Early Russian Ballistic Missiles

space wire

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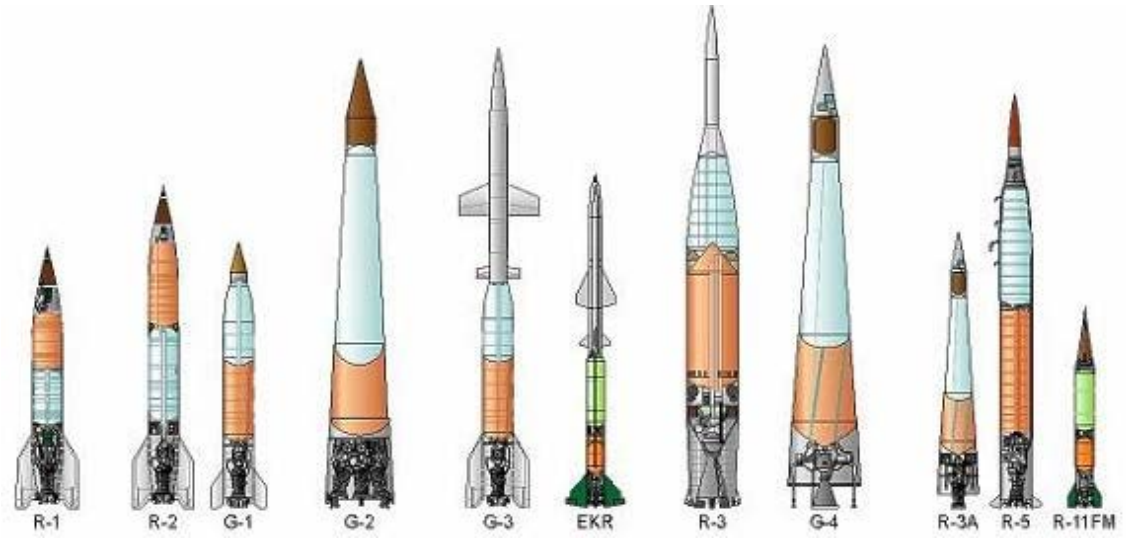

R-1 to R-5
Competing Russian and German rocket designs conceived in the Soviet Union from 1946 to 1953.

The true configuration of the world's first ICBM, the R-7, was revealed only in 1967, ten years after its first test. The Soviet N1 moon rocket was only revealed in 1990, 21 years after its first launch. At the same time, other Russian ballistic missiles were routinely paraded before the cameras of the world press even before they went into service. The extraordinary sensitivity of the Soviet leadership over these Korolev designs may be traced to the fact that they derived from the work of the Groettrup German rocket engineering team.

Official Soviet accounts and memoirs gloss over the German contribution to early Soviet rocketry. In fact, during the early days of Soviet long-range rocketry, competitive design competitions were held between Korolev and the German team. In each case the German design was found superior by state commissions. It was German aerodynamic analysis that came up with the unique conical rocket configuration adopted by Korolev for the R-7 and N-1. It was the German team that suggested fundamental features adopted by Korolev in the R-7 - integral propellant tanks, placement of the liquid oxygen tank forward of the fuel tank. German guidance teams developed a radio-corrected guidance technique that was adopted for the first generation of Soviet ballistic missiles. German-developed engines were used by Glushko as the basis for those of the same missiles. In some cases, German drawings were used without modification, the German text begin erased and Russian text substituted.

The extent of the reliance on the German team has only become apparent in recent years through the work of Dr Olaf Przybilski of the Technical University at Dresden. Dr Przybilski has done new fundamental research with the survivors of the German team and in Soviet archives. The story told in these new documents is significantly different from Soviet accounts.

The Soviets first became officially aware of German long range rocketry research when Churchill wrote to Stalin on 13 July 1944 and informed him of the impending use of the V-2 as a war weapon. In September of that year the Red Army overran the A4 research unit at Dembidze in Poland and the first V-2 wreckage was recovered. In March of 1945 a team of rocket specialists from RNII-1 was sent to Poland. With assistance from members of the Polish resistance, V-2 parts were identified and loaded aboard an Li-2 aircraft (license-built DC-3). The aircraft crashed near Kiev and only some of the parts made it to Moscow. However it was sufficient for a team of ten specialists under V F Bolkovitinov to make the first reconstruction of the V-2 missile.

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Man, that may have been a small one for Neil, but it's a long one for me.

---Conrad

On 19 April 1945 Decree 8206 of the State Committee for Defence ordered formation of TsKB-1 - Central Design Bureau 1 - for the purpose of recovering liquid rocket technology from Germany. By 24 May the first group from the bureau arrived in Berlin (Genera Gaidukov was the leader; members included Semenov, Mriykin, Pobedonsotetsev, V S Budnik, Shaprior, Timofeyev, Chertok, and Volfovich). A week later Stalin decreed that all rocket institutes in the Soviet zone of Germany were to be taken over and put back into operation.

The group reached Peenemuende on the first of June. They were astounded at the variety of rocketry and test stands they found - not just the V-2, but Rheintochter, Rheinbote, Wasserfall, and Taifun missiles. Ten V-2's were partially assembled by German 'volunteer' technicians located in the surrounding area by Soviet security squads. It was clear that the German technological advances were so great that additional experts were needed from Moscow from the automotive and electrical industries..

In July 1945 American forces pulled back from areas of East Germany they had occupied but were allocated to Stalin at Yalta. This included the underground slave-labour V-2 production facility at Nordhausen.. Although the Americans had stripped the facility of V-2 components and left only 'remnants' for the Russians, the remaining materials were more significant than usually noted.

By August reconstruction of the V-2 had begun by 150 German specialists lead by Chertok and Isayev at Bleicherode. On the ninth of August a new group of 284 specialists arrived from Russia, including Korolev, Glushko, Pilyugin, Barmin, and Mishin.

In Prague a special train used to support V-2 flight test was located, and Mishin was sent to fetch it. While drawings of most of the V-2 were located, not all could be found. Therefore Bleicherode set up a bureau to completely reconstruct the missile's technical drawings. It was then to be put into production for the Red Army.

Recruiters combed the occupied zones for German rocket engineers. The most prominent that would consider working for the Russians was Hermann Groettrup, then in the US zone. Chertok conducted two negotiation sessions. Groettrup finally accepted a stipend of 5000 Marks per month plus a villa, and moved his wife and two children to Bleicherode. Chertok considered organising the kidnapping of Wernher Von Braun, but decided not to go through with it. For this inaction he was fingered by his colleagues 24 years later, only partly in jest, as the 'man that lost the moon race'.

The Germans dubbed their facility at Bleicherode 'Institut Rabe' which they told the Russians stood for 'Raketenbau und Entwicklung' (Rocket Production and Development). Only later did the Russians realise what 'Rabe' meant. They then directed that the name be changed to the more innocuous 'Zentralwerke' (Central Works). Barmin headed the counterpart 'Berliner Institut' which was devoted to preparing for Soviet production of the smaller German missiles - Wasserfall, Schmetterling, Taifun, etc.

In August the Zentralwerke's V-2 engine static test stands were back in operation. By December 1945 600 German and Soviet specialists were at work at Zentralwerke. In March 1946 the first two complete V-2's were ready for test. At the engine test stands German and Russian specialists tweaked the standard V-2 engine for better thrust and performance. A series of 40 test firings between July and September 1946 used modified propellant mixer heads and varying mixture ratios. Thrust of the basic V-2 engine had been increased from 25 tonnes to 30 tonnes.

By that summer 5,000 workers laboured on construction of the V-2 throughout the Soviet zone. Buyers were sent to the Western zone and France to purchase certain necessary parts from the original manufacturers. The parts were smuggled to Zentralwerke without much trouble. By September 1946 the first ten series N new-production V-2's were completed. Five were equipped for atmospheric measurements, and five for radio guidance tests.

But moves were afoot to move this work deep into Russia, away from the eyes of Western observers. On 13 May 1946 a secret decree created an array of new research institutes on Soviet soil with the objective of comprehensively exploiting German rocket technology. Ustinov was put in charge of the entire effort. The new institutes were:

- NII-88, at Podlipki, General Gonor in Command, Korolev Chief Designer, for rocket design
- OKB-46, at Khimki, Glushko Chief Designer, for duplication of the V-2 engine
- NII-885, Ryanskiy Chief Designer, Guidance Systems
- NII-885 at Monino, Pilyugin Chief Designer, Control Systems
- NII-10, V I Kuzentsov Chief Designer, Gyroscopes
- GSKB, Barmin Chief Designer, Launch equipment
- General Vosnyuk, Commander, Soviet Rocket Test Range (site to be determined)

Following months of preparation, the Soviet secret police struck on the night of Tuesday, 22 October 1946. A huge party was thrown for the 234 German specialists, with plenty of toasting in the Russian tradition in order to put the attendees under the weather. At 4 am in the morning the hung over specialists were awakened by Red Army soldiers banging on their front doors. They were asked to immediately volunteer for five years work in the Soviet Union. On the following morning the specialists, their families, and their belongs were loaded on trains and shipped to Russia.

When the specialists first arrived in Russia, they were assigned to work closely with the Russian teams in Khimki, Monino, and Podlipki. But slowly they were all moved to Gorodomlya, an island used for research into animal diseases (and possibly biological warfare) in the 1930's. By May 1948 the entire German team was there, and no longer privy to what the Russians were actually doing with their designs, or what progress they were making. The first Soviet V-2 test stands were built in the Crimea, using equipment taken from Peenemuende. Later the focus of the effort moved to Zagorsk, nearer Glushko's primary facilities.

The first group of 234 specialists was moved to Gordodomlya on 22 May 1947 and given the task of designing a 600 km range rocket (the G-1/R-10). Work had begun on this already in Germany but the initial challenge in Russia was that the technical documentation was somehow still 'in transit' from the Zentralwerke. The other obstacle was Russian manufacturing technology, which was equivalent to that of Germany at the beginning of the 1930's. Nevertheless the team completed the G-1 draft project and defended it on 28 December 1948.

Meanwhile the Russians were secretly preparing to test the N-series German-built V-2's at the new test range at Kapustin Yar. The test stand was completed in September 1947 with the objective of having the first launch by the 30th Anniversary of the October Revolution. However the Soviet technicians could not get the rocket's igniter to work due to miswiring of the electric starter. In desperation on 13 September 13 German technicians were loaded on a train and brought to the secret test site. They arrived on 28 September, but the wiring problem was not identified and corrected until 15 October. The first rocket successfully thundered aloft on 18 October, although it immediately veered into the wrong direction. German 'sabotage' was suspected. Nevertheless by 13 November all ten of the rockets had been launched. The German team was back on Gordomlya by 9 December, once more in the dark about the program. They were never informed of the production of the Soviet copy of the V-2, the R-1, or of its first flight test series beginning in September 1948.

Meanwhile the German team at Khimki was completing build of ten KS-59 'Lilliput' subscale versions of a radical new flat-plate injector combustion chamber with a 60 atmosphere chamber pressure. The first engine was completed at the end of 1948. These were designed to test the design planned for the G-4/R-14. From the summer of 1949 to April 1950 100 tests were made of the engine. A wide range of propellants were used, including exotic fluorine compounds and suspended beryllium hydride fuels. The Lilliput endured them all.

During the test series the Russians gradually took over the testing. The German team was not even aware that tests continued beyond the end of 1948. Without their knowledge Glushko built the German design for the next phase of the engine, the 7 tonne thrust ED-140, in 1951. The ED-140 configuration would form the basis of Glushko's rocket engines for the next fifteen years.

For Korolev's R-3, Glushko proposed to copy the V-2 approach by using 19 of these 7 tonne chambers as 'preburners' to feed a main mixing chamber, producing a high-performance engine of over 100 tonnes thrust. However during development problems of stability in the mixing chamber could not be solved, and this approach was abandoned. Instead he scaled up the ED-140, as the Germans had planned. The first attempt was a leap to 65 tonnes thrust for the RD-105/RD-106 for the R-7. But this also proved unachievable, and Glushko settled for four chambers of 25 tonnes thrust each in the RD-107/RD-108 engines. Although the configuration was new and the performance spectacular, the per-chamber thrust was the same as the V-2.

When the decision was made to develop Groettrup's G-4/R-14 configuration in place of Korolev's R-3, the chief designer finally caved in and adopted the German's aerodynamic solutions with fervour. Although he put the R-3 on a slow track to oblivion, he adopted the German design for the follow-on R-7 ICBM. What started out as 'a cluster of G-4's' (perhaps the mysterious G-5 / R-15) became the R-7 when Korolev conceived of a lengthened core sustainer stage. This would allow all engines to be ignited on the pad, eliminating the problems of air start in the initial 250 tonne two-stage design (as in the US Titan or Groettrup R-12A). It also eliminated the technically complex jettison of 3 to 4 booster engines (as in the US Atlas or Groettrup R-12K).

When the time came for the N1 rocket in the late 1950's, Korolev again turned to the German work. The N1 was the direct aerodynamic descendent of the Groettrup G-2 and G-4. It incorporated all of the

essential features of Groettrup's designs - the 85 degree slope cone, topped by a cylindrical forebody and a sharply spiked nose, and the use of upper stages of the conical vehicle as smaller launch vehicles (the R-12B in the case of the R-12A; N11 and N111 in the case of the N1). It was only the limitations of Soviet manufacturing technology that forced Korolev to adopt the spherical tank design of the N1 in place of the integral common-bulkhead tanks of the Groettrup vehicles.

The German team was aware of none of this. Members of the team began to be repatriated on 3 April 1951. By October 1951 they were completely isolated and work basically stopped. The last member of the group returned to Germany on 22 November 1953. Groettrup made it to West Germany and was debriefed by the CIA in 1957, but provided some deliberately false information and downplayed the importance of the German work in order to avoid Russian retribution. The full story did not come out until the end of the century.

Early Russian Ballistic Missiles

	G-1	The G-1 was Groettrup's first design after the German engineering team had been moved to Russia. On 22 May 1947 he first group of 234 specialists was given the task of designing a 600 km range rocket (the G-1/R-10). Work had begun...more.
	G-2	The G-2 design objective was to create the first IRBM - to deliver a 1000 kg payload over a 2500 km range. The missile would use three V-2 derived engines with a total thrust of 100 tonnes. A variety of alternate configurations (R-12A...more.
	G-4	The G-4 was designed by the Groettrup German team in the Soviet Union in competition with Korolev's R-3. Rocket chief Ustinov informed Groettrup of the requirement on 9 April 1949: to deliver a 3000 kg atomic bomb to a 3000 km. This...more.
	G-5	Some sources indicate the G-5 / R-15 designation was assigned to an ICBM designed by the Groettrup team. If so, it may have been the 'packet of G-4's' that was the direct ancestor of the Korolev R-7. The designation G-5 / R-15 has...more.
	R-3	Development of the long-range R-3 missile was authorised at the same time as the V-2-derived R-1 and R-2 rockets in April 1947. Supplemental authorisation was contained in a government decree of 14 April 1948.The specification was...more.
	R-3A	So much new technology was involved for the R-3 that it was deemed necessary to build an R-3A intermediate experimental rocket, based on the R-2. This would be flown to test new construction methods, guidance systems, and high energy...more.
	R-5	The R-5 was the first Soviet missile to be armed with a nuclear warhead, the first for which the new southern facility at Dnepropetrovsk took over full design and production responsibility. The R-5 could deliver a 1425 kg

		warhead...more.
	R-5M	The R-5M was the first Soviet missile to be armed with a nuclear warhead, and the first to launch a live nuclear warhead in test. The technical characteristics were virtually the same as those of the R-5 basic model, except for an...more.