make his proposal neater and more consistent. Essentially, it amounted to the following points.

During the period 1972-74 ESRO would be restructured into an organisation for science and applications with a strong emphasis on applications. During the transitional period it was proposed that there would be a mandatory programme as a qualification for membership. It comprised three elements: a *scientific satellite programme without*

sounding rocket activity, which meant a discontinuation of ESRANGE or a hand-over of the base to Sweden, *basic activities* (programme studies, technical research, documentation etc) and *fixed shared costs* (administration, operation of facilities).

After 1975 participation in the scientific programme would be voluntary and the mandatory elements would be the basic activities, fixed shared costs and membership of at least one programme/project.

The Swedish delegation had protested to the very last against the cancellation of ESRANGE. But we had opinion in the other ESRO delegations against us – here they saw a chance to save money. The member countries which were still interested in sounding rocket campaigns, for example Britain and West Germany, also complained at the bureaucracy and costs at ESRANGE; they took the view that it would be easier and cheaper to perform launches from Andöya in Norway.

So as not to be taken by surprise, we decided in the course of spring 1971 to take advantage of the proposal to discontinue ESRANGE in the negotiations. We also realised that a take-over of ESRANGE meant the possibility of developing a strong national programme based on sounding rocket launches. Fredrik Engström, who had now replaced Rey as director of RTG, and his colleagues in the group had seen the opportunities at an early stage. I gradually discovered that resistance to the proposal to discontinue ESRANGE had weakened and was no longer consistent with the official Swedish line of opposition. It was easy to realise why and I soon began to mutter conspiratorially whenever ESRANGE was mentioned in ESRO.

A delegation consisting of Stiernstedt, Marianne Thorén, a senior administrative officer from the Ministry of Education, Gunnar Petri, a senior administrative officer from the Ministry of Finance, and Fredrik Engström and Klas Änggård from RTG travelled to London and Bonn in May 1971 for non-binding discussions on the future of ESRANGE. Various alternatives were discussed – closure, multilateral administration, a Swedish take-over, a special project under Article 8 of the ESRO Convention, meaning that interested member states could join together to finance the operating costs. In London we met the ESRO delegate Jim Hosie, in Bonn the ESRO delegate Schramm, assisted by Reimar Lüst. Despite many negotiating tricks on their part – above all the restrictions on launch altitudes at ESRANGE were a sticking point – the results were encouraging. The French also appeared to be favourable in a discussion in the margins of an ESRO Council meeting. For the sake of good order, i.e. Scandinavian cooperation, Engström and I also visited Denmark, which was now considering a return to ESRO, but there was no response.

We were given cautious support in the ESRO secretariat by the new director-general Alexander Hocker and, in an even greater and more tangible way, by the administration director Roy Gibson. The Swedish line of thought was now definitely heading towards the idea of a Swedish take-over and Swedish administration, with funding in the form of a special project.

In July 1971 the ESRO Council met, just for a change, at ESTEC to discuss Puppi's proposals. Moberg had been persuaded to drop the demand for the retention of the sounding rocket programme and continued international responsibility for ESRANGE. In my main statement I was now able to make the following announcement:

In Brussels Sweden declared that a condition for our participation in the scientific programme was that ESRO activities at ESRANGE would continue approximately along the same lines as now. Mr Chairman! Sweden no longer sticks to this condition.

We accept that ESRO will be transformed to an organisation for satellite programmes only. We are doing this because we believe that the only chance for European space cooperation is to concentrate its activities... From a purely national point of view Sweden would have preferred that ESRO still had a sounding rocket programme and had continued to run ESRANGE as an establishment of the organisation... Rather than sticking stubbornly to our old Brussels conditions we prefer to help to achieve a solution of the present crisis...

I went on to declare that Sweden was prepared to take over ESRANGE and to offer services there to scientific groups that wished to avail themselves of the base. One condition was that the necessary economic guarantees had to be given by such groups or their responsible authorities.

As usual, Sweden had acted like a good boy for the sake of European loyalty. When, during and after the meeting, we received so many kind words, I got the strong impression that everyone would have been enormously surprised if we had not done so. Sweden was reliable.

The Council meeting in July marked a major leap forwards in the direction of a solution of ESRO's problems. Puppi's proposals had been modified in one very significant respect. Participation in the scientific programme was now mandatory after the initial period. This meant that scientific activities were permanently protected, or at least virtually protected. Now the scientific programme and the basic programme – the fixed shared costs (technical research, documentation, operation of facilities, administration etc) – were therefore mandatory. Participation in other programmes was voluntary. Three applications projects were initially proposed: a communications satellite, a meteorological satellite and an air traffic satellite.

After the Council meeting, Moberg issued a press release which outlined the Swedish position. It stated *inter-alia*:

The Swedish position at the current meeting of ESRO's Council is fully consistent with the position taken at the Brussels meeting, comments Minister Sven Moberg. This position means that Swedish researchers who have begun to work on research projects in ESRO will be able to complete

those projects. It will, according to Mr Moberg, be possible to limit Sweden's costs over the next few years in respect of participation in ESRO and operation of ESRANGE under Swedish auspices, so that they are kept within the scope of the current appropriation for European cooperation in space research.

I was not happy about this last statement, as I realised that it was completely unrealistic in the long term, but I failed in my attempts to have it removed. Moreover, it was repeated towards the end of the release, where Moberg announced an overhaul of the future organisation of Swedish space activity.

Many issues still remained to be resolved, however. The consensus surrounding the applications projects was not as great as was desired. France and Britain disagreed on the time for making decisions on projects. Sweden was suddenly among those that were still undecided. As usual it was the Telecommunications Administration which was creating the difficulties; interest in communications satellites had cooled. In the voting on this project at the July meeting, Sweden abstained on the grounds that various uncertainties concerning the operational phase had first to be clarified. Other problems, great and small, also had to be settled. One of these was the basis for the ESRANGE hand-over.

Much work was done during the autumn of 1971. After many meetings in Kiruna and in Paris the situation had been clarified to such an extent that a report could be presented to the government. There was a basis of support for a special project around ESRANGE. However, a new factor had arisen. The Germans and British had successfully carried out rocket campaigns not only at ESRANGE, but also at Andöya in Norway, where the same altitude restrictions did not apply as at ESRANGE, since launches were done over the sea. By spring 1971, the Germans had raised the question of whether Andöya should be linked to the special project through an agreement between the Norwegian and Swedish governments. Close cooperation between the two launch ranges would make the special project more attractive; they complemented one another so that benefits achieved from launching from one site or the other during different types of campaign could be maximised. The German proposal was attractive to the Norwegians – it meant that the risk of being pushed out of the market by ESRANGE was ruled out. As far as the Swedes were concerned, we did not exactly welcome the German proposal with shouts of joy, but when we found that it was virtually a condition for German support we went along with it. As a result we proposed that the ESRANGE Special Project within ESRO should encompass both ESRANGE and Andöya.

On 19 November there was an informal session of cabinet. I presented a report on behalf of the Ministry of Education and recommended continued participation in ESRO and a take-over of ESRANGE. I pointed out that ESRO had around 70 people employed at ESRANGE, but that RTG estimated that it could be run with only 30 or so staff. Rey presented the views of the Ministry of Industry and pleaded the case for involvement in the three applications projects – SAAB and LM Ericsson could then expect contracts in the communications and air traffic projects. Participation in the meteorological project was explained to be important for general reasons, in particular because it represented a

first stage towards Earth observation satellites. The telecommunications satellite was support by the Ministry of Transport and Communications. The doubts of the summer had subsided.

After the reports had been presented, a number of questions were raised, including the extent of the involvement of NATO or the Norwegian armed forces at Andöya. I had investigated the matter on a visit to Andöya a few months earlier and could provide a fairly satisfactory answer, to the effect that foreign nationals were permitted to visit the base. Suddenly the Minister for Finance, Sträng, took the discussion along a different path by asking whether industry – if it was now so eager for contracts from ESRO – could join in and pay the Swedish membership contributions for the project. Rune Johansson, who had replaced Krister Wickman as Minister for Industry, looked concerned. One of the officials from the Ministry of Industry replied that it was unlikely that industry could be persuaded to do any such thing.

Then, as was customary, the officials left the meeting room and the government held private discussions. After a few hours, Rune Johansson and Sven Moberg informed us of the decision. It was positive – this was probably helped by the fact that earlier that year Sweden had once again rejected EEC membership. It also raised problems, however. Sweden would continue to participate in ESRO's mandatory programme and take over ESRANGE, the running of which would be partially financed through a special project. It was assumed that the cost of the take-over as provisionally established in negotiations with the ESRO secretariat, 5000 Accounting Units (AU) or around SEK 26000, would not change during negotiations.

Sweden was also willing to join in the three applications projects on the condition that – and this is where the problems arose – the industrial undertakings concerned, SAAB and LM Ericsson, declared that they were prepared to co-finance participation with the aid of profits from possible ESRO contracts. Talks with the companies would be opened immediately. Pending the outcome of those talks, the government's decision would be kept secret for the time being.

This meant that, at ESRO's Council meeting on 8-9 December 1971, I was forced to declare that the Swedish government was extremely favourable, but nevertheless had not yet taken a decision. In actual fact, talks were still in progress between Undersecretary of State Hans Lundström at the Ministry of Industry and the companies. Sure enough, the fears expressed at the informal session of cabinet were confirmed – they were not at all keen to contribute to ESRO membership. Other delegations looked sour when they heard my statement, since the ESRO reform depended on as broad a participation as possible by all or almost all the delegations.

The next Council meeting took place on Monday 20 December. Hans Håkansson and I were there without having received any instructions on the line to take. A fresh round of talks with industry were to be held that morning. The hours passed. I was forced to inform the Council chairman, Puppi, that we were unable to say anything. Nothing had been heard from Stockholm. We became increasingly nervous. Eventually, I was called from

the meeting room for a telephone call from Stockholm. I lifted the receiver, convinced that shortly I would be forced to announce that Sweden did not intend to support the reform proposal. The future of ESRANGE also depended on this, since it was fully apparent that participation in the special project depended on the Swedish attitude to Puppi's proposal. Imagine my surprise and delight when I heard that industry had agreed and promised to contribute 7% of the value of the companies' orders from ESRO, or at least SEK 500.000. The government had then confirmed that we would take part in all three projects, not just one as I feared. Industry's contribution was immediately dubbed the "space tax" by the two companies.

I returned to the Council and asked for the floor. There was immense curiosity – what line would the Swedes take. I could not resist playing with my colleagues a little. "I am glad to say that the Swedish government has decided to participate in the telecommunications project" – long pause for effect, everyone looked relieved, they had not expected any more – "and the meteorological project" – another pause for effect, everyone looked pleasantly surprised – "and the Aerosat project". There was laughter and applause, as well as champagne from the secretariat. The Puppi reform – or "the first package deal" as it came to be called – was home and dry.

A number of resolutions were passed immediately. They meant that all nine voting member states could support the reform – Denmark could not vote as a result of its announcement of withdrawal, France on the other hand had already returned. The three-year budget for the scientific programme was adopted unanimously. However, there was one fly in the ointment. It was as low as 27 million AU per year. Puppi had originally proposed 35 million which was already lower than the original ESRO budget, but in the course of the negotiations the French had demanded a further cut of 8 million. The scientists were not happy, but at the same time they were relieved that ESRO had survived.

Almost all the states supported the three applications projects. With regard to launchers, the Bad Godesberg formula was incorporated into one resolution. A special working group was formed to revise and adjust the Convention in line with the new circumstances.

As regards ESRANGE, the transfer to Sweden was agreed for 1 July 1972. The price proposal put forward by the secretariat and the Swedish delegation, the symbolic sum of 5000 AU, was approved. For mobile equipment and laboratory and workshop equipment Sweden had undertaken, during the negotiations, to pay a total of 37.000 AU or around SEK 191.000, which was also virtually a symbolic amount. Furthermore, the special project was approved, under which Belgium, France, the Netherlands, Sweden, Switzerland, Britain and West Germany made a commitment for five years to contribute to the financing of the running costs. In return they were entitled to use the base for a number of weeks in proportion to the size of their contribution. Britain, whose ESRO delegate Hosie was very active in setting up the project, would later – after Hosie had retired – renege on its commitment and back out of the project. The other participants – with the exception of West Germany – took part more out of solidarity with the ESRO reform than the need to use the base; it was the price for ensuring Swedish involvement.

The contributions were calculated to be a total of 860.000 AU or around SEK 4.5 million, of which Sweden raised SEK 1.245.000. Of the total amount of contributions, SEK 3 million would go to the running of ESRANGE and 1.3 million to the running of Andöya. The remainder would be used to finance a small secretariat at ESRO's headquarters in Paris and a consultative committee.

When the "first package deal" was implemented, ESRO could breathe again. Some internal problems, for example industrial policy, had been swept under the carpet. But financial guarantees had been given so that work could continue relatively peacefully. The European space storms now raged not within ESRO, but outside. One and a half months earlier, the first – and last – ELDO launch from Kourou in French Guyana had failed. 150 seconds after launch, Europa 2, intended as the proud flagship of the European fleet of launchers, exploded.

Nevertheless, together with ESRO's package deal, this meant that a turning point had been reached. The first stage of the rocket which would become the European Space Agency had been launched. Sweden had finally decided to remain in space. Now it needed a national space agency.

The Board for Space Activities and the Swedish Space Corporation are Born

When all the decisions on principle had been successfully taken, the administrative niggling still remained. A large number of agreements would be hammered out, drafted, revised, approved. Experience had shown that this procedure usually meant that new problems arose – when the lawyers were brought in, there were some who almost took pleasure in pointing out problems, sometimes even rather theoretical ones.

There was intensive work in the spring of 1972, filled with major and minor problems. The conditions for Swedish space activity had radically changed. It had already become clear during the autumn that, if Sweden supported the ESRO reform and took over ESRANGE, a new national space programme would have to be built up. Researchers had to receive more funding in order that they could also use ESRANGE and an industrial development programme also had to be built up in order to make participation in ESRO's three applications projects worthwhile.

A new coherent space organisation was required to coordinate Swedish participation in the various ESRO programmes with a strong national research and applications programme. The principles for an organisation had already been discussed in the autumn by the Ministry of Industry, the Ministry of Education and Culture and the Ministry of Finance. At the beginning of 1972 a memorandum was drafted in the first two of these ministries, *Organisation and Financing of Space Activity* (Ds I 1972:1). It described the existing organisation, the national programme, ESRO's programme and the ESRO reform of 1971. Lastly, the following proposal was made.

A space organisation with responsibility for Swedish space activity should be set up. Within the organisation, a clear distinction should be drawn between the programme design and planning functions on the one hand and the executive and resource management functions on the other. This became the guiding principle for the proposal, which put forward the creation of two bodies which had distinct areas of responsibility but which worked together.

It was proposed that the new authority – *the Swedish Board for Space Activities* (*Statens Delegation för rymdverksamhet*) – be set up on 1 July 1972. It was to be responsible for planning and policy, together with allocation of resources to space activities. According to the memorandum, the word "delegation" in Swedish underlined the interim character of the agency which was in keeping with the current assessment of space activity, but it should not, however, be regarded as too short-term. It would at least be expected that the Board would initially be responsible for space activities for a five-year period – the special project agreement regarding ESRANGE expired after five years. It would be governed by a board including representatives of the affected ministries and of consumer, industry and research interests.

It was proposed that activities be divided into three programmes – administrative functions, space research and space applications. The costs were estimated to be roughly SEK 33 million each year.

For the executive functions it was proposed that an independent state-owned limited liability company – the *Swedish Space Corporation* as it would be called – be formed on 1 July 1972. The Corporation would have four main functions:

- to manage the national sounding rocket programme;
- to be responsible for running ESRANGE and integrating it with the sounding rocket programme;
- to carry out secretariat and investigative functions for the Board for Space Activities;
- within the framework of the Board's space applications programme, develop and market Swedish space technology competence.

It would be possible to finance the majority of the Corporation's activities through orders from the Board for Space Activities. Annual revenue was estimated to be approximately SEK 10-20 million. The Corporation was expected to take over the resources and property of the Space Technology Group (RTG). Even though it was not directly stated, it was also clearly understood that the RTG's personnel would be transferred to the Swedish Space Corporation.

The authors of the memorandum had without a doubt cast an eye upon the Space Committee's report. The Space Research Council and the Space Institute surfaced in a new guise, but the principle of drawing an organisational distinction between programming and executive functions had been taken a step further. In the version put forward by the Space Committee, the Space Institute lacked independence and was subordinate to the Space Research Council (see page 122ff). Formally, the Swedish Space Corporation was fully independent of the Board for Space Activities, even though the requirement for the existence of the two bodies was very close collaboration in the form of sale/purchase of services which also entailed close day-to-day cooperation.

The memorandum was circulated to the university authorities, the research councils, industrial companies and organisations etc. The reactions were positive. Space activity was now – unlike in 1964 – an up-and-coming, accepted activity. This had undoubtedly been helped by the rapid developments which had taken place. There was support for a continued and expanded participation in ESRO and for the proposed national organisation. On 10 March 1972 the government decided that the Government Bill 1972:48 concerning space activity should be brought before the Parliament. The bill was presented – “in consultation with Cabinet Minister Sven Moberg” – by the Minister of Industry, Rune Johansson.

The reasons given for the new space effort were relatively brief and emphasised industrial policy.

Among the reasons for pursuing space activity which has gradually developed, I would like to draw particular attention to the value for industry in being able to take part in the European industrial cooperation which has grown up as a consequence of orders from ESRO. It is therefore valuable for Swedish companies and authorities to have the opportunity to cooperate in satellite projects.

Participation up to now in ESRO's programme has given Swedish industry a satisfactory return in the form of development contracts. Our share of both the contracts which have been awarded to industry and the opportunities for experiments which have been offered to Swedish researchers is satisfactory in relation to the Swedish share of contributions to ESRO.

The statement concerning the satisfactory return was based on studies undertaken by the Ministry of Education and the Ministry of Industry. They demonstrated *inter-alia* that during the first six years (1964-69) Sweden had received contracts which, at a value of SEK 23.5 million at current prices, were greater than the amount of the membership contributions paid during the same period. However, the ESRANGE contracts were included for that period. If only development contracts were taken into account, the results were not so good.

The bill adopted all the proposals made in the memorandum. This meant that the Minister proposed that the Parliament should approve participation in ESRO's scientific programme, basic programme and applications programme. It was stressed that the rules for the applications projects entailed an obligation to see the project through to completion, unless the costs were exceeded by more than 20%. It was also proposed that the agreements which had been concluded concerning "suspension of ESRO's activity at the rocket range at Kiruna" and concerning the ESRANGE special project be approved, as well as the proposal for the establishment of a Board for Space Activities and a Swedish Space Corporation. The ESRO Committee and the Steering Group for Space Matters (formerly the Space Board) were dissolved. ESRANGE would be operated and owned by the state-owned Swedish Space Corporation. Compensation for the Lapps and land owners would be paid on the basis of the same principles as previously.

The financing of the Board for Space Activities was proposed to be done through appropriations from the ministerial budgets for education and industry. As far as income was concerned, the Board could also expect contributions from participants in the ESRANGE special project and industry's "space tax".

The costs for participation in ESRO's various programmes were estimated on the basis of a contribution share of 4.62%. The Ministry of Education would be responsible for the contributions to ESRO's science programme and for the national space programme and the operation of ESRANGE. The appropriation of a total of SEK 6 million for national

space activity which the Space Board had received in recent years from the NFR and STU was proposed to continue to be paid unchanged. In addition there was now a new appropriation of SEK 3.2. million for sounding rocket activity – justified on the basis of the fact that costs for participation in ESRO's scientific programme had fallen. A total of SEK 9.2 million was therefore budgeted for the national programme. This was not as much as the RTG considered to be necessary (see page 175) but it was enough to survive – the difficult years were over. The Ministry of Industry would be responsible for paying the costs of ESRO's basic and applications programme and for the Board's administrative functions.

The total space budget was estimated to be SEK 37.5 million, including SEK 32.8 million in government appropriations. Contributions from participants in the ESRANGE special project and industry were calculated to be SEK 4.2 million and SEK 500.000 respectively. In terms of expenditure, participation in ESRANGE was the largest item, amounting to SEK 22.3 million. The costs for ESRANGE were put at SEK 5.5 million, the national space programme, as has already been mentioned, at SEK 9.2 million, and salaries and other costs at the Board would be SEK 500.000.

In one respect the bill did differ from the ministry memorandum. This was one section of the Minister's statement that was dictated by Sven Moberg. He was convinced that ESRO would gradually become an applications organisation and that the research resources would be swallowed up by projects which had nothing to do with fundamental research. He believed that in the long term it could be expected that the fundamental research programme would be discontinued. At the same time, however, he was aware that it was important to protect Hultqvist's experiment in GEOS. He therefore pushed for the following statement:

Because ESRO's activity is now placing its emphasis on space applications, the question of resources for continued Swedish space research, in terms of both cooperation in ESRO's science programme and the connected national activities, should be the subject of an impartial review. In my opinion, however, the Swedish researchers who are currently taking part in satellite experiments in ESRO's on-going satellite project should be given the opportunity to complete those experiments. I therefore recommend that Sweden participates in ESRO's scientific programme for the 1972-1974 period, at the end of which the question of continued Swedish space research must be reviewed again.

The statement was not entirely logical, since at another point in the bill it was stated that continued operation of ESRANGE was assumed even after the end of the five-year term of the agreement. However, in 1974, Moberg's statement had been forgotten. The science programme was running well, both in ESRO and at home. It had not been swallowed by applications and there were no thoughts of a review. Moreover, by then Moberg had left the Ministry of Education.

In the Parliament, everything went on as usual. The communists, led by party chairman Hilding Hagberg, demonstrated their customary view that space cooperation was ultimately under the control of NATO by tabling a motion for rejection. This did not prevent the bill from going through unscathed.

In the midst of all this work which was geared towards establishing Sweden in ESRO and developing the necessary organisation, an event occurred whose future importance for Swedish space research I did not properly understand at the time. In February 1972, I was called on by Professor Carl Gustaf Bernhard, secretary-general of the Royal Academy of Sciences, together with Professor Yngve Öhman and Dr Jan-Olof Stenflo from Lund. They reported that, as part of cooperation between the Swedish and Soviet academies of sciences, Stenflo had been invited, without cost, to add a solar experiment on board a Soviet "inter-cosmos satellite". My interest was aroused – one of the recurrent points in Moberg's criticism of space was the one-sided focus on Western European and American cooperation. Perhaps here was an alternative. I did not know whether there would be money to develop the experiment, but I encouraged further contacts to be made. The visitors were satisfied for the time being. They held further discussions with the Russians. The foundation was thus laid for an important bilateral scientific cooperation programme for many years.

As the Parliament bill was being presented, it was also time to make preparations for the launch of the new organisation which would come into being under the proposal on 1 July 1972. I had already discussed key personnel matters with Hans Lundström, Undersecretary of State at the Ministry of Industry, in February, during the session of the Nordic Council in Helsinki. We agreed to propose to the government the appointment of Hans Håkansson as executive member of the Board for Space Activities and as chairman of the Swedish Space Corporation; we believed that this dual role would strengthen cooperation between the two bodies. I would myself become chairman of the Board for Space Activities. I therefore also became chairman of the organisation committee which was formed on the same day the government passed the Parliament bill. The role of the committee was to implement all necessary administrative decisions. The other members were Håkansson and Axel Wallén, Permanent Under-secretary of State, and Jan Olof Carlsson from the Ministry of Industry. Carlsson also served as the committee's secretary.

There was much to deal with. When the committee concluded its work, it had submitted proposals for instructions for the Board and articles for the Corporation and also seen that the proposals were adopted. It had also drawn up budgets and account charts for the Corporation, organised shared offices for the Board and Corporation next to RTG's old premises in Solna, amongst other things. Even the Norwegian-Swedish agreement on cooperation between ESRANGE and Andöya had been settled. At the end of June, most of the key personnel issues had been resolved. Hans Håkansson had been appointed as the Board's executive member and I had been appointed chairman.

Håkansson was the Board's only employee. The principle that the Swedish Space Corporation should serve the Board was upheld to such a degree that even his secretary was employed by the Corporation. Vice-chairman of the Board was Sigfrid Wennerberg,

head of the Ministry of Industry's department for technical research and development. The other members were Håkansson, Per Olof Forshell from the Ministry of Foreign Affairs, Bengt Furbäck from the Ministry of Transport and Communications, Tore Gullstrand from SAAB, Christian Jacobaeus from LM Ericsson, Bengt Hultqvist from KGO and Sven Olving, a professor in electron physics and pro-vice chancellor at Chalmers.

As can be seen, no fewer than four ministries were represented on the board. This had, against normal practice, been put forward in the bill. The idea was to facilitate quick decisions in the often complicated ESRO and ESC business within the ministries concerned.

As has been stated, Håkansson became chairman of the board of the Swedish Space Corporation and Fredrik Engström became managing director. The other members were Bengt Hultqvist, Ove Norell, Gunnar Wedell and Sigfrid Wennerberg.

At the end of June everything was in place for the new organisation to come into being on 1 July. Notices had already been sent out for the first board meetings of the two bodies. Only the epilogue remained – the formal hand-over of ESRANGE.

Epilogue

In no decade of the twentieth century has Sweden been so committed to research as in the 1960s. The Consultative Committee on Research was formed – its importance was shown by the fact that the Prime Minister himself, Tage Erlander, took the chair. This was not a symbolic action on his behalf; he showed a genuine interest and his involvement in the discussions with professors and economists was remarkable. The work of the committee during its first few years produced direct results, in terms of both the economy and prioritisation. The appropriations to the basic research councils were increased very significantly – as much as 25% in only one year. Alongside this, the university system was expanded to a size not seen before. A specific Ministry for Industry was created. One of its most important tasks was to stimulate applied research and build bridges between it and basic research.

Space research did not enjoy its share of the benevolence, however. Instead, it was forced to play the role of whipping boy. What was the reason for this? For the first half of the 1960s, space activity appeared identical to space research – there was constant terminological confusion between the two. Applied space activity was still in the development stage. It was fully evident that it would come in the form of telecommunications and remote sensing via space, but there had not yet been a breakthrough. Fundamental research still dominated space physics and astronomical research which immediately made use of the Sputnik technology. But it was a newcomer to the research family, and a very expensive newcomer, which is why it was unwelcome. The 1960s pro-research attitude was certainly quite technocratic in nature, and the politicians in particular were tempted to give priority to research which they believed would give quick results. Erlander was the exception. However, if there was any research which was purely fundamental and could not promise quick practical applications, it was space research. Certainly its technology would undoubtedly be able to play an important role in the country's technological and industrial development and hopefully produce new technical achievements; on this there was a broad consensus. In addition, space research enjoyed a good public image throughout the 1960s; it was new and exciting. But it did not help that it could be heard time and again in debates that it was more important to concentrate on life sciences such as biology, chemistry and medicine; in the long term the research in those fields could perhaps contribute to resolving the problem of world famine, something which analyses of the structure of the universe or the connection between the aurora borealis and solar flares could hardly do. Arguments of this type are unfair, but they are popular and difficult to counter, particularly when they are presented by important and influential scientists. There is no doubt that the debate between Tiselius and Alfvén in the Consultative Committee on Research came to play an important role in this respect and had a strong influence on the government.

In debates within the government, the argument would also be raised from time to time – particularly during budget negotiations – that the resources of the research councils ought

to be concentrated on a few councils within the broadest possible areas. The earmarking of appropriations, such as for the separate Atomic Research Council, did not promote competition between projects within the natural sciences. It was claimed that it would be healthier to integrate all resources within the NFR, something which would eventually happen. It was not timely then for the Space Committee to come and propose a separate space council.

But at the same time, there was a nagging feeling of uncertainty within the government. It was not right to scrap a new and, in many eyes, exciting field of research, particularly since it had a strong European element. As is so often the case, the final result was a compromise – it was decided to participate in European space cooperation, but at national level the doctrine of as few research councils as possible predominated and consideration was not even given to the fact that both the European cooperation and the nature of space research – particularly its time-consuming planning – actually necessitated a certain amount of earmarked national funding. It did not concern the government that the research councils then came to this realisation and themselves opted to earmark space funding. The doctrine of “the freedom of science” took over in this case.

In the light of the developments which occurred, the question may be asked whether the government's decision of 1964 was not wiser than the researchers had realised. One can speculate at how things would have turned out if the Space Committee's proposals had been accepted and a space council and an institute for space had been set up with reasonable budgets at their disposal. One problem which would certainly have surfaced was the lack of trained technicians. The young group of engineers that was responsible for the Nausta and Kronogård campaigns had certainly learnt a great deal. But had they been ready to take over an activity on a completely different, and far greater scale? They were all very young, some of them had still not passed their examinations and there is good reason to doubt that the government would have risked passing responsibility for activities to them. On the other hand, the break-up of the group would have meant that the knowledge which had already been developed would have gone to waste – Sven Moberg heeded the arguments put forward by the researchers in this regard and the retention of the Space Technology Group became part of the 1964 space compromise.

As far as the RTG was concerned, the years from 1964 to 1972 were important learning years. It was possible for them to find their feet in the new environment, particularly through the Swedish ESRO cooperation. Plans could be made for the small activity which could still be conducted and, what was perhaps most important, it was possible to plan for the future, to dream of better times by investigating the possibilities for larger-scale activity – satellites for auroral research and various types of sounding rocket campaign.

When the European developments at the beginning of the 1970s necessitated a new Swedish space organisation based in part on the Space Committee's proposals, but even more so on the experiences from the latter half of the 1960s, Sweden was therefore prepared in terms of know-how and organisation to take over quickly. When the Board for Space Activities and the Swedish Space Corporation began work in summer 1972, they had a flying start which aroused surprise and attracted attention internationally.

The launch of the two bodies went very smoothly, which is more than can be said of the take-over of ESRANGE. The in-depth negotiations with ESRO required an enormous amount of time. This was mainly due to ESRO's assistant lawyer, the German Hans Kaltenecker, who was a master when it came to finding new problems at the last minute. His Swedish counterpart, Jöran Mueller, from the Ministry of Education, was a master when it came to solving Kaltenecker's problems, but it took time and it was certainly a trying time before the two lawyers had picked their way through all the documents. Their last negotiation meeting was held on the night of 29 and 30 June 1972.

On the morning of 30 June 1972, however, everything was ready. The previous day, ESRO's Administrative Committee (AFC) had held a meeting at Foresta in Lidingö and it was therefore a representative ESRO group which, headed by Puppi and director-general Hocker, took the morning aeroplane to Kiruna.

The hand-over took place on the afternoon of 30 June. I had the government's full powers to take over ESRANGE. We gathered in the meeting room in the main building. Puppi gave an introduction – for him it meant that one of the more difficult points of his reform proposal had now been settled. Hocker and I then signed the legal documents. We both spoke, and when I read my words now, it appears as if I had taken a glance at Edenmann's address at the inauguration. I spoke lyrically of Kiruna as a meeting place between "modern technology and ... the wilderness, the vast forests, moors and blue mountains of Lapland". After the lyricism, I pointed out that the hand-over was one of many pieces of evidence to show that ESRO's crisis was over and that we could now look to the future with confidence. I thanked all the quiet workers who had helped to work towards that and gave an assurance that Sweden would manage the facility well. I closed by explaining that the newly created Swedish Space Corporation would be responsible for running the facility. "I know that the company will carry on the ESRANGE spirit of doing the utmost to create a good cooperation with all those affected by the activities – both scientists and – which is the most important – the people living up here."

In a press release from ESRO on the same day, the organisation took the opportunity to boast a little of the success of activities at ESRANGE. There had been more than 150 launchings during the eight ESRO years, 85 of which were part of ESRO's own programme and 67 on behalf of various national space organisations. The 85 ESRO launches had included 58 different scientific experiments, each being sent up two or three times on average. 84% of the launches were technically and scientifically successful which was quite rightly observed to be a high proportion.

At the customary dinner at Kiruna town hall (salmon, reindeer steak, cloudberry), I took the opportunity to thank a few of the people who had in some way helped to make the day's events take place – Puppi, Hocker, Gibson, Kaltenecker, Lenman etc. I offered a vote of special thanks to the British delegate, Jim Hosie, who was present. He had ensured in a genuinely constructive way behind the scenes that Sweden was given a favourable agreement. I have reason to suspect that it was his idea that we were given the facility for virtually nothing. When the negotiations opened, the economists in the ESRO secretariat believed – in the narrow-sighted way of economists – that the organisation should sell

ESRANGE at a high price. Hosie understood that in those circumstances Sweden would find difficulties and that there would probably never be any deal. Of course, I could not say all that, but at least he received special warm thanks. He retired just a few years later and I missed the small, fiery Scot. The United Kingdom has never had such a good representative in ESRO/ESA.

After dinner at the town hall, at some time towards midnight, the entire gathering travelled by bus to the top of Kirunavaara. It had been a wonderful day – clear and warm, with views of the mountains in the north of Lapland. The night was, if possible, even finer. The midnight Sun wandered across the horizon.

“As an Italian I am shocked by the Sun’s behaviour, she should be in bed by now”, shouted Puppi.

I remained there for a while after the others had begun to head for the bus. It was twelve o’clock. 30 June was passing into 1 July. I looked out over the mountains and knew that nine years of hard work had been rewarded. I had experienced so much opposition. But now, at that precise moment, I believed that I had been given my reward by the midnight Sun. Finally, the conditions had been met that Sweden would not be excluded from the future exploitation of space as a natural resource and as a vision. All the hopes of Swedish space researchers, space technicians and space enthusiasts from the beginning of the 1960s had been fulfilled. We had our launch site. We had a government space agency. We had a space budget. The wilderness years were over.

Chronology

- 1957 (July) Kiruna Geophysical Observatory (KGO) begins its work.
- 1957 (4 October) Sputnik launched by the Soviet Union.
- 1958 The United States sets up the National Aeronautics and Space Administration (NASA).
- 1958 (July) In a letter to European colleagues, the Italian physicist Edoardo Amaldi proposes that a European space research organisation be set up.
- 1959 (February) Amaldi discusses his proposal with his French colleague Pierre Auger during a walk in the Jardin du Luxembourg.
- 1959 (April) Amaldi summarises the proposal in a document which is sent to around seventy European scientists and research administrators.
- 1959 (April) The Swedish Natural Science Research Council (NFR) proposes that a joint space research committee of the Swedish research councils be formed.
- 1959 (May) The Swedish Space Research Committee is formed.
- 1960 (January) COSPAR meeting in Nice informally discusses Amaldi's proposal. Auger and Sir Harrie Massey float the idea of a Swedish sounding rocket base north of the polar circle.
- 1960 (February and April) Representatives of European space research committees informally discuss Amaldi's proposal in Paris and London.
- 1960 (June) Representatives of European space research committees and affected ministries discuss the proposal at a meeting held at the French Ministry of Foreign Affairs. The Groupe d'Etude Européen pour la Recherche Spatiale (GEERS) is formed.
- 1960 (November) Intergovernmental conference near Geneva organised by GEERS. It decides to form a Preparatory Commission (COPERS) to set up the European Space Research Organisation (ESRO). Sweden decides to participate in the work.
- 1961-1964 Swedish rocket campaigns each summer at Nausta and Kronogård in Lapland.
- 1961 (January) Meeting at governmental level discusses Anglo-French proposal to form the European Launcher Development Organisation (ELDO).
- 1961 (October) Proposal for ESRO's scientific programme approved by COPERS.
- 1961 (autumn) Sweden decides not to join ELDO.
- 1962 (May) Swedish Parliament decides (Bill 1962:85) to approve signature of the ESRO Convention and to conclude an agreement concerning a rocket range in the Kiruna area.
- 1962 (May) Special commission of inquiry – the Space Committee – convened by the government to study the organisation of Swedish space research etc.
- 1962 (June) Sweden is among the countries which sign the ESRO Convention.
- 1963 (September) The Space Committee proposes the establishment of a space research council with its own budget and – for executive functions – an institute for space. It is also proposed that Sweden participate in ESRO.
- 1964 (March) ESRO and ELDO Conventions enter into force. Pierre Auger is director-general of ESRO. Sweden ratifies the ESRO Convention.
- 1964 (May) Upon a proposal from the government (Bill 1964:69), the Parliament rejects the Space Committee's proposals with the exception of participation in ESRO. It is expected that space research will be financed through

- appropriations primarily from the Natural Science Research Council (NFR).
- 1964 (May) Swedish ESRO Committee set up to be responsible for Swedish participation in ESRO.
- 1964 (July) The Space Board of the Swedish Research Councils formed by the research councils and the FOA.
- 1966 (September) ESRANGE inaugurated.
- 1966 (December) The first European Space Conference (ESC) takes place. It is followed by a further seven ministerial conferences up to 1975. A number of investigative committees are set up to review the organisation of European space cooperation. Negotiations on a merger of ESRO and ELDO break down time and again.
- 1968 (May) ESRO's first satellite is launched from the United States.
- 1968 (autumn) The Space Board's first rocket campaign from ESRANGE.
- 1971 (December) ESRO's "first package deal". The organisation decides to develop applications satellites for telecommunications, meteorology and air traffic control. The first step towards the formation of the European Space Agency (ESA) is thus taken. ESRO's research budget is reduced and the sounding rocket programme is discontinued. On 1 July 1972 ESRANGE is handed over to Sweden, which also participates in three applications projects.
- 1972 (May) The Parliament decides, upon a proposal from the government (Bill 1972:49), to set up on 1 July 1972 a Swedish space authority – the Swedish Board for Space Activities – and, for executive functions, a state-owned corporation, the Swedish Space Corporation.

Sources and References

1. Non-Printed Sources

(The brackets after the different archives indicate the abbreviation used in section 3 below). All Swedish publication titles appear in parentheses.

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Cartledge: Ministry of Foreign Affairs. Memorandum 16/3/62, Sv Esro.

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Erlander's EEC address: Tage Erlander: The sixties. Conversations with Arvid Lagercrantz, Stockholm, 1982, page 123 f.

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11. Negotiations with COPERS

page 99 Visit to COPERS by Sidenbladh: KS 24/4/62. Memorandum concerning discussions within COPERS on 11 and 12 April 1962 on the rocket range in the Kiruna area, Sv Esro.

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- page 102 Fremlin complains in spring 1963: Memorandum of 17/5/63, Sv Esro.
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- page 103 Planning of buildings and facilities: Letter of 15/1/63 from Lines to Hulthén, Hulthén's reply of 25/1/63 and Lines' undated reply, Hulthén's collection, IRF.
- Hulthén's letter to Auger: Letter of 24/4/62, RF.
- Director of ESRANGE: Rune Fremlin: Memorandum of 30/3/63, Sv Esro.
- Handling the Tuaregs: Own recollections; the arguments was used in all seriousness by the ESRO secretariat in discussions with me in 1964.
- page 104 Swedish safety requirements: Rune Fremlin: Memorandum of 30/3/62, Sv Esro; COPERS/Min 8 Paris 21-22/2 1963 and COPERS LPSC/70, Annex 1, rev 1, 5/4 1963, ESRO. Bert Bolin 7/3/63: Certain aspects of Swedish space research, Sdt.
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- page 106 Space Committee, Technology Group (Rey), 25/3/63: Results of the informal discussions with the COPERS secretariat (Vandenkerckhove) in Paris on 19-20 March 1963. Hulthén, 15/5/63: Aide-mémoire on the definition of "safety" for a rocket range, with special regard to the Kiruna range. Edelstam's letter of 7/6/63 to Lines with an aide-mémoire on the definition of "safety" for a rocket range, with special regard to the Kiruna range Hulthén's collection, IRF.
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- Åström, MFA, 14/11/63, letter concerning the Kiruna agreement, Sv Esro.

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12. Kronogård 1962-64

- page 109 Bolin's report in autumn 1961: Bolin's letter of 4 October 1961 to the Space Research Committee, Sv Esro.
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Letter of 27/2/62 from the Space Research Committee to the National Forests Board, RF.
Rey-Brändefors-Engström-Lundblad: Preliminary technical plan, 13/3/62, for Kronogård 62, RB.
Bolin's memorandum to the MFA: Memorandum concerning Swedish-American cooperation for investigations of the atmosphere at an altitude of 60-100 km using rockets, Sv Esro.
- page 110 *All clear from the Space Research Committee*: Minutes of 26/2/62, RF.
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Costs: Bolin, 3/10/62: Economic survey of Kronogård, Sv Esro.
Experiments: Bolin's report, autumn 1961, see note xxx; MISU/Engström 28.6.62: The scientific experiments during "Kronogård 62"; Lübeck, 3/6/62: Recovery systems at Kronogård 62, RB.
- page 111 *Technology was largely the responsibility of the same space technology group*: RTG's annual report year ending July 1965, RTG.
Acquisition of equipment: RTG's annual report year ending July 1965, page 18 ff, RTG.
7 August: Rey, August-September 1962: Reports of sounding rocket launchings, K62-1, 2, 3, 4 and 5; Rey 10/11/62: Launch data, Kronogård 62, RB. See also Grahn-Borg. The sky is not the limit, 1982.
- page 113 *The Space Committee Technical Group*: RTG's annual report year ending July 1965, page 5 f; Memorandum (LL/EL) 12.5.64. Space Committee. Technical Group, RB.
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- page 114 *The summer of 1964*: MISU, Bolin, 1/4/64: "Kronogård 64" experiments; MISU 17/6/64: Collection of data during Kronogård 64; MISU. Technical Group 3/9/64; Report on sounding rocket launchings; RTG No 66-14 (14.4.66) Rey: The Kronogård Range, RB.

Guarantees for campaign costs: Letter of 18 March 1964 from the Space Committee to MFR, NFR and TFR with a request for a guarantee from the councils for costs for Kronogård 64, which were estimated at SEK 1.525.000; Minutes of the Space Committee, 10/6/64: guarantee given by NFR for SEK 1 million and by TFR for SEK 500.000, *RF*.

13. The Space Committee of 1962

- page 117 *Hulthén vice-chairman:* Space Committee minutes No 2, 6-8 August 1962, *RK*.
First meeting: Space Committee minutes No 1, 1 June 1962, *RK*.
Working party: Space Committee minutes No 12, 13 May 1963, *RK*.
Kerstin Fredga: Space Committee Working Party minutes of 1 July 1963 and Space Committee minutes No 23, 10 June 1964, *RK*.
- page 118 *Conference in January 1963:* Space Committee: Survey of the interests of Swedish science and industry and the opportunities for development in the space sector and views on the organisation of Swedish space activity, *RK*.

14. Thumbs Down for the Space Committee

- page 125 *Research council appropriations 1963/64.* Source: official document allocating appropriations.
- page 126 *Handling of the Space Committee's report:* The consultation period was set for 1 December 1963. The statements of the bodies to which the report was referred can be found in the files on Bill 1964:69 in the archive of the Ministry of Education and Culture, *RA*.
- page 133 *Consultative committee on research:* See Bill 1964:69. Report on the activity of the Consultative committee on research during 1963, *Sdt*.
- page 134 *Preparatory meetings on space:* My own recollections and memorandum of 25/1/64 from Fremlin concerning follow-up to the government's declaration of intent with regard to space research etc, *Sv Esro*.
- page 135 *Erlander's statement:* Tage Erlander: *The sixties: Conversations with Arvid Lagercrantz*, Stockholm, 1982, page 93.
Approval of the Kiruna agreement: Government decision of 29/6/64 concerning approval of an agreement between Sweden and ESRO concerning a rocket range at Kiruna and certain agreements concerning compensation for encroachment etc, *RA*.
 Government decision 6/11/64 concerning the disposal of certain sums payable to Sweden by ESRO; Government promulgation decision of 4/6/64 in connection with Bill 1964:69, *Sdt*.
- page 136 *Meeting on 14 March 1964:* Notice of 3/3/64 signed by Bror Rexed, by order of Sven Moberg, to attend a meeting "for information concerning Swedish space activity with reference to the forthcoming bill", *RK*.
- page 137 *Question:* Record of proceedings of the Upper Chamber, 1964.

15. The ESRO Committee and the Space Board

- page 139 *Space Board of the Swedish Research Councils, composition, finances etc:* Space Board's annual reports for 1964/65-1970/71, *RN*. Also Space Committee: Memorandum concerning the organisation of Swedish space research during the 1964/65 financial year, *Sv Esro*, *RK*.
- page 140 *The government therefore remained wisely silent:* Conversation between Moberg and me. We were in full agreement not to question the decision of the research councils. To

do so would have meant an infringement of the councils' right of autonomy and that right was not only a matter of principle, but was also very convenient for the government which could also point to it when a decision was criticised.

Joint Group for Swedish Space Research: Letter of 2/10/64 from the group to the Swedish ESRO Committee, *Sv Esro*.

Handling of ESRO participation Discussion between Moberg and me in spring 1964 after Bill 69 had been brought before the Parliament. From the very beginning, Moberg was clear in his view that the NFR, and in particular the Space Board, could not be entrusted with responsibility for ESRO cooperation, since the issue was too inflammatory. The scientists were not happy. In a conversation with me, Funke intimated that the formation of a special committee was an encroachment into the preserve of the research councils. Why were the councils relied on for CERN, but not ESRO? "However", he added bitterly, "the government can always do what it wants". In that he was right.

Composition of the ESRO Committee etc: Cabinet decision of 10/4/64 and ministerial records of 10/4/64, 30/6/65 and 3/6/66.

page 141 *Future of the Space Technology Group:* Space Committee: Memorandum concerning the organisation of Swedish space research during the 1964/65 financial year, *Sv Esro*, RK. ESRO Committee minutes 1964 and 1965. Bert Bolin: Letter of 27/8/64 to the space researchers' joint body concerning costs, personnel requirement etc for the Technical group (four annexes). Letter of 6/10/65 from Stiernstedt, ESRO Committee, to the research councils, Space Board, industry, TUAB etc, containing the draft agreement on the Technical Group, *Sv Esro*.

page 142 *Aeronautical Research Institute:* Rey-Lübeck, 17/10/64: Memorandum concerning negotiations with the Aeronautical Research Institute concerning space technology services, *Sdt*.

Original agreement (undated) between the Space Board, the ESRO Committee, ASEA, Telefon AB, LM Ericsson and SABB AB concerning the Space Technology Group, *Sv Esro*. Bengt Resare: Proposal for an agreement between AB Svensk Rymdteknik and the Swedish State concerning space technology services (photocopy), *Sdt*.

page 143 *RTG's personnel:* Annual report of the Space Technology Report year ending 1 July 1965, *RTG*, *Sv Esro*.

Another body: Cabinet decision and ministerial records, 24/9/64, *Sv Esro*. Letter of 2/2/65 from Auger to Moberg and reply of 20/2/65 from Stiernstedt to Auger. Minutes of 6/9/68 of the meeting of the consultative committee, *Sdt*.

16. ESRANGE finally ready

page 145 *The ESRO Committee's Lapland trip:* Own recollections and notes in a pocket book

page 146 *Future of the Space Technology Group:* Committee meeting in Älvsbyn. ESRO Committee minutes of 3/8/64, *Sv Esro*.

page 147 *Inauguration of ESRANGE:* Jan Stiernstedt: Draft, in Swedish, of Edenman's address for the inauguration. Ragnar Edenman: Draft address in English for the inauguration. ESRO: Inauguration of ESRANGE programme and detailed programme. ESRO: Inauguration of ESRANGE programme exhibition Olle Bonniér. ESRO: Placing of guests, menu. Norrländska Socialdemokraten, report of 24/9/66 from ESRANGE, DN and Sv D, 25/9/66, reports on the inauguration, *Sdt*.

page 150 *Two months later:* RTG No 68-2: Launch activity at ESRANGE 1966 and 1967 – Results and recommendations. L. Rey and K. Änggård, January 1968, *RB*.

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An interminable series of administrative questions: Where not otherwise specified, the source is the minutes of ESRO Committee meetings 1964-72, *Sv Esro*. Also letter of 5/10/64 from Kaltenecker, ESRO, to Sven Moberg, *Sdt*.

Privileges and immunities: Bill 1966:29, 27/1/66 concerning the provisional application of measures regarding privileges and immunities for the European Space Research Organisation. Board of Customs, 7/4/66, to the Ministry of Finance concerning the application of the protocol on privileges and immunities and the ESRO Committee statement on the letter of 23/5/66. Government decision of 6/5/66 to conclude an agreement with ESRO concerning the application of the protocol on privileges and immunities; Government decision of 2/9/66 concerning the application of certain parts of the protocol on privileges and immunities. Letter of 23/9/66 from Depasse, ESRO, to Holmberg, ESRO Committee. Board of Customs, letter of 2/11/66 to the Board of Excise concerning the proposal from ESRO regarding restitution of taxes and customs duties. ESRO/JUR 31 15/6 1968. Brief notes concerning a meeting in Stockholm on 30 April 1968 concerning ... questions regarding the application of the ESRO Protocol on Privileges and Immunities. ESRO/AF/889/20/5 1969: Complementary Agreement between Sweden and ESRO in accordance with Article 30 of the Protocol on Privileges and Immunities. Government decision of 10/4/70 concerning the agreement with ESRO on matters of immunity and privilege, *Sdt*.

Social security agreements: Letter of 31/7/64 from Crowley, ESRO to Stiernstedt; Letter from Hamdahl, Ministry of Health and Social Affairs, to the MFA, 5/10/64, *Sdt*.

Liability issues: Letter of 28/1/65 from the Private Insurance Supervisory Service to the ESRO Committee, *Sdt*.

Thickness of the shelter's roofs: Letter and memorandum of 23/1/67 from Rey, RTG, to Stiernstedt. Letter of 27/8/68 from Stiernstedt to Kaltenecker, ESRO, *Sdt*.

Telemetry station at the Sekujärvi lake: Letter from the MFA to the Ministry of Agriculture, 6/8/66. Opinions of the Board of Telecommunications, 18/8, the National Board of Agriculture, 24/8, National Judicial Board for Public Lands and Funds, 27/8, National Union of the Swedish Lapp People, 27/8, Defence Staff, 7/9, Board of Forests' District Office in Luleå, 15/9, Talma Lapp village and others, 18/9, Norrbotten county administrative board, 23/9, Board of Civil Aviation, 24/9, Board of Forests, 27/9, and Ministry of Agriculture, 1/10/65. MFA memorandum of 6/6/66. ESRO/AF/486 rev 1: Draft Separate Agreement concerning an Observatory Station. Jan Stiernstedt: memorandum of 27/7/66 concerning an extraordinary meeting of ESRO's Council on 18-20/7/66; ESRO Committee memorandum, 22/12/67, *Sdt*.

Safety measures: RTG: Report from talks on 3-4/5/65 with ESRO concerning certain safety issues for launches from Kiruna. Letter of 17/8/65 from Auger (signed by Mussard) to the chairman of the Swedish ESRO Committee requesting permission to launch Boosted Skylarks. RTG: Undated memorandum concerning permission to ESRO to launch Skylark rockets equipped with launchers at the Kiruna launching range. MFA memorandum of 30/3/66 concerning discussions with the Finnish and Norwegian embassies concerning the types of rocket to be used in launches from the rocket range at Kiruna. Royal Norwegian Embassy (Stockholm), 20/4/66: Note to the Ministry of Foreign Affairs concerning types of rocket for launches from Kiruna. Minutes from the ESRO Committee meeting on 15/4/66. Stiernstedt: memorandum of 4/5/66 concerning ESRO's rocket range at Kiruna. Government decision of 27/5/66 concerning the approval of certain types of rocket for launchings from ESRO's rocket range at Kiruna with attached letter to ESRO's director-general. Letter from ESRO (Lines) 8/7/66 concerning safety at the Kiruna range. MFA (Edelstam) memorandum of 20/1/67 concerning safety issues at ESRANGE. Letter of 21/3/67 from Eckerberg, MFA to Kaltenecker, ESRO. Letter of 28/4/69 from Kaltenecker, ESRO, to Holmberg,

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- page 152 *Revision of the Kiruna agreement:* ESRO Committee memorandum of 18/5/67 concerning the meeting regarding certain Kiruna matters. ESRO Committee memorandum of 26/6/67 concerning the meeting held on 15/6 regarding certain Kiruna matters. Letter of 28/6/67 from Stiernstedt to Kaltenecker concerning the "revision of the Kiruna Agreement". RTG (Rey, Ångård), July 1967: Aspects of the revision of the Kiruna agreement. ESRO Committee, 9/11/67: Notes from the meeting on 8/11/67 concerning certain Kiruna matters. RTG, 23/11/67: letter to Stiernstedt with cost calculations for reinforcement of shelters. Letter of 3/1/68 from RTG (Rey) to the ESRO Committee concerning certain Kiruna matters. ESRO Committee 16/5/68: Preliminary memorandum concerning the meeting regarding the revision of the Kiruna agreement. ESRO/JUR/32/Rev/10/9/1968: Minutes of the meeting... concerning the revision of the Kiruna agreement ...14-15 May 1968. Two letters of 11/9/68 from Kaltenecker to Stiernstedt. Letter from Stiernstedt to Kaltenecker concerning the agreement proposal. Telex of 29/5/69 from Kaltenecker to Stiernstedt concerning the agreement proposal. 1970 concerning the revision of the agreement between Sweden and ESRO on a rocket range in Kiruna and the annexes thereto. Consultative local ESRO committee, minutes of 9/12/70. OECD delegation in Paris, letter of 26/3/71 with the Swedish copy of the agreement, *Sdt.*
- Swedish use of ESRANGE. Extension of zone A:* RTG (Rey) memorandum of 4/8/66 concerning negotiation on Swedish use of ESRANGE. Letter of 20/9/66 from Stiernstedt to Bolin, ESRO. Letter of 16/1/68 from RTG (Rey) to the ESRO Committee concerning the planned rocket campaigns extending zone A. Letter of 21/3/68 from Holmberg, ESRO Committee, to Kaltenecker, ESRO with a notice and agenda for a meeting in Stockholm on 3-5/4/68. Preliminary notes of 16/5/68 from a the meeting on 3-5/4. Letter of 4/6/68 from Halvorsen, ESRANGE, to Stiernstedt with notes from the meeting 15/5/68. Sept 1968 Report by the Joint ESRO-Sweden Working Group on extension of zone A at ESRANGE. February 1969: Translation of the above-mentioned report. ESRO Committee: memorandum regarding the Swedish campaign at ESRO's rocket range at Kiruna. Letter of 5/3/69 from the ESRO Committee to the Government, forwarding the above-mentioned report. Letter of 2/12/69 from Kaltenecker to Stiernstedt concerning compensation for the extension of zone A. Government decisions of 24/11/67, 31/3/67, 5/4/68, 28/5/68, 28/6/68, 19/12/68, 7/3/69, 14/5/71, 4/2/72, *Sdt.*
- page 153 *Destruction system:* RTG 68-27 Rey: Destruction system at the Kiruna range? *RB*
- Correspondence between Stiernstedt and Bondi:* Letter of 30/9 and 24/10/68 from Stiernstedt to Bondi and reply of 11/11 from Bondi and of 26/11/68 from Stiernstedt. Letter of 28/12/68 Stiernstedt to Bondi and reply of 21/1/69 from Bondi, *Sdt.*
- page 154 *Town of Kiruna's tourist board:* Letter of 1/7/65 from the ESRO Committee to the town of Kiruna's tourist board, *Sdt.*
- School for French children:* Letter of 9/5/69 from ESRANGE to the ESRO Committee, *Sdt.*
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One slightly comical episode: Letter of 13/10/60 from Hermann Bondi to Jan Stiernstedt and reply of 22/10/69 from Stiernstedt, together with annexes, *Sdt.*

page 155 *Director of ESRANGE:* Letter of 19/2/65 from Moberg to Auger. ESRO Committee memorandum of 4/6/65. Jan Stiernstedt memorandum of 27/7/66 concerning the extraordinary meeting of ESRO's Council on 18-20/7/66. MFA memorandum 8/10/65 concerning ESRO's prospective rocket range in Kiruna, *Sdt.* Minutes of the ESRO Committee, 6/9/66, *Sv Esro.*

17. Sweden in ESRO

page 158 *Technical and scientific attaché:* Costs were shared between the Ministry of Education and the Ministry of Trade, later the Ministry of Industry. Pilo, OECD delegation: Annual report for the technical and scientific attaché in Paris. 1966/67 financial year, *Sdt.*

page 159 *Swedish non-alignment:* Own recollections. Ministry of Foreign Affairs (Örjan Berner) memorandum of 15/7/64. ESRO-French agreement on rocket launchings, *Sdt.*

Interests of the Swedish electronic and aviation industries: ESRO Committee minutes of 27/2 and 21/5/65. Letter of 21/9/65 from the Working Group on Space Technology of the Swedish Association for Metalworking to the Ministry of Education and Culture. Stiernstedt: memorandum of 21/4/65 concerning the handling of the contract for the ESRO I satellite at the meeting held in Paris on 23/3/65. Holmberg, ESRO Committee: memorandum of 30/10/66 on tenders by and contracts awarded by ESRO to Swedish companies. Holmberg: memorandum of 26/1/67 on the shares of Swedish companies in the TD1 and TD2 satellite contract. DN 1/2/67 "SAAB's share of the space order is the communication systems for two ESRO satellites". Holmberg, ESRO Committee, 12/11/67: memorandum on the objectives, motives and a programme of action for contacts with Nordaviation with regard to possible Swedish participation in the BAC consortium. RTG, 21/2/72 (Martin-Löf): Sweden's industrial return in the form of the 1971 ESRO contract, *Sdt.* RTG October 1967: The industrial space market, *RB.*

page 160 *Handling of the TD contract:* Own recollections and Pilo's annual report, page 3.

page 162 *TD satellite special project:* Government decision of 18/10/68 concerning the approval of the proposal for an agreement ... and of 27/6/69 concerning the appropriation to European space research cooperation. DN, 19/6/68, "SAAB's first space order stands firm, but is cut", *Sdt.*

page 163 *Swedish personnel:* Letter of 4/1/63 from Edelstam, MFA, to Kaltenecker, ESRO. ESRO Committee: Undated memorandum concerning issues raised by B. Oskarsson (Consultative Committee on Research), *Sdt.*

page 164 *One matter relating to flying saucers:* Letter of November 1967 to Tage Erlander from ICUFON, the Intercontinental UFO Research and Analytical Network, RTG No 68-12, *Sdt.* The UFO issue: an overview. J. Martin-Löf, February 1968, *Sv Esro.*

18. Wilderness years

- For the entire chapter* reference is made to the Report on the activities of the Space Board of the Swedish Research Councils for the 1965/66, 1966/67, 1967/68, 1968/69, 1969/70 and 1970/71 financial years (last year of activity), minutes from the meetings of the Space Board and plans for the various years of activity, *RN*. Also Space Technology Group's annual report year ending 1 July 1965 and for 1965//66, 1966/67, 1967/69, 1969/70, *RTG*.
- page 165 *Barely SEK 6.3 million in 1971/72*: Letter from the Space Board to the STU and NFR, 7/6/71, *RN*.
Funding would always be lacking: See the annual reports and letter from the Space Board to the MFR, NFR, TFR and FOA of 17/3/66. Space Board memorandum of 8/6/70 concerning Swedish space research's funding problem. Letter from NFR and TRF, 23/9/66, to the government, *RN*. Letter of 2/10/64 from the space researcher's joint group to the Ministry of Education and Culture, *Sdt*.
The space industry also complained: Letter from the Working Group on Space Technology of the Swedish Association for Metalworking to the Ministry of Education and Culture, *Sdt*. Also my own recollections of calls made on the Ministry of Education and Culture. SAAB was particularly active through Tore Gullstrand and Gert Larsson.
There were also complaints in the media: UNT, 4/6/64, DN 17 and 24/2/66, DN 21/3/69. Also minutes from the first meeting of the Joint Group for Swedish Space Research, 21/5/64, *Group's archive*.
- page 167 *However, the Board adopted a wise policy*: See the annual reports and activity plans, *RN*.
In addition, the Board supported: See the annual reports and the memorandum from Bolin concerning space research in Sweden, undated, spring 1964, *Sdt*.
- page 169 *Hultqvist's satellite experiment in ESRO*: Krige-Russo: Europe in space 1960-1973, ESA 1994, page 49 ff. European Space. A Silver Jubilee Celebration, ESA 1989. Annual reports and Hultqvist: *Space, science and me*, manuscript 1995, chapter 6.
- page 170 *Quotation from Hultqvist: Space, science and me*, manuscript, chapter 6.
- page 171 *GEOS approved by the ESRO Council in 1969*: Stiernstedt: Memoranda, 24/10/70, *Sdt*.
A national experiment programme: Annual reports and activity plans. Press release from the Space Board, 30/9/68 concerning Swedish sounding rocket tests, *RN*. Witt, MISU and Derblom, UJO 9/9/70: The summer's sounding rocket experiments and some views on the continued cooperation with foreign research groups, *RN*. RTG Änggård, 21/4/70: ESRO Charging Policy. RTG Engström-Änggård: Order of 15/9/70 to SAAB concerning the auroral probe, *RTG*.
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Symposium in February 1966. Invitation to the symposium, February 1966, *RN*.
Swedish satellite: Annual reports and RTG, Rey, October 1967: Proposal for a first Swedish satellite. RTG, Lübeck, October 1967: Technical plan for a first Swedish satellite. RTG, Lübeck, September 1968: Results of discussions with NASA on the Swedish satellite project. RTG, Rey, December 1968: A first Swedish satellite project. Bolin, 28/3/69: Letter to STU. RTG, Rey, 31/10/68: Need for a decision on the proposed Swedish satellite project. RTG, Martin-Löf, 2/3/70: Proposal for a plan of action for the Space Board's satellite project. RTG, Rey, 3/3/70: Brief history, with references, of the proposed Swedish satellite project. RTG, Engström, 24/11/70: Progress report on the Swedish satellite and proposal for measures to be taken for the

development of the project, *RTG*. Also *Swedish and European Space Activity*, page 80 f, Ministry of Industry, 1969:3.

page 173 *There was not only a focus on satellites*: Annual reports.

page 174 *Swedish two-stage rocket*: Holmberg, ESRO Committee: Report from a meeting of the Space Board of the Swedish Research Councils held on 18 December 1967 and annexes. Rey: Contribution to an FOA report on the possibility of Sweden developing a stabilised sounding rocket, *Sv Esro*. FOA 2 Report C 2240-46, February 1968: memorandum on the possibility of developing a stabilised sounding rocket in Sweden, *Sdt*.

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page 175 *Reaction in the Ministry of Education and Cultural Affairs*: Own recollections. Handwritten memorandum from Fredrik Engström to Stiernstedt 20/5/71, *Sdt*.

19. ESC and ESRO's First Package Deal

page 177 The international arena was dominated: Memorandum concerning Swedish and European space activity, page 18-19.

Development in the field of telecommunications: See Ploman, 1969 and 1972, Russo 1994, Sebesta 1994 and Krige-Russo et al. Also memorandum concerning Swedish and European space activity and Ministry of Industry memo 1970:4.

page 178 Criticisms of European space activity: Ministry of Foreign Affairs, Edelstam 8/8/66: memorandum concerning coordination of space activity in Western Europe (3 annexes), *Sdt*. Also my own recollections.

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Sven Gustafson's report: Council of Europe, 9 January 1966. Doc 2165. Consultative Assembly. Opinion on first General Report of the European Space Research Organisation (ESRO) 1964/65 presented by the Economic Committee (Rapporteur Mr Gustafson), *Sdt*.

page 179 Wedgwood Benn: Krige-Russo, page 65.

Result of the first ESC conference: Swedish OECD delegation in Paris, Pilo: Report of 27/12/66 concerning the European space conference with the conference resolutions as annexes, *Sdt*.

page 181 Hopes were raised in the space industry: See memorandum concerning Swedish and European space activity, page 9 f.

At the same time, another group was working: I have been unable to find any documentation from this group. Its existence was so informal that it mainly worked without papers. The account is therefore based on my own memories. Even though the

- group is not mentioned, some of the background can be found in Rydbeck 1990 and Ploman 1969 and 1972.
- page 182 The European picture was still confused: Swedish embassy, Rome, Pilo: Report on ESC's ministerial meeting in Rome on 11/13 July 1967. ESC Committee of Alternates CSE/CS (68)9 15/2/68: Summary of Report of the Advisory Committee on Programmes. MFA, Eckerberg, 18/1//68: Memorandum. The European Space Conference. MFA reports 1966-71, Sdt. Also my own recollections.
- page 183 Wickman's answer came on 28 April 1970 in the Upper Chamber as a reply to a question asked by Nyman, a Liberal, regarding the assessment of conditions for a expansion of the Swedish space programme.
- page 184 The situation was not made any better by the fact that the Swedish delegation had gone to Brussels well prepared: Apart from Ministry of Industry memo 1970:4, there are a number of working papers in which various alternatives for participation and economic levels are outlined: Ministry of Education memoranda concerning European space research 28/6, 21/10, 30/10 and 3/11/70. Ministry of Education, 17/10/70: Swedish costs for participation in European cooperation in space research etc 1962-80. November 1970: Statistics concerning ESRO's expenditure in Sweden compared with Sweden's contribution to ESRO. Ministry of Education, 3/11/70: Possible decisions (i.e. at the forthcoming Brussels conference). All the above documents are unsigned, but were drafted by Stiernstedt and Holmberg. November 1970. Three main alternatives for the structure of Swedish space activity. Undated and unsigned, but drafted in the Ministry of Industry, Sdt.
- page 185 Before the conference broke down, Krister Wickman made a statement: ESC: CSE/CM (November 1970) PV/1 annex III: Declaration by the Swedish Minister of Industry, Sdt.
- The collapse of the Brussels conference: RTG, Ingemar Skoog, 23/1//70: The European space situation after the Brussels conference, 4 November 1970, Sdt.
- In Stockholm we had already analysed the consequences of leaving ESRO: Ministry of Education, 27/10/70, A.s./Bhg: Memorandum regarding the consequences of a Swedish withdrawal from ESRO with respect to the ESRO rocket range at Kiruna. Engström, 7/1/70: Summary of a discussion between Dr S. Lindgren, F. Engström and the chairman of the ESRO Committee, J. Stiernstedt. MFA U 20/6/71 MT (Marianne Thorén): Letters from NFR and STU regarding Swedish space activity, Sdt.
- page 186 Puppi's proposal: Own recollections and Krige-Russo.
- page 187 A delegation consisting of Stiernstedt: Letter of 6/5/71 from Stiernstedt to Hosie (SRC, London), Schramm (Bundesministerium für Bildung und Wissenschaft, Bonn) and Obling (Forskningens Faellesudvalg Köpenhamn). Ministry of Education, 13/5/71: Report on discussions held on 12/5/71 with representatives of the Science Research Council concerning the future organisation of administration and activity at ESRANGE. Ministry of Education, 19/5/71: Report on discussions held on 12/5/71 with representatives of the Bundesministerium für Bildung und Wissenschaft concerning the future organisation of administration and activity at ESRANGE. (The latter two memoranda are unsigned, but were probably written by Marianne Thorén). Ministry of Education, 21 and 30/6/71: Memoranda on European space activity (unsigned, but drafted by Stiernstedt prior to the preparatory meeting for Wickman, Moberg and Norling), Sdt. RTG A5 4-

4. The future of ESRANGE, RB. Stiernstedt: Letter of 7/7/71 to all chief delegates on the ESRO Council, Sdt.
- page 188 In July 1971 the ESRO Council met: Stiernstedt's contribution at the Council meeting. A typed draft was prepared in advance in Stockholm a handwritten, revised version was prepared on the spot – this was the statement made, Sdt.
Puppi's proposal for the scientific programme: See Krige-Russo.
After the Council meeting, Moberg issued a press release: Ministry of Education, Sven Moberg: Press release, 14/7/71, Sdt.
- page 189 Much work was done during the autumn of 1971: Letter of 28/7/71 from Stiernstedt to Hocker and to all chief delegates on the ESRO Council with an invitation to discussions on ESRANGE to be held in Paris on 6/9/71. Ministry of Industry Unit 3 LR/aö: Memorandum of 12/10/71: Decisions which must be taken by industry on ESRO's three applications projects during autumn 1971. RTG, Zetterquist, 25/10/71: Andöya rocket launching range. Report from a visit on 7 October 1971. RTG 19/10/71: The Norwegian-Swedish proposal for maintaining Andoya Rocket Range and ESRANGE, and Addendum, 22/19/71, Sdt.
On 19 November there was an informal session of cabinet: Ministry of Education, 18/11/71: Memorandum concerning European space activity (unsigned, but drafted by Stiernstedt). Ministry of Industry LR/ak.
Memorandum I, 18/11/71: European industrial cooperation in ESRO's applications programme; Memorandum II, 19/11/71: Grounds for Swedish participation in the applications programme. Ministry of Industry memorandum of 22/11/71: Informal session of cabinet on space matters on 19/11/71 and certain related events. Ministry of Industry LR/aö: Memorandum of 23/11/71: Space in the budget work. Swedish ESRO Committee B Hg, 1/12/71: Alternative I and Alternative II. MFA, 13/12/71: The ESRO situation in brief and draft telex from the MFA to the Swedish Embassy in The Hague, Sdt.
By spring 1971: Discussion in Paris with Fredrik Engström, 25/11/96.
- page 190 ESRO's Council meeting on 8-9 December: Draft minutes ESRO/C/MIN/43, Sdt.
The next Council meeting took place on Monday 20 December: ESRO/C/Res.3 (Final): Resolution on the Reform of the Organisation (formally adopted by the Council at its 44th session). ESRO/c/XLIV/Res 2: Declaration concerning the ESRANGE special project. ESRO 20/2/71: Agreement between Sweden, other member States of the European Space Research Organisation and the European Space Research Organisation on a special project concerning the launching of sounding rockets. Ministry of Industry and Ministry of Education, 21/12/71: Press release, Sdt.
20. The Board for Space Activities and the Swedish Space Corporation are born
- page 193 *Principles for an organisation.* Ministry of Industry, Rey/aö, Memorandum of 5/11/71: A new space organisation on 1 July 1972. Swedish ESRO Committee, 22/12/71: Graphical outline, Sdt.
- page 195 *The statement concerning the satisfactory return:* Swedish ESRO Committee, November 1970: Statistics concerning ESRO's accumulated expenditure in Sweden compared with Sweden's contributions to ESRO, Sdt.
The financing of the Board for Space Activities : Ministry of Education, 26/1/72: ESRO appropriation: Modification of appropriation for 1971/72 and 1972/73, Sdt.

- page 197 *In the midst of all this work ... I was called on:* Ministry of Education, Jan Stiernstedt: Notes from a visit on 2 February 1972 by Professors Bernhard, Öhman and Stenflo concerning Russian-Swedish cooperation in satellite research, *Sdt.*
Even the Norwegian-Sweden agreement: RTG, 24/2/72: Proposal for an agreement between Norway and Sweden. MFA, Political Division, Unit 4, Forshell, CB: Memorandum of 29/2/72. Cooperation agreement between Sweden and NTNf. Draft government decision concerning the signature of a cooperation agreement between Sweden and Norway's Council for Technical Research, *Sdt.*
Håkansson was the Board's only employee: Organisation committee for space activity: communiqué of 21/6/72. Also includes the composition of the boards, *Sdt.*

21. Epilogue

- page 201 *I had the government's full powers:* Ministry of Industry, extract from the ministerial records, 7/6/72 §3: Appointment of J. Stiernstedt to receive the facilities and equipment at ESRANGE on behalf of the government, *Sdt.*
The hand-over took place in the afternoon: Letter from J. Arets to B. Holmberg, 15/6/72 with a programme etc. ESRANGE hand-over from ESRO to Sweden. Programme. Menu and seating plan at the dinner given by the City of Kiruna and the Swedish Ministry of Education and Cultural Affairs on the occasion of the handing-over of the ESRO sounding rocket launching range (ESRANGE) to the Swedish authorities. Kiruna City Hall, June 30 1972 at 9.00 pm. RTG: Press release from ESRO concerning the transfer of the ESRANGE rocket launching range to Sweden, *Sdt.*
We both spoke: Typed draft of Jan Stiernstedt's address at the hand-over and handwritten draft of his dinner speech, *Sdt.*

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Abbreviations

AFC	Administrative and Finance Committee (ESRO/ESA)
AFR	Swedish Atomic Research Council
AT&T	American Telephone and Telegraph Company
CEPT	European Conference of Postal and Telecommunications Administrations
CERN	European Centre for Nuclear Research
CETS	European Conference on Satellite Communications
COPERS	European Preparatory Commission on Space Research
COSPAR	Committee on Space Research
CTH	Chalmers Institute of Technology, Sweden
DFR	Board for Space Activities
EC	European Community
EEC	European Economic Community
ELDO	European Launcher Development Organisation
ESA	European Space Agency
ESDAC	European Space Data Acquisition Centre
ESLAB	European Space Research Laboratory
ESRANGE	European Space Range
ESRIN	European Space Research Institute
ESRO	European Space Research Organisation
EST	European Satellite Team (Industrial Consortium)
ESTEC	European Space Technology Centre
FFA	Aeronautical Research Institute, Sweden
FOA	Swedish National Defence Research Institute
GEERS	Groupe d'Etude Européen pour la Recherche Spatiale
GEOS	Geostationary Scientific Satellite
IAF	International Aeronautical Federation
ICSU	International Council of Scientific Unions
INTELSAT	International Telecommunications Satellite Organisation
IRF	Institute for Space Physics, Sweden
IVA	Academy of Engineering Sciences, Sweden
KGO	Kiruna Geophysical Observatory
KTH	Swedish Royal Institute of Technology
KVA	Swedish Royal Academy of Science

LPAC	Launching Programme Advisory Committee
MESH	Matra, Erno, Saab, Hawker-Siddeley (Industrial Consortium)
MFA	Ministry of Foreign Affairs
MISU	Meteorological Institute, Stockholm University
NASA	National Aeronautics and Space Administration (USA)
NATO	North Atlantic Treaty Organisation
NFR	Swedish Natural Science Research Council
OECD	Organisation for Economic Cooperation and Development
RRV	Swedish National Audit Bureau
RTG	Space Technology Group, Sweden
SAR	Scandinavian Working Group on Space Research
SMHI	Swedish Meteorological and Hydrological Institute
SRC	Science Research Council (UK)
SSR	Swedish Sami (Laplander) Union
STU	Swedish National Board for Technical Development
TD	Thor-Delta Rocket, ESRO satellite launch with TD rocket
TFR	Swedish Council for Technical Research
UJO	Uppsala Ionosphere Observatory
UNESCO	United Nations Educational and Scientific Organisation

Space research is an age-old science. Man has always dreamed of reaching the heavens. This dream has survived in myths, legends and in reality. When the Soviet Union launched Sputnik in 1957 space research had a new technology. For scientists the window was opened not only to outer space, but also to the earth. A space authority – NASA – was formed in the United States and proposals were made in Europe to form a European space organisation – ESRO, later ESA. Sweden was there at an early stage. A Swedish space research committee was formed as early as 1959.

Sweden in Space. Swedish Space Activity 1959-1972

is an account of the early years of Swedish space research, up until the formation of the present national space organisation. It is a story of scientific successes, optimism and pioneer spirit, but also of the resistance that was encountered by a new and expensive activity as it sought to find a place in the established research and technical community.



Jan Stiernstedt, born in 1925, has been an official in the Swedish Ministry of Education and Cultural Affairs, where his responsibilities included research matters, and chairman and director of the Board for Space Activities (Swedish National Space Board). In those roles, he

came into contact with space research and space activity early on. For more than 25 years he represented Sweden in ESRO (European Space Research Organisation) and in its successor, ESA (European Space Agency). For a time he was also chairman of ESA. He is currently working on an account of Swedish space activity from 1972-1989.

***European Space Agency
Agence spatiale européenne***