Germany Blasts Off into Space

It's been 40 years since the first German satellite lifted off into space and turned the country into a space-faring nation. The project was named *AZUR*, and one of its goals was to provide new insights into the northern lights. The Scientific Director was **Erhard Keppler** from the former **Max Planck Institute for Aeronomy** in Lindau/Harz.

TEXT **ELKE MAIER**

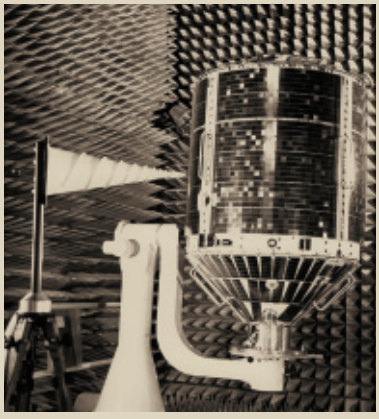
The noise was deafening: At dusk on November 7, 1969, at precisely 5:52 p.m. local time, a four-stage Scout-B launcher lifted off from the Western Test Range in Vandenberg, California. Shortly afterward, a voice from a loudspeaker announced the news everyone had been waiting for: "We have lift-off!" For the assembled scientists and engineers watching the launch, this was the signal to break out the champagne: *AZUR*, the first German satellite, was heading for space after almost five years of development.

Some 45 minutes after launch, the German control center in the Bavarian town of Oberpfaffenhofen announced that it had received the first data, and that the arm on which the magnetometer was installed, and the yoyo system that decelerated the spin of the satellite, were working correctly. *AZUR* had reached its planned orbit without a hitch. Permanent magnets used the Earth's magnetic field to align the space probe and thus stabilize it. Some 5,300 solar cells on its outer skin guaranteed its energy supply.

The plan was for *AZUR* to orbit Earth in a strongly elliptical polar orbit at a height of between 383 and 3,145 kilometers, and transmit data to Earth from eight measuring instruments. Its mission: to investigate charge exchange processes in the inner Van Allen Belt – a ring of high-energy particles that are trapped by the Earth's magnetic field. In addition, the scientists wanted to measure energetic particles from solar flares with the aid of the satellite, and investigate the phenomenon of the northern lights.

With *AZUR*, Germany leapt into space in the same year in which mankind first set foot on the Moon – 12 years after the Russian satellite Sputnik 1 had heralded the age of space travel. In 1969, only five nations, apart from the Soviet Union and the USA, had their own satellites: Great Britain, Italy, France, Canada and Australia. After World War II, the decisions of the Allied Control Council had thwarted Germany's plans for its own space flights.

It was only after the Federal Republic obtained its sovereignty in 1955 that Germany was again allowed to carry out research on space flight, but the necessary expertise was lacking. German companies had practically no experience in the construction of spacecraft. In 1962, the aviation pioneer and entrepreneur Ludwig Bölkow initiated the first German space project. He was the driving force in national aviation and space travel, and championed the development of new technologies in his country.



It turned Germany into a space-faring nation: The research satellite *AZUR*.

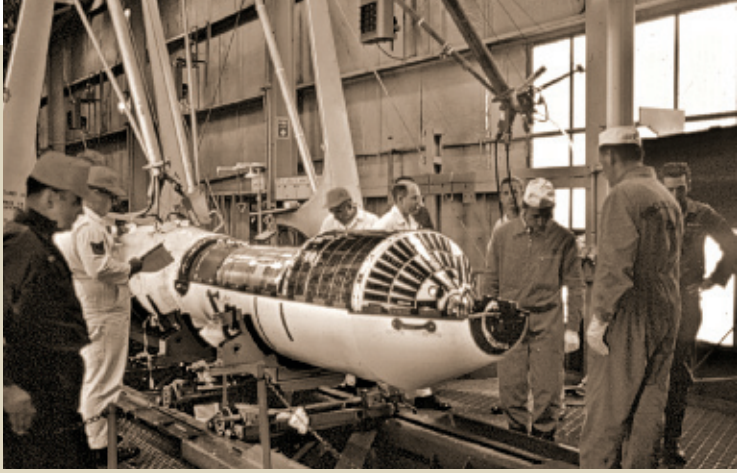
The most important cooperation partner was the US space agency NASA, which provided support for project management and technical matters. After three years of preparation and planning, and numerous discussions, NASA and the Federal Ministry for Scientific Research signed a Memorandum of Understanding on July 17, 1965 with the aim of starting a joint satellite project – 625A-1 – later called *AZUR*. The plan was for Germany to develop a satellite and its scientific payload, with the US providing a launcher to bring the satellite into its orbit and monitoring the space vehicle's trajectory with its ground stations.

AZUR was a challenge for Germany, and not only due to its lack of technical experience. There was neither an organization to coordinate the project, nor did the necessary infrastructure exist – there were no test ranges or ground stations. The Society for Space Research (GfW) was established for the sole purpose of managing the complete project.

Erhard Keppler of the Max Planck Institute for Aeronomy in Lindau/Harz took on the role of scientific head of *AZUR*. In 1966, the then 35-year-old physicist also initiated the construction of a ground operating station on the site of the German Aerospace Center (DLR), which was intended to make it possible to control the satellite, monitor its orbit and receive the data from space. This initiated the establishment of what would later become the renowned German Space Operations Center (GSOC) in Oberpfaffenhofen, southwest of Munich.

Keppler also arranged for the construction of three ground stations in Sodankylä (Finland), Reykjavik (Iceland) and Fort Churchill (Canada), in order to be able to investigate solar X-ray flares

Photo: DLR archive, Cologne



German-American collaboration:
Engineers integrate *AZUR* on a US Scout launcher.

in the upper polar atmosphere in real time. The operation of these stations turned out to be a logistical masterpiece because, at regular intervals, the control center in Oberpfaffenhofen had to produce new punched tapes containing the control commands to adjust the antennas. Lufthansa pilots flew them to the relevant country and intermediaries took them to their destination.

In order to test satellites before their launch, the company IABG in Ottobrunn, near Munich, built suitable testing facilities, including vibrating tables, thermal vacuum chambers and a high-tech magnet testing unit. It comes as no surprise that the total cost of the project went way over budget: *AZUR* carried a final price tag of well in excess of 70 million German marks instead of the planned 30 million marks.

The scientific experiments had been selected in consultation with NASA from 100 submitted project proposals. Five scientific institutes were involved in the development and assembly of the measuring instruments aboard the satellite, which was 115 centimeters long and weighed around 72 kilograms: The Max Planck Institute for Aeronomy, the Max Planck Institute for Extraterrestrial Physics in Garching, the Institute for Nuclear Physics in Kiel, the Institute for Geophysics and Meteorology in Braunschweig and the Institute for Atmospheric Physics at the German Test and Research Institute for Aviation and Space Flight (DFVLR) in Oberpfaffenhofen.

Göttinger Tageblatt from November 5, 1969

» When one considers how much time (...) has been spent on the organizational preparation (...) alone, one can understand the scientists' wish that, after Azur (...), the wheels of German "space bureaucracy" will turn not only as precisely but also as quickly as the speed of space research in other countries has been dictating for the past decade.

All instruments had to be manufactured in duplicate, as NASA had stipulated that the performance of the equipment had to be validated by flying it on sounding rockets before the real mission. To this end, it provided four sounding rockets, two of the *Javelin* type and two of the *Nike Apache* type, which were launched in 1966 and 1967 from Fort Churchill in Canada, from Kiruna in Sweden and from Natal in Brazil. The tests were successful – a further hurdle had been cleared.

In September 1967, work was finally able to begin on the production of the qualification, prototype and flight models of *AZUR*. Between the beginning of the qualification tests and the launch, a large number of faults were remedied. In early October 1969, the ground operating system commenced its permanent simulation operation right on time in order to be prepared for the flight phase. Things went off without a hitch during launch preparations on the range in California.

AZUR transmitted the measurement data it collected during its roughly two-hour orbit around the Earth in real time to the ground stations. Simultaneously, a magnetic tape on board recorded the data. As soon as the satellite flew over the ground station in Oberpfaffenhofen, the control center called up the tape. Unfortunately, the tape recorder stopped working just four weeks after the launch; nevertheless, the researchers were still able to receive around 70 percent of the data in real time by involving additional real time ground stations. Overall, the satellite transmitted 30 billion bits of information in real time and around 250 million bits of data on tape.

On June 29, 1970, 233 days after the launch, contact was suddenly lost. The cause was never ascertained, but the high radiation level to which *AZUR* was exposed on its orbit probably damaged the data transmitter. Although the satellite did not attain its planned lifetime of one year, research, politics and industry considered the project to have been a complete success. It provided valuable scientific insights that contributed above all to a better understanding of the physics of the Earth's radiation belt, and brought together state institutions, scientific institutes and companies. Six German companies provided the complete functional systems of the satellite. The system leader, Messerschmitt-Bölkow-Blohm GmbH (MBB), brought all the various strands together.

The knowledge and experience gained by the German researchers and companies paved the way for participation in future space projects. And it must not be forgotten that *AZUR* was the start of a close German-American collaboration in the field of space research. This cooperation made it possible to undertake such successful projects as the two *HELIOS* Sun probes, for example, which set off on their journey into space in 1974 and 1976 from Cape Kennedy in Florida to carry out research in the vicinity of the Sun. *AZUR* continued to orbit through space even after it had lost contact with Earth. And it may still be orbiting today. Although some sources reported that the space vehicle burned up upon entering the Earth's atmosphere some ten years after its launch, other information indicated that the satellite is still in space – together with thousands more that have followed it since. ◂

Dr. Erhard Keppler was the scientific project manager of *AZUR* and later the Technical Managing Director at the Max Planck Institute for Aeronomy in Katlenburg-Lindau. He passed away in February 2010.

Photo: Erhard Keppler