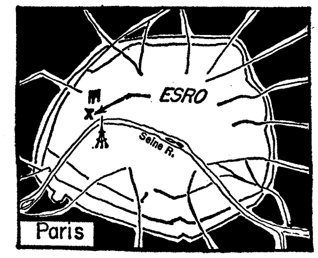

The Cooperative Space Research Agency

Paris. The organizational phase of the effort to create a cooperative space science agency in Europe has been successfully concluded. The treaty establishing the European Space Research Organization (ESRO), signed 14 June 1962, came into force 20 March 1964. The ten signers are Belgium, Britain, Denmark, France, Holland, Italy, Spain, Sweden, Switzerland, and West Germany. Austria and Norway signed an earlier agreement (December 1960) setting up the preparatory commission, but backed out of ESRO because of the cost.

The new ESRO took over the offices and staff of the preparatory commission, which had worked 3 years to frame a scientific program and plan the installations needed to carry it out. ESRO headquarters are in Paris, not far from headquarters of the French space program, whose administrators plan to launch a French satellite from a site in the United States in 1965 and several more, with a French rocket assembly, from the Sahara, starting in 1966. Italy and Britain have been moving ahead with their own space programs. On 15 March the Italians, with an American rocket, launched a scientific capsule 250 kilometers up from a floating platform in the Indian Ocean, and a week before that the second British satellite went into orbit from Wallops Island, Virginia.

The cooperative European space science program will begin in much the same way that the individual European programs began, by making atmospheric and ionospheric observations from instruments launched by American rockets. Naturally, ESRO hopes that its first two satellites—one to study auroras in the polar regions and the other to measure x-rays, ultraviolet radiation, and particle radiation from the sun—will be close enough to American scientific aims to be incorporated in the program of the National Aeronautics and Space Administration and be eligible for the kind of help already given Britain, Canada, France, and Italy.

Thus, neither ESRO nor individual European nations are beginning their satellite programs with a declaration of independence from the United States. NASA has offered cooperation from the start, and an all-European booster is some years off.

The problem is put this way in the 1963 annual report of the French space agency:

"Building satellites . . . is still, in France, in an embryonic state. It is impossible that France propose ambitious programs until the indispensable technical and industrial base has been set up, a task of several years even if we can keep the required continuity of views.

"To catch up, only close contact with American specialists would permit acquisition of the indispensable techniques. . . .

"To profit from the experience acquired by the Americans and to avoid as many difficulties as possible which the Americans have met," the French space agency sent a dozen younger engineers to study satellite design and construction at NASA's Goddard Space Flight Center in the United States. These engineers are now the nucleus of a group building the first three French satellites.

On 23 March, the day of the first ESRO council meeting, ESRO handed the press a statement which included a paragraph in which the issue is put differently:

"In the selection of European experiments, great care has been taken to avoid any waste of resources, financial or intellectual, and any involuntary duplication of the work carried out by NASA. Discussions have taken place between European and American scientists to ensure that there is no overlapping of scientific goals. Negotiations are also in progress between Europe and the United States in order to allow a joint utilization of the space documentation collected by both parties."

Despite its announced aim to extend resources of money and talent by shouldering a space program that would cripple a single country, ESRO will not be the only European path into space.

Apparently ESRO has been taking this fact into account in its planning. Director-General Pierre Auger, until recently the scientist-president of the French space agency as well as executive secretary for the preparatory commission, reports:

"[The preparatory commission] agreed that to attain maximum efficiency the organization would act as a stimulus and a supplier of services, but not as a competitor with the national organizations of the member states.

"The organization will make available to the member states the laboratories and technical equipment required for carrying out the research conceived by research teams at universities and national institutes and, in collaboration with industry, will undertake the advanced technological research necessary for the implementation of such a program."

ESRO's organizers hope that it will catalyze the work of scientists in many fields who use information generated by rocket-borne equipment. They hope that ESRO's program will modestly stimulate Western European industry—which has formed its own consortium of firms to cooperate on space programs—and prevent the migration of scientists to the United States.

The Program

ESRO's program—which is to cost $300 million over the first 8 years—is tiny compared to the total budgets of the American and Russian space programs, and small enough when compared, more properly, to the unmanned scientific program of NASA. (The development of the all-European booster is a separate enterprise, undertaken by six ESRO members—Belgium, Britain, France, Holland, Italy, and West Germany—who plan to spend $200 million on it, over 5 years.)

Because it covers only the common program of development, technical service, and administration, ESRO's budget under-reports its total program. Besides their contributions (Britain pays a quarter, France and West Germany each about a fifth), ESRO members are expected to provide roughly matching sums to support their space scientists' work on ESRO experiments and to meet the cost of instruments to be launched.

The experiments will be sent aloft in 400 sounding rockets, six small and eight medium-sized satellites, seven space probes, and a large orbiting astronomical satellite envisioned for the early 1970's.

For the 12 sounding-rocket launches planned for 1964, ESRO is turning to Britain and France. The British will supply Skylark rockets, the type presently being launched from Woomera in Australia at the rate of about 25 a year for upper-atmosphere studies approved by the Royal Society. The French will provide the Centaure, of which 24 were launched from the Mediterranean region, the Sahara, and Argentina during the 1962–63 budget year, chiefly for study of a series of cloud emissions (sodium, aluminum, and other substances) directed by J. E. Blamont.

Among the rocket experiments to be attempted in 1964 will be measurements of solar ultraviolet and x-radiation and of upper-atmosphere electron temperature and density. Possible launching sites are the Ile du Levant off the French Riviera and Salto di Quirra on Sardinia.

Design studies for ESRO's first satellite should begin soon in Sweden and Italy. The satellite will attempt to make simultaneous measurement of the luminosity of auroras and of flux and energy of protons and electrons descending on the upper atmosphere.

Auroras occur with a frequency that matches the 11-year sunspot cycle, and most frequently in a beltlike zone that coincides fairly closely with the outer edge of the outer end of the Van Allen radiation belts. It is thought that auroras are caused by particles accelerated in the belts and then ejected. The auroras are frequently related to the arrival at the earth of particles associated with flares in the sun.

When the satellite is launched into a near-polar orbit from Point Arguello, California, in late 1967, the sunspot cycle should again be building up to its maximum. Pointing out at the particles will be a Danish proton detector, British electron detectors, and a Swedish electrostatic analyzer, according to the preliminary scientific program.

The electrostatic analyzer has a close connection with instrumentation for other high-latitude studies. It was developed from an American instrument used in the joint American-Swedish series of rocket launches from Lapland which succeeded in 1962 in capturing a dust sample from a noctilucent cloud (these are puzzlingly high stratospheric clouds which occur naturally in high latitudes at sunset in late summer) and, in 1963, in measuring unexpected coolness in such a cloud. The series will end this summer with launching of rockets equipped for simultaneous particle trapping and firing of grenades for making temperature measurements.

The Swedish instrument was developed at the Kiruna Geophysical Observatory, where ground-based observations of the absorption of radio waves over the polar cap and radio-wave echoes from auroras are an important part of the program. The particle detectors will cover a range of energy from a few hundred up to 10 million electron volts. The photometer for direct observation of the displays will be Norwegian.

Studies for the second ESRO satellite are already under way in Belgium and Switzerland. Besides measuring radiation from the sun (particles, x-rays, and ultraviolet waves), the ESRO-2 will also make particle measurements in the Van Allen radiation belts. This satellite, too, is intended for launching in 1967–68.

Several design-study contracts, among them contracts with the British Ministry of Aviation and the French space agency, have been made for work on the large orbiting astronomic observatory. Instruments for measuring x-rays and ultraviolet waves are to be aboard the satellite.

Scientific Subcommittees

To consider proposals for research—more than 70 each for sounding rockets and for satellites have come in already—ESRO has set up a group of scientific subcommittees. The groups and their chairmen are as follows: Atmospheric structure, R. Frith of Britain; Ionosphere and auroral phenomena, Bengt Hultqvist, Sweden, director of the Kiruna Geophysical Observatory; Sun, C. de Jager, Netherlands, director of the Utrecht Observatory; Moon, planets, comets, and interplanetary medium, Ludwig Biermann, Germany, director of the Max Planck Institute for Astrophysics in Munich; Stars and stellar systems, P. Swings, Belgium, professor of astronomy at the University of Liège; Cosmic rays and trapped radiation, G. Occhialini, Italy, professor of high-energy physics at the University of Milan.

The scientific program these groups are framing appears to fit in rather closely with the satellite projects of Britain and France.

Satellite Projects of Britain and France

The British satellites—Ariel I, launched in 1962, Ariel II, launched 27 March, and the third, scheduled for launching in 1966—have emphasized the measurement of distribution of ions in the upper atmosphere. Nonetheless, the program has room for projects developed by astronomers; an aerial developed by the Cambridge radio-astronomy group under Martin Ryle to listen to low-frequency emissions apparently blocked by the atmosphere and a micrometeorite-measurer developed at Jodrell Bank both flew aboard Ariel II.

When the first French satellite goes up from California aboard a Scout rocket, it will carry a receiver of very-low-frequency (VLF) radio waves, to be used for listening to VLF emissions from ground stations in France and the United States and to the abundant natural VLF "noise."

Active in developing this experiment is L. R. O. Storey, the English pioneer in studying the "whistler" VLF radio waves given off when strokes of lightning hit the ground and are propagated along the earth's lines of magnetic force, often for many trips from Northern to Southern Hemisphere "conjugate points," an effect that can also be produced by VLF broadcasts. Storey, who used to work for Blamont in the aeronomy group of the National Center for Scientific Research (CNRS), has now moved to the Ionospheric Research Group (GRI).

Some VLF radiation is reflected by the ionosphere's lower edge, but some passes right through it and gives measures of the total electron concentration along a force line, as well as of the distribution of electrons along force lines in the magnetosphere. The experiments aboard the first French satellite are the responsibility of the National Center for Telecommunications Studies (CNET).

So far, the French have made plans for only one satellite to be launched in the United States, although an experiment of Blamont's—to measure the luminescence of the night sky—has been included in NASA's polar-orbit geophysical satellite POGO.

The first two satellites to be launched from the Sahara in 1966, D-1 and D-2, will be technological. Launched southeastward at a 30-degree inclination to the equator, the satellites will orbit between 600 and 3000 kilometers, to test the effect of radiation on their solar cells. The first will only transmit when it is within sight of a telemetry station; the second will have a recorder for storing data.

Only after launching these technological satellites will the French launch a scientific satellite aboard their Diamant rocket assembly. The first, called D-3, will study the distribution of atomic hydrogen with an optical resonance device from Blamont's group, to measure the intensity of Lyman alpha radiation from the atomic hydrogen. D-4 will seek to measure rapid but feeble variations in the earth's magnetic field. Experiments for D-5, still not fixed, apparently will concentrate on solar observations with a telescope and spectrometer.

European Booster

When the national and the ESRO satellite programs are viewed together, it appears that the European aim is to arrive, through experience with smaller satellites, at a point, around 1970, when ESRO can profitably launch a complex astronomical telescope—or perhaps the lunar probe that it is still pondering—and have a tested European booster available.

This is the booster that is being developed by the six members of ESRO who have formed the European Launcher Development Organization (ELDO). The first effort of ELDO is to marry the discarded British Blue Streak, a military medium-range rocket, to a modified French Veronique rocket as second stage and to a German third stage. The Italians are to provide a technical satellite. Australia, a seventh member, contributes the Woomera range, while the Belgians contribute downrange guidance and the Dutch contribute the telemetry.

The first launching test of the Blue Streak, which burns kerosene and liquid oxygen, is scheduled to take place at Woomera in April. The changed Veronique, which is to burn unsymmetrical dimethylhydrazine (UDMH) and nitrogen tetroxide, is to be used in the Sahara launching planned for early 1965.

There is much criticism of the ELDO program, particularly on the part of British engineers, who would like to see Blue Streak married to the British Black Knight rocket, for all-British satellite launchings. The critics say that American rockets will suffice for scientific launchings, and that the only important use of the European booster would be to launch a European communications satellite, so that Europe might have a hand in a world system of communications satellites. Now that the United States has gained a long lead in testing medium- and high-altitude communications satellites, this possibility is now academic in the eyes of such interested parties as the British General Post Office.

Long-Range Plans for ESRO

In its 3 years of getting ready for ESRO, the preparatory commission, headed by Sir Harrie Massey of Britain, also planned a technical infrastructure for ESRO. This includes:

1) A site for launching sounding rockets. This will be at a lonely spot east of the Swedish arctic iron-mining town of Kiruna, at the edge of the zone of maximum auroral frequency. The site is not expected to be ready until 1966.

2) A technical center at Delft, Netherlands, which will include a large environmental testing facility. Here scientists will have laboratories for putting their experiments together in the form of satellite instrumentation. The staff will ultimately number about 800.

3) A data-handling and mathematics center at Darmstadt, Germany, where scientists will have facilities for studying their data.

4) A plasma physics center near Rome, for which a director and a site are yet to be chosen.

The preparatory commission also began negotiating for a network of tracking, telemetry, and data-acquisition stations for its satellites. Possible high-latitude sites include the British-ruled Falkland Islands, where Britain maintains a tracking station, and Alaska.

The negotiations for the Alaskan site apparently do not envisage the use of the two large 85-foot (25-meter) data-acquistion dishes NASA has built as part of a network to recapture information in vast quantities from the Nimbus meteorological satellites and the orbiting geophysical and astronomical observatories.

For points between 30°N and 30°S, ESRO will be able to use a network the French are building across Africa, at Colomb-Béchar in the Algerian Sahara, Ouagadougou in Upper Volta, Brazzaville in the Congo, and Pretoria in South Africa. The French are also negotiating for a site in Lebanon for surveillance of its satellites at the point of injection into orbit southeast of Colomb-Béchar.

In the complex negotiations, ESRO's preparatory commission was doubtless considerably helped by the long experience of its director-general, Auger, in administering large collaborative scientific programs. Auger was in charge of physics in the Anglo-Canadian project to develop a heavy-water pile at Chalk River in World War II. With Frederic Joliot-Curie, he helped establish the French Atomic Energy Commission in 1946, was director of UNESCO's department of natural sciences from 1948 to 1959, and played a role in the foundation of the European Center for Nuclear Research (CERN) before moving on to help establish the French and European space programs. He is professor of quantum physics at the University of Paris.

In Auger's eyes, setting up international collaboration in science is not easy, and not always justified unless the subject is of "very general interest" and "made necessary by the sheer magnitude of the undertaking in terms of staff, time and money."

Space research fitted his criteria.

—VICTOR K. MCELHENY