13 May 1964

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SPECIAL REPORT

WESTERN EUROPEAN SPACE PROGRAMS

CENTRAL INTELLIGENCE AGENCY

OFFICE OF CURRENT INTELLIGENCE

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44-228525/2

1 May 1964

WESTERN EUROPEAN SPACE PROGRAMS

Western Europe has organized two cooperative ventures in the fields of space research and launch-vehicle technology: the European Space Research Organization (ESRO) to conduct basic space research, and the European Launcher Development Organization (ELDO) to develop a three-stage satellite booster based on the British Blue Streak rocket. The treaties establishing these organizations have only recently come into force, and the French, who have an energetic, well-organized, national space program already in being, will exert significant influence in them. Britain has a limited space program, and West Germany is just starting one.

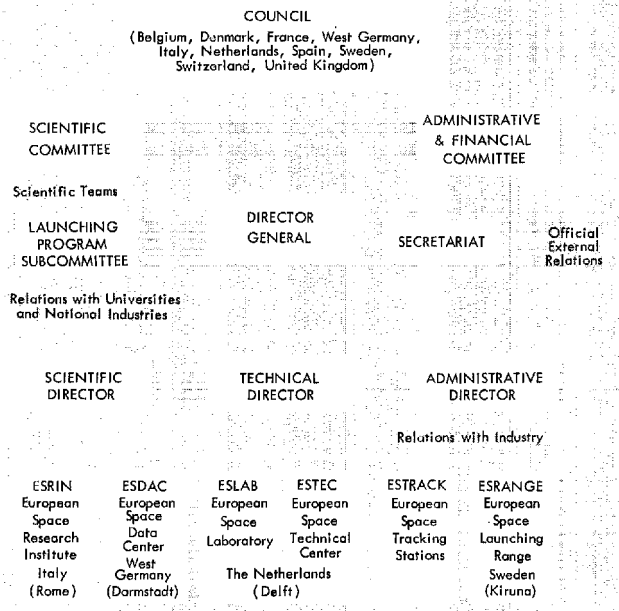
The national and cooperative programs are motivated both by the promise of industrial, scientific, and commercial benefits and by considerations of national prestige. The present level of resources allocated to space activities, however, will not allow the European countries either individually or collectively to rival the efforts of the US and the Soviet Union. Moreover, the rate at which they progress toward their more modest goals in space activities will continue to depend heavily on the support they receive from the US, both officially--in joint endeavors with NASA, and unofficially--through continued purchases of US equipment and technology.

European Interest in Space

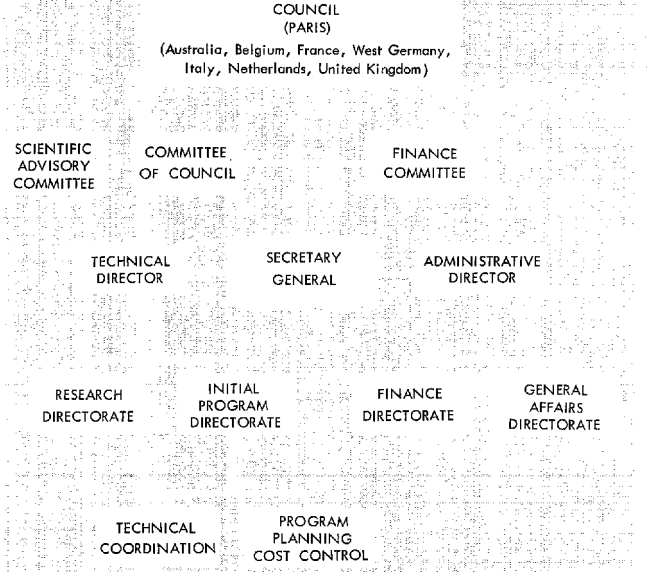
Nearly two and one half years elapsed after the launching of Sputnik I in 1957 before the Western European countries began to consider seriously their potential role in the space age. The impetus then came in large part from a belated recognition of the immense repercussions on the scientific and technical industries of the development of highly complex launchers and space research equipment.

In particular, the Europeans became aware that an important part of the progress made in electronics, in metallurgy, and in certain fields of chemistry and physics in the US could be attributed to the impulse given by the conquest of space. They feared that, lacking a similar effort, Europe would continue to lose its top researchers and technicians to the "new world," and that the "old world" would never regain its traditional prominence in the fields of science and technology. The key attributes of national power would thus be irrecoverably lost.

PROPOSED
EUROPEAN SPACE RESEARCH ORGANIZATION
(ESRO)



PROPOSED
EUROPEAN LAUNCHER DEVELOPMENT ORGANIZATION
(ELDO)



PROPOSED PROGRAM

ESRO

YEARS	1st	2nd	3rd	4th	5th	6th	7th	8th
SHORT TERM PROJECTS								
Sounding rockets (figure indicates maximum number of launches proposed for each year)	10	40	65	65	65	65	65	65
MEDIUM TERM PROJECTS								
Small satellites in near-Earth orbits				4	6	4	4	4
Space probes						2	3	3
LONGER TERM PROJECTS								
Stabilized astronomical satellites						2		
Lunar satellites							1	1

ELDO

Design, development, and construction of a space vehicle launcher with participation distributed among ELDO membership as follows:

Australia	use of Woomera range
Belgium	ground control instrumentation
France	second stage of launcher
West Germany	third stage of launcher
Italy	experimental satellite
Netherlands	ground support
United Kingdom	first stage of launcher

Concurrently, ELDO will "investigate future possibilities and requirements for rockets and ranges."

PROPOSED BUDGET

ESRO

ESRO expenditures are expected to total $78 million for the first three years and $122 million for the next three years, with a ceiling limit of $306 million for the first eight-year program. As in the case of the European Nuclear Research Center (CERN), financial contributions have been levied in proportion to national income, but no member country is expected to contribute more than 25 percent of the total budget.

ESRO's budget was allocated among the envisaged participants as follows. Adjustments will have to be made to take account of the withdrawal of Austria and Norway.

Austria	1.99%	Netherlands	4.04%
Belgium	4.21	Norway	1.60
Denmark	2.10	Spain	2.53
Federal Republic of Germany	21.48	Sweden	4.92
France	18.22	Switzerland	3.27
Italy	10.64	United Kingdom	25.00

ELDO

The proposed initial five-year ELDO program would have a budget of $196 million, allocated as follows:

Australia (use of range)	0
Belgium	2.85%
France	23.93
West Germany	22.01
Italy	9.78
Netherlands	2.64
United Kingdom	38.79

A budget of $5.6 million, as yet unallocated, has been earmarked for the proposed concurrent two-year program.

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In the words of General Aubiniere, director of the French National Center for Space Studies, "space technology touches so many disciplines that to neglect it would signify for our peoples, formerly masters of the world, a decadence and underdevelopment and an unacceptable economic servitude, no matter whence it comes."

Establishment of ESRO

Impelled largely by these considerations, the Committee on Space Research (COSPAR) of the International Council of Scientific Unions, at its January 1960 meeting in Nice, set up a study group to investigate the feasibility of a joint European space research and technology program. The group's report led to other meetings, and eventually a 12-country European Preparatory Commission for Space Research (COPERS) was established to draft a charter for a multilateral space research organization patterned after the already existing and highly successful European Center for Nuclear Research.

The European Space Research Organization convention was signed in Paris on 14 June 1962 by all but two of the members of COPERS, and came into force on 20 March 1964. The signatories are Belgium, Denmark, France, West Germany, Italy, the Netherlands, Spain, Sweden, Switzerland, and the United Kingdom. Austria and Norway declined to participate primarily for budgetary reasons although it is highly likely that Norway will join ESRO within the next year or two.

ESRO's Program and Budget

ESRO's program--exclusively for peaceful purposes--is built around the designing and construction of sounding rocket payloads and earth satellites and the launching of space probes.

The proposed short-term projects will be limited to studies of the upper atmosphere in the auroral zone by means of sounding rockets. The organization hopes to reach a launching rate of 65 sounding rockets annually by the third year. Beginning in the fourth year of its existence, ESRO would attempt to put small satellites into orbit or to launch probes of outer space. Longer term objectives are a stabilized astronomical observatory in earth orbit and a long-life planetary observatory in lunar orbit. A manned spacecraft program is beyond ESRO's resources and level of technology and is therefore not contemplated in present planning.

ESRO's eight-year program calls for expenditures of $78 million in the first three years, $122 million in the second three-year period, and a total expenditure of $306 million. Three quarters of the costs will be met by the UK, West Germany, France, and Italy.

The facilities to be established include: (a) a space laboratory and technology center at Delft, in the Netherlands; (b) a space data processing center in Darmstadt, West Germany; (c) a space research institute in Rome; (d) a sounding rocket launching range at Kiruna, Sweden; and (e) various tracking stations around the world.

ESRO's Prospects

The distinguished French scientist, Pierre Auger--prospective director general of ESRO--has described the scope of ESRO's program as equivalent to one fifth the US effort, minus the US manned spacecraft program. Although the ESRO budget will be much less than one fifth the US space budget, Auger expects disproportionately favorable returns through an efficient use of all available resources and the incorporation of advanced technology.

This estimate is probably too optimistic, but ESRO could make a significant contribution, particularly if its program is coordinated with and is complementary to the work being done in the US. ESRO's scientists apparently desire to avoid duplication of efforts, and they have held several meetings with NASA to discuss space objectives toward which the Europeans might effectively direct their energies.

ESRO is interested in having NASA launch its first two satellites, planned for the fourth year of its program. Although further evaluation is needed, NASA tentatively considers both ESRO I (polar ionosphere satellite) and ESRO II (solar astronomy and cosmic ray satellite) to be well-conceived scientific projects, and believes the orbital requirements can be met with the US Scout vehicle. ESRO planning also envisions arranging, through NASA, launchings from US ranges using the Thor-Delta booster. For orbiting larger payloads, ESRO is considering both launches using the ELDO A vehicle and, possibly, launches from the US using Thor-Agena, Atlas-Agena, and Atlas-Centaur vehicles. It has indicated an interest in locating a tracking station in Alaska. These inquiries have in general been favorably received by the US agencies concerned.

The implementation and evolution of ESRO's program will provide European scientists and engineers opportunities to increase their competence in various aspects of space science and spacecraft technology. It will not allow them to compete across the board with the US and Soviet Union.

Creation of ELDO

As compared with the ESRO program, the European cooperative effort to develop a launching capability has been much more controversial. Indeed, the ESRO planners rejected such an undertaking for their own organization--partly because the neutrals had qualms about the "cold war" implications of launcher development, and partly because it was generally felt that such an effort would be a wasteful duplication of US programs.

In 1960, however, the British long-range ballistic missile program--built around the Blue Streak, which was developed with extensive US technological assistance--was canceled after an expenditure of the sterling equivalent of over $182 million. In an effort to salvage some of this investment, Peter Thorneycroft, then Britain's minister of aviation, offered to make the Blue Streak and the British Black Knight available as a two-stage launch vehicle for cooperative European development and use. This generated little interest at first, but the French were eventually attracted by a British offer to substitute a French rocket for the Black Knight.

These two countries thereupon sponsored a conference in early 1961 from which ultimately emerged the European Launcher Development Organization. The ELDO convention--signed in London on 29 March 1962 by Australia, Belgium, France, West Germany, Italy, the Netherlands, and the United Kingdom--became effective as of 29 February 1964.

ELDO Program and Budget

ELDO's initial program calls for the development of a three-stage rocket--the ELDO A vehicle. As expected, the first stage will be the British Blue Streak and the second stage will be French; the third stage is to be developed by West Germany. Italy has been alloted the design, development, and construction of the test satellite; Belgium and the Netherlands will supply ground stations for radio guidance and telemetry. Test firings of both the first-stage Blue Streak and of the complete multistage vehicle will be from the Woomera range in Australia.

The convention also calls for concurrent study of future launcher requirements, and after a period of two years the organization will consider what new program it might undertake. This provision was inserted to placate Italy and West Germany, which felt that ELDO should not be too firmly bound to the Blue Streak project.

Status of ELDO's Program

The Blue Streak first stage of the ELDO A vehicle is already at the Woomera range and is expected to be fired sometime during May or June of this year. The second stage is scheduled to be fired in September 1965 from France's Colomb-Bechar/Hammaguir range in Algeria. Work on the third stage is proceeding but has been slowed by organizational problems in the West German Government and industry, and in ELDO itself. The difficulty of coordinating the multilateral efforts will probably also contribute to some delays in the original schedule, which called for test firing of the completed vehicle in 1966. Present estimates place this firing between 1967 and 1969.

ELDO's Military Implications

ELDO's charter restricts it to the peaceful applications of space vehicle launchers and equipment. However, the organization has no enforcement machinery to police compliance, and the possibility is raised that ELDO might contribute to the spread of ballistic missile technology.

This issue has already presented itself to the US in the form of requests for the export of propellants, guidance components, and other launch-vehicle hardware and technology. Licenses have been granted for the export of only a few selected items. However, the export of ballistic missile technology occurs "in bulk" via normal commercial channels. Multimillion-dollar annual sales to the Western European nations include quantities of missile components and of research, development, and test equipment, as well as the visits of US technicians and engineers to install, calibrate, and service this equipment. If these sales were cut off and the Western Europeans were dependent on their own resources, both the national and multinational programs would be delayed considerably.

ELDO's Prospects

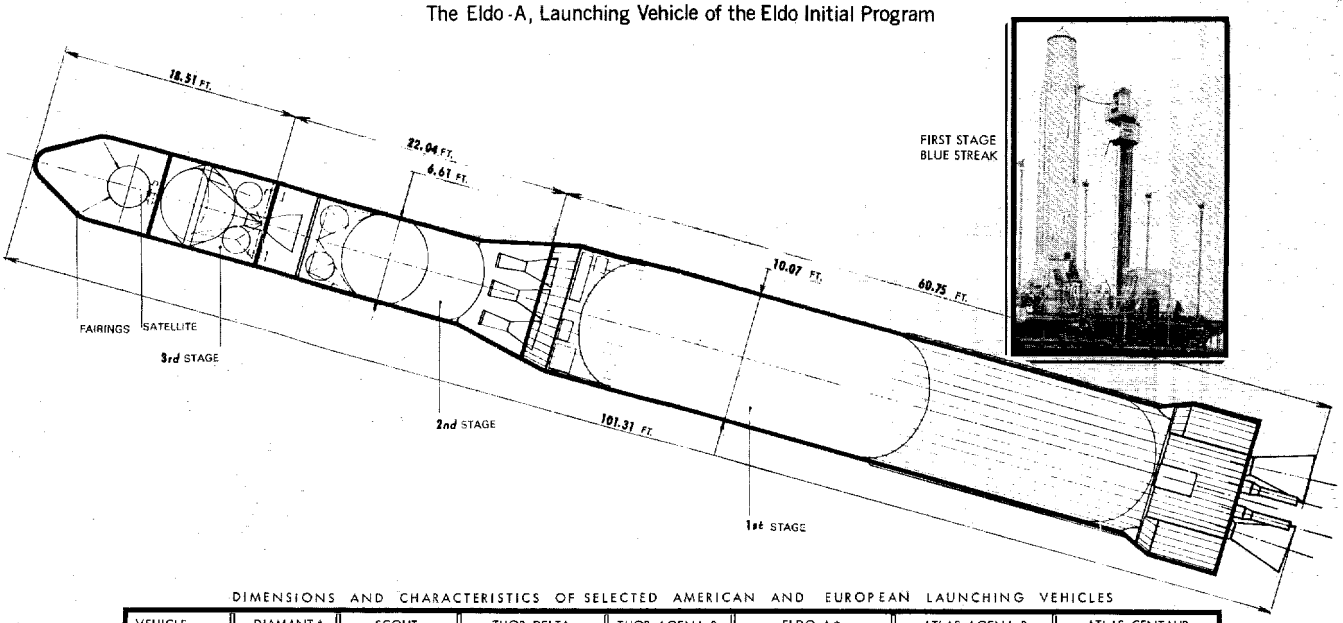
Compared with US vehicles, the three-stage ELDO vehicle will be obsolete when completed. It could meet some of ESRO's advanced program needs, however, and the desire to promote Western Europe's self-reliance will add to the attractiveness of the ELDO booster in both ESRO and the major national space programs.

For the short term, therefore, ELDO's prospects are dependent on its ability to carry through the ELDO A project to a successful conclusion close to planned schedule and cost. To continue after that, ELDO will have to gain support among its members for the development of advanced vehicles beyond the ELDO A.

Role of European Industry

European industry is increasingly engaged in space-

The Eldo-A, Launching Vehicle of the Eldo Initial Program



DIMENSIONS AND CHARACTERISTICS OF SELECTED AMERICAN AND EUROPEAN LAUNCHING VEHICLES

VEHICLE	DIAMANT *	SCOUT	THOR-DELTA	THOR-AGENA B	ELDO A*	ATLAS-AGENA B	ATLAS-CENTAUR
Stages	3	4	3	2	3	2	2
Propellants ** 1st stage	nitric acid & turpentine	solid	LOX/RP	LOX/RP	LOX/RP	LOX/RP	LOX/RP
2nd Stage	solid	solid	UDMH & IRFNA	UDMH & IRFNA	UDMH & N_2O_4	UDMH & IRFNA	LOX/LH
3rd Stage	solid	solid	solid		UDMH & N_2O_4		
4th Stage		solid					
Thrust (in lbs.) 1st stage	62,900 at sea level	86,000 at sea level (Algol II-A)	170,000 at sea level (Thor, DM-21)	170,000 at sea level (Thor, DM-21)	299,200 at sea level	367,000 at sea level (Atlas D) 80,000 (Atlas D sustainer)	367,000 at sea level (Atlas D) 80,000 (Atlas D sustainer)
2nd Stage	32,600	64,000 (Castor)	7,700 (AJ10-118)	16,000 (Agena B)	61,000	16,000 (Agena B)	30,000 (Centaur)
3rd Stage	5,600 - 11,900	23,000 (Antares)	2,800 (Altair)		4,950		
4th Stage		3,000 (Altair)			plus supplementary booster for high-orbit missions		
Max. Diameter (excluding fins)	4.59 ft.	3.3 ft.	8 ft.	8 ft.	About 10 ft.	10 ft. (16ft. at base)	10 ft.
Height	About 62 ft. (incl. satellite)	65 ft. (excl. spacecraft)	88 ft. (excl. spacecraft)	76 ft. (excl. spacecraft)	About 101 ft. (incl. satellite)	91 ft. (excl. spacecraft)	100 ft. (excl. spacecraft)
Payload	200 lbs. into 300 n.m. orbit	220 lbs. into 300 n.m. orbit	800 lbs. into 350 n.m. orbit 130 lbs. escape	1,600 lbs. into 300 n.m. orbit	About 2,650 lbs. for low orbit. About 440 lbs. for high orbit.	6,000 lbs. into 300 n.m. orbit 750 lbs. escape 425 lbs. to Mars or Venus	8,500 lbs. into 300 n.m. orbit 2,300 lbs. escape 1,300 lbs. to Mars or Venus

* Dimensions for the Diamant and the Eldo A have been converted in round figures from metric units.

** Key to abbreviations of propellants:
- LOX/RP - liquid oxygen and kerosene
- UDMH - unsymmetrical dimethylhydrazine
- IRFNA - inhibited red fuming nitric acid
- LOX/LH - liquid oxygen and liquid hydrogen
- N_2O_4 - nitrogen tetroxide

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age research and technological development.

In 1960, two firms--the British Hawker-Siddeley and the French SEREB (Societé pour l'Etude et la Realisation d'Engins Balistiques)--jointly produced a study on "Industry and Space," emphasizing the desirability of unified European action. In May 1961, these firms took the lead in establishing with other members of the European aerospace industry a Committee for European Space Research (EUROSPACE). Participating in it are other French and British industrial firms, as well as members from Belgium, West Germany, Italy, Norway, the Netherlands, Sweden, and Switzerland.

Headquartered in Paris, EUROSPACE now includes almost all the European aircraft and missile industries, the greater part of the electronics industry, the principal companies in the fields of chemistry and materials, and firms concerned with precision and civil engineering. Eight US firms are affiliated members without voting powers.

The organization's first report issued a year ago called for a greatly accelerated space program. It stressed in particular the development of synchronous and medium-altitude communications satellites, timekeeping, meteorological, and propulsion systems and associated projects; it recommended further that the European governments move quickly to establish a European communications satellite system program.

While these are rather wishful objectives, the members of EUROSPACE are bound to have considerable influence on the future course of Western European space activities. Although EUROSPACE will not develop and implement its own space program, it does provide a forum in which the individual member firms can coordinate their space efforts.

Communications Satellites

Several European countries have for some time been intensely interested in the developing technology of communications satellites. The United Kingdom and France, for example, participated with NASA in the highly successful experimental program utilizing the RELAY and TELSTAR satellites.

These experiments convinced a number of European telecommunications officials of the desirability of regional cooperation in this field as well. They appreciated that a large number of ground stations to serve Western Europe could not be justified technically or economically, and they further felt that, in view of the technological superiority of the US, European interests would be best protected if the Europeans could speak with one voice.

In December 1962 the European Conference of Postal and Telecommunications Administrations (CEPT)--Austria, Belgium,

Cyprus, Denmark, Finland, France, West Germany, Greece, Iceland, Ireland, Italy, Liechtenstein, Luxembourg, Monaco, the Netherlands, Norway, Portugal, Spain, Sweden, Switzerland, Turkey, and the United Kingdom--decided to establish an ad hoc committee to study the question of European participation in a global communications satellite system. The work of this committee led eventually to the convening of a "European Conference on Satellite Communications" in London in July 1963 and in Rome the following November. At Rome the conference agreed that a new European regional agency should be created, reconstituted the conference as the provisional organization, and authorized its Committee of Deputies to serve as the organization's temporary executive.

The European Conference and the US and Canada met in Rome in February of this year. The US pressed the Europeans to accept--pending establishment of a global communications satellite system--an interim arrangement whereby the US Communications Satellite Corporation would be charged with the design, deployment, and management of an initial basic system. The Europeans have indicated a willingness to go along with such an arrangement; they lack the technology and resources to go it alone, and the US has made it clear it would set up the system on its own if necessary. The Europeans want assurances, however, that the interim arrangements will be of a fixed and short duration and that they will thereafter have a greater voice in the system's management and operation.

Discussions will continue with the Western Europeans--and also Canadians, Japanese and Australians--looking toward the early conclusion of an interim intergovernmental agreement.

French National Space Program

France is at present the only West European nation spending more on its national space program than it contributes to the cooperative ventures, and that program is a vigorous, well-organized one. Financial resources earmarked for nonmilitary space research have steadily increased from approximately $8 million in 1961 to more than $30 million in 1963 and over $46 million in 1964. From this, France is contributing in the neighborhood of $14 million annually to ESRO and ELDO.

These funds are intended to finance a broadly based sounding rocket experiment program using a relatively wide range of French-built vehicles. A French-built satellite is scheduled to be orbited in 1966 by a three-stage French vehicle, the Diamant. This booster is designed to orbit a 200-pound payload in a 300-mile-high circular orbit. In addition, France has concluded bilateral cooperative agreements for sounding rocket experiments with Argentina and India, and NASA will launch a French VLF radio-propagation satellite (FR-1) in late 1965.

COMPARISON OF ANNUAL SPACE EXPENDITURES BY COUNTRY

The figures below, estimated in millions of US dollars as of September 1963 (except where otherwise indicated), were derived from documents which reflect both funded and expended amounts and both calendar-year and various fiscal-year accounting. They are very rough and intended only to show relative proportions.

	National	ESRO-ELDO	Total
France	20.0 *	13.5	33.5
West Germany	11.0	14.0	25.0
United Kingdom	4.5	14.5	19.0
Italy	3.5	6.5	10.0
Belgium	--	2.5	2.5
Netherlands	--	2.0	2.0
Sweden	0.5	0.5	1.0
United States	3,700.0 **		
Soviet Union	1,500.0 to*** 3,500.0		
Japan	3.0		
Canada	2.5		

* Does not include launch vehicle expenditure by military or communications satellite ground terminal cost.

** NASA's fiscal 1963 budget. Fiscal 1964 calls for $5.1 billion.

*** The USSR's estimated annual expenditure rate as of the beginning of 1964.

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France's military missile program has first priority for funds and manpower. However, there is firm evidence that the military and space programs are closely intertwined, with the quasi-governmental organization SEREB responsible for both large missiles and space boosters. The French are reported to be developing a solid propellant grain considerably larger than would be needed for any known French military requirement. If such a component were utilized in the development of a space vehicle, it would give the French considerably more lift capability than either Diamant or the ELDO A and would reduce their interest in non-French or multilaterally developed boosters.

Britain's Space Program

Britain's national space program is considerably smaller than France's, although British scientific achievement is more advanced in certain areas. Three fourths of the UK's annual space budget of approximately $20 million is contributed to ESRO and ELDO, the latter to receive around $14 million.

The UK's major national program is organized around cooperative arrangements with NASA. The UK provided the instrumentation payload for a satellite--UK 1 (Ariel)--which was launched by NASA in April 1962. UK 2 was launched by NASA from Wallops Island, Virginia, on 27 March 1964. In its agreement with NASA for a third satellite launching, the UK is moving into a new phase by assuming responsibility for the design, construction, and testing of flight-qualified spacecraft. British scientists are conducting a limited sounding rocket program at Woomera, Australia, their major launch range.

The UK has competent space scientists, and has developed excellent experiments for its cooperative satellite program. However, the government has not supported an extensive space research program, and there is no indication that the existing program will be expanded significantly.

Program in West Germany

The West German Government has geared its initial space efforts to participation in the two European organizations. The greater part of its activity is concerned with the development of the third stage of the ELDO A vehicle. There is, however, growing activity in other areas of space research and technology --particularly the latter--for which the government has provided approximately $11 million.

The West Germans are prohibited from the production of missiles which exceed the maximum characteristics described in the London and Paris Agreements of 1954. They are not proscribed, however, from the development of hardware which is intended for civilian and scientific purposes.

Industrial and commercial interests, as well as considerations of national pride and strength, are likely to increase pressures in Bonn to implement a more comprehensive program of basic space research and rocket development. Nevertheless, the West Germans will probably proceed cautiously, not wishing to raise the apprehension of their allies and of the Soviet Union.

Italian Space Program

The Italians have concluded a bilateral arrangement with NASA for the launching of an Italian satellite designed to measure air density at the equator. The first phase of this "San Marco" project--suborbital testing of the payload--is already under way. The launch platform is in place off the Kenya coast and a suborbital launching from there is planned for later this year. The second phase will involve the launching of a satellite prototype from Wallops Island, and the third phase, the actual satellite launching from the platform, is tentatively scheduled for 1965.

This project has placed a heavy strain on the limited resources allocated by Italy for space research, and there has already been considerable slippage in the planned schedule.

The Smaller Countries

Neither Belgium nor the Netherlands has much of a national space program apart from their participation in ESRO and ELDO. They have, however, joined these organizations in order to provide research, development, and production opportunities for their industrial and scientific communities.

Sweden and Switzerland have a potential role in the production of space hardware, although their present activities are limited. Both have small research programs, and Sweden has been conducting a small sounding rocket program in cooperation with NASA.

Outlook

The longer term prospects for collective Western European efforts and achievements in the field of space research and technology are hard to predict. Ultimate success will depend on the degree to which each of the participants is willing to furnish funds, manpower, equipment, and technology, and factors underlying such a decision differ for each of the participating nations.

Belgium, the Netherlands, Sweden, Switzerland, and, to a lesser extent, Italy will support a Western European effort because it holds promise of achievement beyond their own individual resources. The West Germans are probably giving preference to the collective program for the time being in part because of the nervousness of their neighbors; they can be expected, however, to develop the relevant technology and hardware on a national basis if it is not available multilaterally. While the British have a capability for a national program of reasonable stature, they are likely to seek instead to play an important role in any continuing Western European effort.

It begins to look as though the French, stimulated by their efforts in the military missile field, will elect--as long as De Gaulle is on the scene--to reduce their participation in the European effort and push ahead with a domestic space program of sizable proportions.

In any event the assistance of the US--both officially and through unofficial commercial channels--has been, is, and will probably remain the critical factor in the success of any European space program during this decade.

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