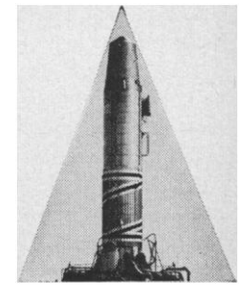

European Launcher Development Organization: Its Changing Role

London. The goals of the six-nation European Launcher Development Organization (ELDO) have been undergoing attrition for some time. Originally ELDO was to provide launchers for the European Space Research Organization (ESRO). But for at least a year it has been known that the rocket ELDO has been developing would be too powerful for launching any of ESRO's prospective scientific satellites except for an astronomical platform. Now the word is going round that the rocket's second stage, which the French are developing, is likely to have only half the lifting power predicted for it, not enough thrust for the astronomical platform.

The program, which was originally expected to cost about $200 million, became possible when Britain decided in 1960 against developing its Blue Streak into a strategic missile. At that time the Blue Streak, which burns liquid oxygen and kerosene, had not flown, but it had already cost at least $180 million, and its development into a weapons system would have cost another $1.6 billion. After cancelling further development of Blue Streak, Britain offered to share it with France and other European nations. Discussions led to a preliminary agreement in 1962, and to a final treaty, which came into force in 1964. Behind these arrangements was the feeling that Western Europe should be enjoying general technological stimulation of the kind that space programs are apparently bringing to the United States and the Soviet Union.

In accordance with the treaties, the British Blue Streak is to be used as the first stage of an ELDO rocket; France is developing the second stage, as mentioned above; West Germany is building the third stage; Italy is building an experimental satellite; Belgium contributes the range guidance; and the Netherlands provides the telemetry. Australia makes no contribution to ELDO's budget, but it is providing the Woomera rocket range.

The French second stage (called "Coralie") is not likely to be launched until mid-1966. The lower-than-anticipated thrust affects not only the launching of ESRO's astronomical platform but other ELDO goals. One is the goal of giving Europe a chance to launch some of the satellites of the proposed world communications satellite system, for which negotiations are scheduled for 1969. Another is that of giving European electronics firms an opportunity to test, in orbit, components which might be included in the system's satellites. To place a small experimental package of communications-satellite equipment into a stationary orbit 36,000 kilometers above the equator would require the addition of a small rocket, to be fired at apogee, to the ELDO rocket's three stages. A lower-than-anticipated thrust for Coralie would reduce the permissible size of the package.

Coralie burns unsymmetrical dimethyl hydrazine, along with nitrogen tetroxide (N_2O_4) as the oxidant. Instead of being pumped, the fuels are forced into the combustion chambers by pressure furnished by water vaporized by heat from combustion gases. This technique is similar to that used in the pressure-fed Véronique sounding rocket, developed from German designs shortly after World War II by the Laboratoire de Recherches Balistiques et Aerodynamiques (LRBA), which is now developing Coralie. Although simple, the technique of pressure-feeding (used in solid-fuel-burning missiles as the Polaris) is not necessarily more reliable than pumping.

In addition to Coralie and Véronique, LRBA has developed another pressure-fed liquid-fueled rocket, the Emeraude. This rocket is the first stage of the Diamant satellite launcher that France is developing on its own. Before two successful launches from Hammaguir, one in March and one in May, the Emeraude failed at least three times, and perhaps four. Combustion in the chambers was reported to have set up back-pressures, slowing the flow of fuel and inducing harmful oscillations. These problems appear to have been solved, and four firings of Emeraude have been scheduled for later this year. But the problems reduce the confidence of French engineers in pressure-fed rockets and reinforce their desire to push on to other concepts, not only for the French national program but also for the upper stages of the ELDO rocket.

Among the new concepts being considered is a solid-fuel-burning first stage for Diamant and use of a rocket that is being developed for the silo-based and submarine-borne military missiles France plans to have by about 1970. Since the Diamant's third stage burns solid fuel, this would be an all-solid-fuel version of the Diamant. Another new concept, more important for ELDO, is the use of liquid hydrogen and liquid oxygen in a second stage that would replace Coralie in the ELDO rocket and remove the need for a third stage of the type being developed in Germany. Such rockets could also be used as the upper stage of an all-liquid-fueled Diamant rocket.

Rockets fueled with liquid hydrogen represent, in the minds of rocket specialists, the next generation of chemically fueled rockets. Instead of the emission velocity of 2.4 kilometers per second yielded by present chemical fuels, liquid hydrogen-fueled rockets are expected to

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have an emission velocity of 3.2 kilometers per second. There is impatience in Europe to get on with development of such rockets, to overcome some of the overwhelming superiority of the United States and the Soviet Union in rocket propulsion.

Considerations of this kind led French specialists to propose, at a January meeting of ELDO-nation representatives, called at the insistence of France, that ELDO stop work at once on its first rocket, called ELDO-A, and move on immediately to B-1 and B-2. These latter rockets would retain the Blue Streak as first stage but would use liquid-hydrogen-fueled rockets as second stages.

There was another reason for the proposal: money. ELDO's original budget of $200 million is sure to rise to $300 million or more. This became evident last fall, about the time Harold Wilson's Labor government took office in Britain in a period of financial crisis. Italy, too, was worried about the overruns.

The French specialists thought ELDO could save some money by pushing on to B-1 and B-2 right away and stretching spending over a longer period. France, which was in the midst of a year of budgetary stringency, was interested in such a stretch-out. The French specialists spoke with some authority about the situation, because the overruns originated less with the Blue Streak than with the French and German stages.

This proposal dismayed the five other members of ELDO. The other governments suspected that the French would just as soon see another international effort wither, since they had their own increasingly expensive national space program. In the excitement, pessimists tended to forget that there are strict limitations to French spending on space, and that those limitations keep spending well below the sums needed to develop the liquid-hydrogen-fueled upper stages (at least $240 million). Far from wishing to destroy ELDO, France seemed to need ELDO to develop its own rocket concepts, just as Britain needed ELDO to finish developing the Blue Streak.

In the 2 months that followed the French proposal, other arguments against it appeared. For one thing, a halt on the ELDO-A rocket would remove all chance of launching some experimental communications-satellite equipment before the 1969 negotiations. The end of ELDO-A would also mean the end of the program to develop the small apogee rocket, called "AS" for apogee system. This project would cost an estimated $70 million beyond the $300-million cost of ELDO-A.

Also, the delay would break up engineering teams assembled at great trouble and expense. And German engineers would lose any ground they had gained from their work on the third stage. The German engineers rushed to carry out the first static firing of the rocket at full power before a meeting of ELDO ministers in Paris in early April.

Distrust promised to be the atmosphere of the meeting. But on its eve there was a dramatic move by the French Government. On the advice of Yvon Bourges, the new secretary for science, the French cabinet decided that France did not have the money to urge an immediate start on B-1 and B-2. So the ministers were able to compromise by authorizing further studies of the apogee and B rockets and voted money to continue ELDO's program through this year, even though the original $200 million will be exhausted. There is time for consideration, for the first launching of Blue Streak with dummy upper stages is not scheduled until the spring of 1966 (the first three launches of the unencumbered Blue Streak were all successful).

But the compromise did not end uncomfortable reflections about ELDO. In Britain they seemed to increase. Specialists in rocket development found it as hard to foresee missions for the B-1 and B-2 as for the ELDO-A. They were uneasy over the prospect that perhaps half of Britain's budget for rockets and space would be going to international programs when many observers thought that national spending should exceed international by 3 or 4 to 1. The complexity and inflexibility of ELDO also were discouraging.

After the meeting, Britain began giving much more intense consideration to developing a satellite launcher, Black Arrow, from a rocket called Black Knight. The Black Knight, which first flew in September 1958, was developed first to test nose cones for warheads intended for the Blue Streak medium-range missile. After 1960, Black Knight was turned over to a joint U.S.-British program set up to study the reentry aspects of an antimissile system. The rocket has been under development ever since. It was expected that the satellite would carry a 50- to 100-kilogram payload northward from Woomera into a circular polar orbit 480 kilometers up. More recently, it has been estimated that the payload could be as much as 200 kilograms.

One strong argument for building the Black Arrow satellite launcher is the cost of using larger rockets, like ELDO-A, for scientific experiments. A Black Arrow launch might cost as little as 5 percent of the cost of an ELDO-A rocket launch. The Black Arrow could be sold to ESRO for launching scientific satellites, and it could be used for many of the tests of communications-satellite equipment which would otherwise be made with the ELDO-A rocket.

The Black Knight is considered to be very reliable. British sources say it has been launched 20 times, each time successfully.

While the British study the Black Arrow concept, the French, despite shortages of money, are pushing ahead with a $60-million project to prepare a rocket-launching site on the coast of French Guiana, northwest of Cayenne. This site is only 5 degrees north of the equator, and the French express the hope that both the Americans and ELDO will want to use it for launching communications satellites into stationary equatorial orbits. These are only two of various signs that the Europeans, despite the faltering of ELDO, continue to search for a vigorous role in space.—VICTOR K. MCELHENY