1 Introduction: Space, a tale of several Europes

A SPACE PHENOMENON ON EARTH

When Sputnik traced the opening of the Space Age against the void, the Europe it sped across had no more than cartographical meaning for the handful of space-related activities taking place there.

Today, Europe is a space power in its own right, with its own means of access to space, satellites that scan the Earth every minute of the day, others that relay broadcasts, voices and information from the Atlantic to beyond the Urals, and science probes that have hurtled past Jupiter, encountered comets, measured starbursts and explored the secrets of black holes. Europe is also part of a space station project that figures among the largest cooperative ventures ever undertaken, and is familiarizing itself with ideas about activities on the Moon that may take place in years to come.

The story of the process that has produced this change has many dimensions. Seen at one glance these produce an impression of "intimidating complexity", to borrow the words of one expert panel. Seen in separate parts, though, the whole starts to make sense.

We shall thus try to unravel some of the field's complexity in the following pages by showing step by step 1) how a "Europe" came to exist at all in connection with an undertaking that stretched even the superpowers' sinews and 2) what its present components and issues are, and how the most important components function, with a view to becoming better equipped to handle the future's enigmas.

APPROACH

Inevitably one must start at the very beginning, that is, with the Space Age that gave rise to European space efforts. There, we shall find in Part I the stirrings of the first in a series of at least ten "Europes" with which we shall become acquainted in the course of this book. Their natures form the book's main subject-matter. As we proceed, the reader will discover that even in the present day there is no single, simple entity upon which one can fix the label of the space Europe, although the European Space Agency (ESA) remains the major player today and will be given the greatest attention.

The absence of a unified research and development (R&D) entity in the early days of European space cooperation dictates the structure of Part II, whose chapters interweave descriptions of the various events and bodies that preceded ESA's foundation in 1975. Part III is devoted to the ESA system and its various relationships, while Part IV examines the wider space field in Europe today in the sense of national programmes, exploitation bodies, sectoral issues and the EU's role.

Each Part is preceded by a short introduction as a quick aid to the reader when generally choosing content of interest. To help the reader track down specific items, each chapter has been subdivided into numbered headings which are indicated in the Table of Contents and are used to provide cross-references within the text.

In thematic terms, we shall rely on and seek to reflect the organic character of the European space field through taking its actors as the primary points of reference. While it might have been possible to use technological themes throughout as an alternative approach, it is the entities in the field which actually have to deal with technological questions along with political and other ones; these entities therefore provide suitable surfaces on which to arrange the majority of content in a coherent way. Departures from this scheme occur when presenting background, especially in Part I, and when reviewing some of the issues the field has yet to answer, especially utilization ones in Chapter 19. In keeping with the predominance of government funded R&D and in light of the relatively late arrival of exploitation activities, the bulk of the book is devoted to the R&D part of the European space field.

To conclude this introduction, some words are required additional to those in the Preface concerning the type of matter we shall be covering.

Firstly, while variations on familiar legal tools like the contract are of interest in their own right in the space R&D domain, and we shall be making reference to them as well as to financial and managerial mechanisms, far more fundamental are the political and technical decisions which have been encapsulated over time in organizational legal texts, policy resolutions and international agreements. Their conclusion together with the appearance of major policy reports indeed provide many of the field's milestones and so stand alongside the more dramatic events we shall also be mentioning associated with programmes, crisis points and external factors. Such documents are, in addition, vital both in coming to grips with how the system of space relations works today and for the reservoir of useful experience they constitute. They will hence receive corresponding attention, and the reader will notice particularly how pervasive has been the influence of the major organizations' Conventions in the affairs of the sector.

Secondly, economic questions will be treated primarily as a subplot to R&D policy developments, although we shall be giving them independent attention when turning to issues of competition and utilization. A similar approach applies, thirdly, to the human dimension of events; this is naturally taken into account, but usually not to the level of individual involvement unless a person's actions had a particularly profound influence.

But now to our tale . . . how did it all begin?

PART I
THE GENESIS OF COOPERATION

This Part exposes the environment within which organized European space activities took place, starting with the background in which space technologies were developed by the Soviet Union and the United States. The role of Britain is then explained as the main progenitor of space cooperation in Europe, although we shall see that the space science community too provided its own initiative which rapidly took shape.

2 Rockets, the Cold War and Sputnik's civilian legacy

1 THE CHALLENGE OF SPACEFLIGHT

An iron principle has ruled our planet since its formation. It is measured at 11.2 km per second for any body, unless so minute as to be subject to Brownian motion. Described as "escape velocity", it denotes the speed any mass leaving the Earth's surface must sustain if it is to free itself from the pull of the Earth's gravity. Particularly in evidence when hurrying up a long flight of stairs, it is no less relevant when quite still on the ground floor, since the level of gravitational force to which it corresponds is also fundamental to most of the conditions that have allowed complex organic structures to form. It is thus the prime shaper of life on Earth.

Until this century, there was little question of challenging this natural parameter. Any other considerations apart, no living or mechanical system could carry sufficient energy reserves to give it the thrust-to-weight ratio necessary to propel it to orbital height. Nor, before 1942, had any engine or any fuel offered any significant fraction of that thrust-to-weight efficiency.[1] But the course of events afterwards did see humankind break its planet's ancient grip. We shall in this chapter examine the background of the early Space Age and particularly its connection with Cold War technologies, since it is in this context that the genesis of Europe's main space activities is to be found.

2 THE ORIGINS AND STRATEGIC APPLICATIONS OF SPACE TECHNOLOGY

2.1 Early Developments

It was a Russian, Konstantin Edouardovich Tsiolkovsky (1857-1935), who fathered the theoretical engineering and physics necessary to translate to spaceflight the principle of reaction flight demonstrated first by the rockets of the Chinese Han dynasty and later taken to Europe by Marco Polo.

Despite his own dreams of a day when humans would "build mobile stations in the sky, would create living rings around the Earth and Sun, [and] would observe Mars from a score of miles",[2] Tsiolkovsky's equations were, in the revival in rocketry science after World War I, mainly confined in the Soviet Union to immediate military applications. But these in themselves marked rare pioneering work, distinguished by the Red Army's development in the 1920s and 1930s of light, mobile, battlefield rocket batteries (updated versions of which are still in use)[3] and, in the mid-1930s, by firings of rockets capable of attaining 400 metres altitude using fuels of petroleum and liquid oxygen.[4]

Elsewhere, and most notably in the United States and Germany, parallels to Soviet advances were made, but, until 1930, essentially on a privately-funded, non-military basis; the availability of artillery left in general little need to develop alternatives, if (unlike the Soviet Union) a nation had sufficient heavy industrial capacity.

Germany, however, did feel such a need. Despite having industrial capacity in plenty, and, from 1930, a government set on increasing its military power, it was constrained by the 1919 Treaty of Versailles' armaments limitations, which severely curtailed the number of German artillery pieces. The incentive therefore existed to develop secretly new weapons technologies. One means to this end was the establishment of a small Wehrmacht rocket-development section under the command of a young officer, Captain Dornberger. His unit soon managed to integrate the considerable experimental expertise of the originally private Verein für Raumschiffart (VfR) into the military research effort.[5]

A decade of work under Dornberger's leadership saw the accomplishment of a basic rocketry research and testing programme, which included the launch in 1942 of an operational missile, the A5, that was capable of unaided flight for 200 km and of extra-atmospheric flight. This wartime success coincided with the loss of German air superiority over the European Continent, a circumstance which caused Dornberger's team, now at Baltic Peenemünde, to be entrusted from 1943 with an attempt to stave off defeat through production of *Vergeltungswaffen* (arms of retribution), and in particular the V-2 which was derived from the A5. The new weapons could not ultimately save Germany from its fate; but they were none the less formidable assets and were able partially to fill the Luftwaffe's role against British and Soviet military and civilian targets from July 1944 to April 1945.

Fortunately for humanity, atomic bomb research in Nazi Germany never progressed to the point where Dornberger's own plans to load suitably adapted V-2s with atomic weapons could be realized. Instead, Allied victory saw the dispersal of most (about sixty) of the remaining V-2s to the one power that had already developed a nuclear weapon, the United States, three to another heavily involved in the same effort, the United Kingdom, some further units to France, and the remainder to a fourth power, which not only had a mature missilery tradition but would also soon have the greatest incentive to complete its nuclear weapon research programme – the Soviet Union.[6]

2.2 Sputnik and the Age of the ICBM

That incentive came first from news of the successful explosion of an atomic device at Alamagordo, New Mexico, and then, following the annihilation of Hiroshima and Nagasaki with just two bombs, from the lessons taught by the consequent capitulation of the hitherto dauntless Japanese Empire. For, in many Soviet minds, reflected in official doctrine throughout the Soviet era, the Nagasaki bomb was addressed not only to the Japanese High Command, but also to the Kremlin. It was seen as service of notice that the "American Century" had begun.[7]

While the threat to the USSR from the nuclear forces of its American antagonist was potentially real enough in the Cold War that followed World War II, it does not itself explain why heavy rocket research would secure the highest priority in Soviet military planning after hydrogen bomb development. The motivation in fact lay in the same factor that caused the German High Command to pin hopes on rocketry from 1942 onwards – American (and, to a lesser extent, British) air superiority. Nothing comparable existed in the Soviet Union to the sophisticated avionics industries of its two former allies. It thus lacked the capacity for several years following the war to build a fleet of long-distance bombers to match the US' B-29s (or, later, its B-52s).

In short, even when the USSR successfully exploded a hydrogen device in 1953, it did not have a sufficient system to deliver it.[8] Without an effective nuclear counterforce, the Soviet Union would thus be doomed to climb down in a military confrontation, as it had already been obliged to do in Korea. During this time a nuclear ring was furthermore being drawn ever tighter around the USSR with additions to existing US forward bases in West Germany, Okinawa and Alaska and the establishment of new strategic air bases following conclusion of the NATO (1949), SEATO (1954) and CENTO (1955) treaties. Again, the USSR was left with little recourse strategically beyond consolidation of its wartime gains.

The final impetus to develop rocketry as the alternative delivery system to the long-range bomber came with the advent of Kruschev, whose administration directed the necessary resources to speedy completion of operational Semerkev (Sapwood-SS6) ICBMs. Heavy, extremely large vehicles, these solid-fuel rockets were uniquely Soviet in their overall conception, gaining the extra power needed to carry lower-energy fuels than the V-2's by strapping on "clusters" of smaller rockets to the main booster.[9] At the strategic level, this relatively simple approach gave the USSR a delivery system that was adapted to industrial production, easy to store and fast to launch, so providing the Soviet Union reasonably quickly with the means to create the counterforce it desired.[10]

Yet it is one thing to develop an ICBM, another to impress upon a foe that it is a credible threat. There had to be a demonstration, but one which stopped short of actually firing an ICBM at a potential target. Because the burn-time of a Semerkev in flight to a US target necessitated a phase beyond the Earth's atmosphere, and its warhead required decoupling before re-entry, what better demonstration was there than by placing a dead warhead into orbit? Sputnik I performed this mission perfectly on 4 October

1957,[11] and, being announced as a contribution to the International Geophysical Year (IGY), accomplished the additional *coup* of being hailed by the world as a great scientific achievement.

Thereafter, demonstration followed demonstration, beginning with the launch of Sputnik II, a particularly important event because its weight (500 kilograms) indicated that the Soviet ICBMs were capable of launching the high-megaton H-bombs the USSR was now testing. The demonstrations continued until even the most skeptical observer had to concede that the Soviet Union was now, like the United States, able to obliterate any target on Earth at will – only faster. For who could deny the accuracy of missiles designed to hit targets some thousands of miles away when the Soviet Union, with the flight of Luna-2, could hit one a quarter of a million miles away, namely the Moon.[12]

Possession of ICBM capabilities could now also be used politically, for example, as a shield for the USSR's Caribbean ally, Cuba.[13] And the very fact of the technological achievement meant that, whereas the Korean conflict and the suppression of the Hungarian uprising had painted the Soviet Union as a power on the defensive, it was now able to put itself forward to colonial peoples as the model by which their nascent States could steer themselves towards autonomous development.[14] This, in its turn, implied that, instead of the post-colonial States following the pattern of Latin America and passing from British to American economic domination, the United States risked losing potential influence, either through these States attaching themselves to its Soviet rival or through their non-alignment. In sum, by 1961 the Soviet ICBM seemed to many to have nipped the "American Century" in the bud.

3 THE AMERICAN MOBILIZATION FOR SPACE

The story is already familiar of the American public's trauma over Sputnik and the Soviet missile threat, and of Congress' pressure for rapid ICBM development and a space programme that would culminate in Project Apollo. Two particular aspects, though, require mention here, namely, the line of technological development pursued in the rocketry field, and the institutional mechanism, NASA, used to achieve a civil space programme.

3.1 The US' Strategic Reaction to Sputnik

American rocketry had made advances on wartime rocket design, but work on heavy (ICBM) rockets was still at an intermediate stage in 1957. It was for our purposes important, though, that priority had already been given to liquid-fuelled systems, under the influence of the von Braun team at the Redstone Arsenal in Huntsville, Alabama. By contrast, it was only when an imminent Soviet ICBM capability began to be taken seriously in 1956 that *solid-fuel* rockets (Polaris and Minuteman) were approved. These would be capable of equalling Soviet launch times and so could act as second-strike weapons.

Until completion of the development and testing period for solid-fuelled systems – which would occur in the early 1960s – the United States had no choice but to work urgently through the enormous first-generation problems associated with liquid-fuel, and more specifically cryogenic,[15] technology derived from the V-2. It took until 1960 for the first flight of a US ICBM properly so called, the Atlas-Agena A. Development of intermediate-range missiles (IRBMs) was, on the other hand, closer to fruition, and the von Braun team was able to put an orange-sized Explorer 1 into orbit on 31 January 1958 with Juno I.[16]

Putting the US' early lag to one side, the possibility to add lower-power rockets as extra stages for ICBM boosters (as is the case with the Atlas-Centaur and Thor-Delta combinations) would, after several false starts, endow the United States with a high-performance collection of ICBMs, satellite launchers and astronaut carriers by 1962/63. It is noteworthy in particular that the huge design and development effort prior to 1960 was sufficient to provide the basic elements for the prime US space transportation systems of the 1960s and 1970s, from Atlas-Centaur ("Mercury", for manned missions) to Titan ("Gemini", for manned missions) through to the satellite-only launchers, Scout, Titan III and Thor-Delta. With Atlas, and having all undergone adaptation, these satellite launchers are still in use today. Even NASA's Saturn V system, used for the Moon missions, relied on Rocketdyne motors derived from Atlas and Centaur engines. It would not be until the era of the Shuttle that further major advances in engine technology would be required.

A final, and unavoidable, feature of the line of technical development just described lay in its methodology. The requisite materials and systems at many points exceeded the state of the art, implying costly "high-technology" solutions that themselves influenced the direction of future developments and produced a corresponding culture in NASA in particular.

3.2 The First Civilian Space Agency: NASA

In the US Congress, the fact that the first Sputniks had caught the United States off-guard prompted a "Preparedness Investigating Subcommittee" of the Senate Armed Services Committee to examine questions of missiles and satellites in exhaustive detail from the end of November 1957 onwards. Scores of scientists, officials and industrial experts passed through its hearings, which saw nearly 2,500 pages worth of testimony by the end of July 1958.[17] Other bodies (for example, the Rand Corporation) performed their own analyses, which were equally provided to Congress and the Administration.

The experts that testified to the Preparedness Subcommittee performed an outstanding service. Fresh from experiments and collaboration with foreign scientists during the International Geophysical Year, they convinced members of Congress and the Administration that there was much more to the new technology than only rockets and warheads. They opened eyes not only to the challenges of space science but also to the civil and military benefits of such practical, realizable applications of the space environment as telecommunications and weather forecasting. Their own recent experience showed, moreover, how international cooperation could join the mindpower of US and other scientists in finding answers to common questions.

Its enthusiasm thereby aroused for civilian space activities and such cooperation, Congress' abiding concern nevertheless remained that of "insuring the preeminence of the United States in the space field".[18] The question was, how to do it?

The task of answering this question fell first and foremost to a Senate *ad hoc* Special Committee on Space and Astronautics that was established in February 1958. Chaired by the (then) Senator Lyndon Johnson, it was to study objectives for the exploration of space in general but most especially the related issues of government organization. In the meantime an Advanced Research Project Agency (ARPA) of the Department of Defense would assure the conduct of both military space projects and non-military ones like Endeavour.

Institutionalizing the ARPA approach for hardware aspects and creating a separate civilian apparatus for relevant applications (essentially the Soviet solution) had its attractions and there were advocates for this option within the government. But the nature and sheer breadth of those applications led it to be discarded early on. President Eisenhower instead proposed to Congress, in a draft bill, that the existing civilian National Advisory Committee for Aeronautics (NACA) should in virtue of the proximity between advanced avionics and space technologies be adapted and expanded into a new National Aeronautics and Space Administration,[19] while the Department of Defense (DOD) should retain primary responsibility for defence programmes.

Congress adopted this solution and passed it into law by the National Aeronautics and Space Act of 29 July 1958.[20] But the Space Act's drafters went several steps beyond this basic allocation of roles. They recognized too that a number of other government agencies than NASA and DOD would have an interest in space activities (nine others did in 1958, eleven do today). Coordination of all within a "comprehensive space programme" consequently seemed to them to be the prerequisite for an effective and efficient national effort. The objection could, on the other hand, be made that space was so new a field and the need to set up a programme so urgent that comprehensiveness should await another day.

Johnson's Special Committee refuted such arguments by pointing out that not even the unique characteristics of space activities placed their organization outside known principles of public administration. Applying those principles, the committee accordingly incorporated a two-tier system in the Act to achieve an overall US government policy and programme. The first tier would operate at working level between NASA and DOD (through a "Civilian-Military Liaison Committee") and would promote routine coordination, the sharing of resources and the transfer of results and techniques. The second would function at the level of the President, who would be responsible for overall policy direction on the advice of a national space council representing the various interested agencies. Thus, it would be the President who would decide inter-agency disputes and order the allocation of facilities between agencies, if contested.[21] Congress, of course, would determine budgetary allocations.

With this clear system of authority in place, broad mandates could be granted in the Act to NASA and DOD in particular, with NASA's main roles being in space research and development, the promotion of international cooperation and the dissemination of information to Congress, the nation and internationally. Other provisions in the Act allowed NASA special powers, including freedom to employ non-US citizens and to offer salaries above the federal employee scale; this foresight proved its worth in the 1960s and contributed to a "brain drain" of European scientists, engineers and managers to the United States.

Succeeding NACA, NASA came into existence officially on 1 October 1958 with a budget for Fiscal Year 1959 of $181 million. It acquired eighteen NACA or DOD centres

Cambridge University Press
978-0-521-03022-9 - A New Force at a New Frontier: Europe's Development in the Space Field in the Light of its Main Actors, Policies, Law and Activities from its Beginnings Up to the Present
Kevin Madders
Excerpt
More information

or facilities. Few have since needed to be established, the Houston Manned Space Center being a major exception.[22]

The political structure for space that Senator Johnson and his colleagues built was researched, planned, legislated for, funded and established within ten months. It has now endured for more than three-and-a-half decades. True, the space council Congress introduced would not be a stable part of the American space picture; it disappeared in the Nixon years and, after a revival in the Reagan/Bush period, has, under the Clinton Administration, been absorbed by the Office for Science and Technology Policy. Yet the essential *function* of settling a comprehensive governmental space policy at the level of the President has survived, while NASA itself proved an agency capable of fulfilling missions within the next decade that had been in the realm of science fiction in 1958. As to its goal of disseminating information, NASA became certainly the only United States federal agency known to virtually the entire human race. And, while the agency has had its troubles since then – not least at the hands of its architect, Congress – NASA remains one of the success stories anywhere of the meeting between science and government.

***

The US' civil space arrangements are of especial significance for the European context, on two counts. First, they set an early Western standard for others to look to if they wished. This standard was of greatest relevance during the period considered over the rest of Parts I and II of this book, but is relevant also to some current concerns treated in later chapters. Second, some of the same issues Senator Johnson and his colleagues spotted – such as the relationship between the military, civil and advanced avionics sectors, the need for a comprehensive programme and policy, and the necessity of a central determining mechanism – have to be addressed in organizing space affairs elsewhere, even if different constraints may apply. Concerning those constraints, we may also note that the process of the US Space Act's elaboration represented something of an ideal case. In particular, it benefitted from: the priority given it at the highest levels of a national political system; the availability of necessary resources nationally; well-established channels for refining and debating technical and political issues; unity of political purpose in response to an urgent external threat; and, last but not least, the authority reposed in the coordinating efforts of one man, the formidable Senator Johnson himself.

3.3 Fruits of the US' Early Space Activities

To conclude this overview of America's mobilization for space, let us cast an eye forward to what its implications would be, since, again, the United States would be the standard by which other Western space efforts would always be judged.

By 1960, technology R&D had become the surrogate battleground of the Cold War, with the US and USSR each spending over $20 billion at prevailing values on all R&D in that year.[23] NASA's budget alone stood at between $2.5 and $5 billion a year during the 1960s, while DOD continued to pump further billions annually into nuclear missilery and lesser amounts into satellite applications. At the peak of Apollo development (1966), NASA funds paid for 420,000 persons working on its projects. In addition, the formation of a powerful manufacturing capacity for US communications satellites[24] would supply the prime means to connect military bases[25] and NASA tracking stations worldwide, while contributing to the US' attaining a 65% share of world telecommunications traffic by 1970.[26]

With this pace of growth, what we may term the space-related sector formed, by 1964, both the largest US domestic industry and the most value-intensive one on Earth.[27] Moreover, the various programmes' punishing demands for miniaturization, data-processing, light metals and heat/vibration resistant compounds transformed swathes of the American electronics, equipment fabrication and metallurgy industries. The spinoff effects of this process were so pervasive that their real value has never been satisfactorily estimated, but some idea is given by the fact that solid-state electronics in the home to this day owes a great deal to such spinoff, to cite only one example. A related effect of special concern to European policy-makers was that, while the US already had the world's most powerful and dynamic economy, its industry was with R&D-derived products now making substantial new inroads in trade.

And the bulk of the above transformation came about in just seven years from Sputnik's first orbit.

4 BRITAIN, BLUE STREAK AND THE SPACE OPTION

As recounted in the previous sections, the Cold War and the beginning of the Space Age were inseparable. The space race which took place in the 1960s would, indeed, provide the kind of direct technological and ideological contest between the behemoths of applied science that, if transposed to the military sphere, would have spelt Armageddon. Space in this time had, certainly, a further aspect, the cultural and scientific one of discovery. But it was high politics that suffused the venture at the governmental level in both superpowers, and did so in a way whose character has perhaps never been fully appreciated outside them, even up to the present day. To leave, though, the dominating front line of the Space Age, let us now turn to the nations that looked on, and in particular to that power which was then the only other nation to have the military potential and interest to acquire viable space capabilities within a reasonable time.

Where, then, did Britain stand?

4.1 The Development of British Strategic Missile Technology

The Britain Sputnik I glided above had, in May 1957, become the third thermonuclear power.[28] Its newly-arrived Vulcan and Victor medium-range bombers (the "V-force") moreover supplied a delivery system.[29] But it had been realized since the Soviet explosion of an H-bomb in 1953 – several years earlier than expected – that the V-force would be insufficient militarily, for it was evident that the small number of Soviet bombers that might be expected to breach UK air defences could, with thermonuclear weapons, both obliterate key strategic air bases and devastate most of Britain. In a surprise attack, it would then be unlikely that enough UK bombers would be left to survive Soviet air defences and destroy any substantial portion of the USSR's highly dispersed potential.

In other words Britain would have a strategic nuclear capability but lacked the delivery system for a credible *deterrent* of its own. Only an adequate IRBM system could fill this