Appendix G
BACKGROUND FOR INTERNATIONAL PROGRAMS

Early United States/Soviet Competition

Prior to world War II, the leading centers of rocket research had been Germany and the Soviet Union. In both cases the primary impetus for research was military, supported by extensive amateur and civilian activities. The United States, by contrast, lacked a coordinated rocket program, though the work of isolated individuals, notably Robert Goddard, helped give the United States an important experimental base.

During the war many nations developed rockets for various military uses, particularly tactical battlefield support (the Soviets relied heavily on massed rocket barrages); but by far the most advanced work was done by the Germans. This culminated, late in the war, in the first long-range unmanned vehicles: the **V-1, an air-breathing "cruise missile" used for short-range attack on population centers such as London, and the much more advanced and dangerous V-2, the first operational ballistic missile.**

At the end of the war two of the rival victors, the United States and Soviet Union, divided up the majority of the German rocket assets. The Soviets, having occupied the main German testing center at Peenemunde on the Baltic Sea, seized the bulk of the hardware, while the Americans (along with the British and French) succeeded in capturing and employing many of the most talented scientists and engineers, including the most important, Wernher von Braun. **In both the United States and U. S. S. R., these resources formed the basis for each country's succeeding rocket** programs.

The direction and pace of these programs were determined above all by the differing military requirements of the two nations. During the decade following World War 11, the United States relied for its security (and that of its allies) on its large fleet of long-range bombers equipped with nuclear weapons. Stationed in Europe and the Far East, these forces were capable of directly attacking the Soviet Union and hence of deterring any hypothetical Soviet conventional attack in Europe. The Soviets, on the other hand, had no comparable delivery system, for they lacked both the bombers and, even more importantly, forward bases within range of the continental United States. The Soviets therefore saw long-range ballistic missiles as the only way to counter U.S. nuclear superiority, and placed a correspondingly high priority on their development. The type of missile they proceeded to build was determined first of all by the extreme heaviness of the first generations of Soviet weapons, as well as by the inaccuracies of the missiles themselves. To be effective at long ranges, even against large unprotected targets (i.e., cities), these missiles had to carry very heavy, high-yield (multi megaton) warheads. Hence, the missiles themselves had to be, above all, large. The result was a series of large, inexpensive, inefficient (relatively low thrust) boosters capable of carrying thousands of pounds halfway around the world —or into orbit. It is these early designs, first perfected in the mid-l 9s0's, that still today serve as the backbone of the Soviet missile fleet, both for intercontinental ballistic missiles (ICBMS) and for orbital launchers.

The United States, in contrast, did not at first feel a similar urgency to develop ICBMS, especially the very heavy variety favored by the Soviets. However, by the mid-l 950's the United States had several rocket development programs under way: the Army's Jupiter booster; the Thor and Atlas missiles (developed by the Air Force); and a civilian booster, Vanguard, which was, however, essentially managed by the Navy.

Contrary to popular belief, the Soviets were not reticent about their intention to launch an artificial satellite; as early as 19.ss, Soviet scientists were predicting success within a few years, and the October 4, 19s7, orbiting of Sputnik was foreshadowed by numerous public statements. Nevertheless, the public and international surprise was intense, and there were widespread demands for the United States to match or surpass the Soviet challenge. There were several reasons. The Soviet Union and United States each had grown accustomed to seeing the other as rivals across a whole range of political, economic, and cultural activities. Both saw themselves as representing social and economic systems whose superiority would be demonstrated by whether they could outperform their competitors. At stake for e,ach was the legitimacy of its system in the eyes not only of its current adherents but of billions of potential adherents throughout the world. The United States was acknowledged to be the leader in economic and scientific affairs, and although the Soviets took pains to publicize the ever-growing amounts of steel, concrete, oil, and foodstuffs produced annually, it was increasingly clear that competition in the nuclear age was more a matter of quality than quantity. In no technical area had the Soviets been able to outperform the West; Sputnik was a blow to the West's confidence in the superior quality of its science and technology, and hence in the superiority of the political/economic system that produced it. With hindsight we can see that Sputnik represented an exceptional case of temporary leadership brought about by the special emphasis on heavy missiles described above. The sophistication of the Soviet payloads and instrumentation, including their manned capsules, was well below that of even the first U.S. satellites. It did not indicate a comprehensive capability in advanced technologies on a par with the United States; it did not even indicate, as many thought it must, that the Soviets enjoyed a dangerous lead in military ICBMS. The "missile-gap" controversy, which played an important role in the 1960 Presidential election, and which prompted a major commitment by the United States to the deployment of U.S.-based ICBMS and foreign-based MRBMs, as well as to civil defense, was a chimera. There is no doubt that the Soviets, upon seeing Sputnik's effect on world opinion, did their best to foster the notion of across-the-board Soviet technical and military equivalence, if not superiority, and that this effort, abetted by the extreme secrecy with which the Soviet program was conducted, was largely successful, especially in the third world. In particular, Premier Khrushchev asserted that the Soviets, with their ICBMS, which could supposedly "hit a fly in outer space," had achieved strategic nuclear parity with the United States.

That these claims were exaggerated became clear in 1962 when Khrushchev, lacking the credible Soviet-based ICBM force he had earlier claimed, attempted to redress the balance by placing MRBMs in Cuba, with disastrous results. Soviet space successes, and the Western reaction, played an important role in public estimates of comparative military strength. The above shows why it was the United States and the U.S.S.R. that were the first to develop boosters capable of launching substantial payloads into orbit. Other countries, lacking these military/competitive needs, did not at first choose to expend the resources needed to develop an independent booster capability. It is instructive to note that France, the European nation historically most eager to have its own launcher, and the one that has already built its own MRBM deterrent, is also Western Europe's largest nuclear power and the one most determined to remain independent of the superpowers. Similarly, China's launcher development program has been motivated by its determination to field a nuclear delivery system.

Having developed missiles capable of launching payloads into orbit, both the United States and the U.S.S.R. began to construct a number of different satellites. Scientific instruments, remote-sensing cameras, satellites for weather observation and military surveillance, communications satellites, and manned spacecraft were all flown within a few years of Sputnik. The type and pace of development were determined by a combination of scientific and technical curiosity, military requirements, prospective social and economic benefit, and, especially for the manned programs, prestige and competition. By the end of the decade, the United States had developed manned and unmanned civilian systems demonstrably superior to those of the Soviet Union. During the 1970's, competition was reduced, due partly to d~tente and a general lowering of tensions between the two countries, and also to the differing emphases of the respective programs, While the United States focused on the space shuttle, the Soviets orbited the Salyut series of manned, resupplyable orbiting laboratories. increasingly, competition with the Soviets has changed from open and highly publicized civilian space spectaculars, to secret military and intelligence systems. (For further details see ch. 7.)[1]

Joint European Efforts

In 1960-61, three separate European agencies were created to deal with different aspects of space. The European Launcher Development Organization (ELDO) aimed at creating a jointly funded launcher, eventually named the "Europa. " ELDO was basically a coordinating body for separate national projects; the eventual plans for Europa called for a British first stage (the Blue Streak military IRBM), a French second stage, a West German third stage, Italian test satellites, Belgian downrange guidance systems, and Dutch telemetry links. By 1968, the cost estimates for the Europa had climbed from an initial $190 million to $71o million to $77o million, causing intense disagreements among the participants. The military implications of possessing a long-range missile complicated agreements even further.[2] As a result of the problems caused by inadequate coordination, none of the 11 test launches of the Europa, the last of which took place in 1971, succeeded in placing a payload in orbit.J Along the way the British, dismayed by rising costs for what they saw as obsolescent technology, decided in 1968 to reduce their financial commitment and eventually withdrew altogether. This left France as the project's strongest backer. In 1973, the Europa was finally cancel led in favor of a new project, the Frenchdominated Ariane, which was eventually taken up by the European Space Agency (ESA).

[1] For information on the rivalry between the United States and the Soviet Union, see *Soviet Space Programs 1971-75,* 2 vols., Congressional Research Service Staff Report for Senate Committee on Aeronautical and Space Sciences, Aug. 30, 1976; Jerry Grey, *Enterprise (New* York: William Morrow & Co., 1979); and James Oberg, *Red Star in Orbit, (New* York: Random House, 1981).

[2] Mihiel Schwarz, "European Policies on Space Science and Technology 1960-1978," *Research Policy 8, 1979,* p. 208.

[3] See *World-Wide Space Activities,* CRS Science Policy Research Division, report done for House Committee on Science and Technology, September 1977, pp. 265-273.

The second major agency was the European Space Research Organization (ESRO) which **was** formally established in 1962. Loosely modeled on CERN, the cooperative European Nuclear Research Center, ESRO intended to develop satellites and instruments for conducting scientific experiments in space, including tracking and relay stations, and to procure launch services.[4] **ESRO (unlike ELDO) achieved a high degree of credibility, and was able to cooperate successfully with NASA and other countries. A major difficulty** ESRO faced, one which it shared with **ELDO, was the principle of "juste retour" (fair return). Participating countries contributed to the agencies a certain assessment (for ESRO, an amount roughly** in proportion to their gross national product), and the agency contracts were supposed to be let in the same ratios; i.e., if France provided 20 percent of the budget, 20 percent of the amount of ESRO'S contracts were supposed to be with French firms (in fact, France's share of the contracts was consistently higher than its budget contribution).s This resulted in many contracts being let on political and partisan grounds rather than to the lowest or most qualified bidder.[6] Eventually, to circumvent the destructive and time-consuming quarreling over contracts, European aerospace and electronics firms formed themselves into three formal multinational consortia-called COSMOS, MESH, and STAR– to bid on European projects.

From 1967 to 1975 (when it merged into the **ESA), ESRO launched nine scientific satellites and 168 sounding rockets**[7] The most important development over time was a growing interest in applications satellites; in 1968, ESRO was first given a mandate to study applications, especially in communications and meteorology. By 1975, ESRO was engaged in four major applications projects: 1) a maritime navigation satellite, Marots; 2) an experimental communications satellite, OTS; 3) Aerosat, a joint venture with the United States for aeronautical communications; and 4) Meteosat, a regional meteorological satellite.

A third organization, the Conference Europeéne de Telecommunications par Satellites (CETS), was formed to discuss European participation in INTELSAT. It was made up of national Postal, Telephone, and Telegraph (PTT) agencies and played little role in formulating space policy or programs.

In 1966, the members of ELDO, concerned about lack of harmony between countries and programs, established the 12-nation European Space Conference (ESC), which met for **the next 9 years and provided the forum for the founding of** ESA in 1975.

There was first of alla consensus within the ESC that there should be a single coordinated European program, but there was disagreement about the relative weight to give the three program areas: science, applications, and launch vehicles. **Basic science and launcher development were already the province of ESRO and ELDO, respectively, but applications activities were seen as increasingly important. For one thing, U.S. and Soviet successes with communications and weather satellites had** shown the usefulness of space applications. For another, there was increased European awareness of the importance of advanced technology in maintaining a competitive position in international trade and influence vis-à-vis the superpowers, especially the United States. In 1967, J. Jacques Servan-Schreiber's book, "The American Challenge, " in which he predicted the decline of European industry faced with American technical and managerial superiority, "polemicized the United States economic invasion of Europe and aroused a popular interest in technology comparable to the Sputnik aftermath in the United States."[8] At the same time, however, there was increasing concern in both Europe and the United States about reaping useful economic and social benefits from space technologies; by the end of the 1960's, there was little enthusiasm on either continent for large prestige projects such as Apollo. To be publicly acceptable, investments had to be justified by concrete and relatively short-term payoffs,

The British skepticism about continuing the Europa project, mentioned previously, reflected this shift; the British saw Europa as an unnecessary and expensive item being pursued to the detriment of more useful and technically advanced applications satellites. The British, along with the Italians and a few others, thought U.S. launchers were perfectly adequate and likely to be considerably cheaper than the inefficient Europa. The prolauncher countries, however, led by France, Belgium, and the Netherlands, thought that the United States could not be counted on to launch European applications satellites that might compete with U.S. systems, especially in telecommunications. The United States had launched ESRO'S scientific satellites without any problems, but there were no guarantees as to other types of payloads.

In 1969, the question of the American relationship became a key issue. In making plans for the post-Apollo space program, U.S. policy makers placed strong emphasis on soliciting European participation,

[4] 1 bid., p. 237.
'See Walter McDougall, "Space Age Europe 1957-1 980," paper presented at the Conference on the History of Space Activity, Yale University, **Feb. 7 1981, p. 6.**
[6] Schwarz, **op. cit., p. 211.**
[7] *World-Wide Space Activities,* **op. cit., pp. 254-256.**

[8] Henry Nau, *National Politics and International Technology* **(Baltimore: Johns Hopkins University Press, 1974), p. 55.**

partly to strengthen political and economic ties and partly to lessen the costs. In October 1969, the United States proposed that Europe undertake to build a major segment of the proposed space transportation system. Emphasis was placed on the "space tug, " an expendable orbit-to-orbit rocket, because the expertise accumulated in developing the Europa could be used to develop the tug. The Europeans concurred, and began extensive planning for eventual construction. However, in 1972 the United States withdrew its offer, partly because the entire post-Apollo program was being scaled back, because of doubts about European technical capabilities; and also because the Air Force thought the military potential of the tug was too great to permit dependence on outside sources.[9] Instead, the United States "offered" the Europeans the sortie lab (later known as Spacelab) or a number of constituent parts of the space shuttle. Withdrawal of the tug proposal angered the Europeans, not only because of the considerable time and expense invested, but because some countries, particularly France, were suspicious that the United States did not want the Europeans to develop their own space transportation capability, and wished instead to retain a U.S. monopoly on launchers. One result was renewed commitment to a European rocket; another was French consultation with the Soviet Union about possible future use of Soviet launchers.

The question of U.S. guarantees to launch European applications satellites was related to U.S.-European collaboration, in that many Europeans were convinced that such guarantees were contingent on European willingness to build and fund part of the U.S. post-Apollo program. **In 1971, the United States promised to assist with launches, provided they were "for peaceful purposes and consistent with obligations under relevant international arrangements''.[10] Similar assurances were later granted to all "other countries and international organizations on a nondiscriminatory, reimbursable basis."[11] The United States insisted that this policy** would be honored regardless of European participation: the qualification of consistency with "relevant international arrangements" was, however, a potential stumbling block, especially to launching European communications satellites. The relevant agreement was the "International Telecommunications Satellite Organization (INTELSAT) Agreement, " signed August 20, 1971, which, in article XIV, required signatories to consult with INTELSAT to ensure the "technical compatibility" of any proposed operational international telecommunications satellites, as well as to avoid "significant economic harm" caused by regional competition. In fact, this issue did affect plans to launch the French-German Symphonic communications satellite, which the United States agreed to do (in 1971) only after it was declared an experimental rather than an operational system, in part to avoid the issue of whether the United States would launch an operational satellite.[12] This experience strengthened French determination to develop an autonomous launch capability.

Resolution of these issues made the negotiations in ESC over establishing ESA prolonged and complicated.[13] Essentially, the successful outcome involved compromise among the three largest participants, France, Germany, and the United Kingdom, with each agreeing to back the others' preferred projects i n exchange for reciprocal support.

The French wanted to build a launcher, specifically the L3S or Ariane, which was first conceived in 1972 as a unilateral French project. In order to get ESA support, the French agreed to provide the bulk of the funding for research and testing (approximately 60 percent), with Germany providing some 20 percent, Belgium 5 percent, and various other participants the remainder. The British reluctantly agreed to a 1 to 2 percent contribution. The Ariane would be launched from France's spaceport at Kourou in French Guiana, and the main contractor would be a French firm, Aerospatiale.

West Germany had been a strong backer of a European launcher and also of the proposed space tug. When the tug offer was withdrawn, the Germans' preferred project became Spacelab, which they saw as a vehicle for conducting scientific and commercial experiments as well as for improving German industrial and technical skills. More so than the French, the Germans believed that U.S. launch guarantees could be trusted. Following high-level talks between President Pompidou of France and Chancellor Brandt of Germany in 1973, the two countries agreed to a quid pro quo: the Germans would fund approximately 60 percent of Spacelab, and the French 20 percent, in return for similar but reversed support for Ariane.[14]

The United Kingdom had less enthusiasm for supporting a wide range of major space projects than either France or Germany, preferring to concentrate on applications satellites and on cooperative scientific

[9] Schwarz, op. cit., p. 22o.

[10] Letter from u, A, Johnson, U ,S. Under Secretary of State for Political Affairs, to Minister Theo Lefevre, Chairman of the European Space Conference, Sept. 1, 1971.

[11] See' 'Launch Assu rances Policy, " White House Press Release of Oct. 9, 1972; in Space *Law: Selected Basic Documents,* 2d cd., committee print for Senate Committee on Commerce, Science and Transportation, December 1978, p. 557.

[12] *World- Wide Space Activities,* op. cit., p.1961.

[13] For detail discussion see *World-Wide Space Activities,* op. cit., PP. 293-303.

[14] *World- Wide Space Activities,* op. cit., p. 286.

programs. Though Britain strongly favored the establishment of a single European space agency, British support for ESA hinged on the potential competition between its Geostationary Technology Satellite (GTS) and ESRO'S proposed Marots maritime communications satellite. Eventually, Britain agreed to drop its GTS in favor of becoming the Marots project leader and providing some 56 percent of the funding. It also agreed to support the Ariane and Spacelab programs, though at fairly low levels. These compromises (the so-called "Second Package Deal") were essentially worked out by July 1973, paving the way for the drafting of an ESA charter and the founding of ESA in May 1975.

France

In 1960, France announced plans to build an IRBM designed to carry nuclear weapons, and an industrial consortium called SEREB was formed to build military missiles. SEREB eventually became active in civilian developments as well. In 1961, a civilian agency, the Centre National d'Etudes Spatiales (CNES), was formed under the Ministry of State for Scientific Research, Atomic and Space Affairs.

At first the French hoped for close cooperation with the United States, but the United States was reluctant to transfer its newly acquired missile technology abroad.[15] After considerable effort, the first operational French IRBM, the S-2, was deployed in 1971, and the first submarine-launched missile in 1972.

Meanwhile, CNES began work on a series of civilian launchers, the so-called "precious stones" series. The only successful launcher was the Diamant version, which in November 1965 orbited the first French satellite, the 42-kg Asterix, from the French testing grounds in Saharan Algeria. France was also a major participant in ELDO, whose ill-fated Europa was to have used a Diamant as its second stage. The Diamant in various versions made successful orbital flights from Algeria and later from the Kourou spaceport in French Guiana until 1973, A large number of the satellites launched were used for military-related geodetic work; others were for experiments in communications and atmospheric research.

The French also built satellites for launch on U.S. and Soviet vehicles; the first U.S.-launched French satellite went upon December 6, 1965 (oniy 10 days after the Asterix, suggesting that the French were understandably eager to have the first French satellite placed in orbit by a national launcher). In 1971, the Soviet Union launched a French scientific satellite, Aureole. Talks with the Soviets began in 1965 and a number of cooperative projects, including the training of two French astronauts for an upcoming Salyut mission, have taken place.

Great Britain

The British initiated a two-stage military rocket program in 1956. In 1960, the program was canceled due to a conviction that it was militarily obsolete; the "Blue Streak" first stage was then proposed as part of ELDO'S Europa launcher, of which Great Britain was initially a strong supporter.

During the 1960's Great Britain developed a number of scientific satellites known as the Ariel series, the first of which was launched by the United States in 1964. Great Britain was an active supporter of both ELDO and ESRO; in addition, it embarked in 1964 on a major launch development program known as Black Arrow. In 1971, the Black Arrow succeeded in orbiting a single 66-kg satellite, called Prospero, from the Australian test range at Woomera, following which the program was canceled. Despite the L1 1.5 million spent, the government determined that using U.S. launchers would be significantly less expensive–unlike the French, the British had no concern that the United States would balk at launching commercially competitive or military payloads. In 1969, the United States orbited the first of two Skynet geosynchronous military communications satellites.[16]

[15] *World-Wide Space* Activities, op. cit., p. 148.

[16] *World-Wide Space* Activities, op. cit., pp. 217-234.