The SS-8 Controversy

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Presupposition clogs the intelligence analysis of a Soviet missile system.

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On the second of February, 1961, the Soviets test-launched a rocket on the Tyuratam range which was immediately identified as a new type. Subsequent launches in March and April made it clear that a flight test program for a new intercontinental ballistic missile had indeed begun. These events were observed with great interest by the small community of missile intelligence experts—but without tremendous surprise.

After all, by then considerable knowledge had accumulated on the first Soviet ICBM (now called the SS-6). Although much remained to be discovered about the SS-6, it was known to be a very large missile, that it almost certainly was very expensive, that it used difficult-to-handle liquid oxygen as one of its propellants, and that the Soviets would in all likelihood find this monster next-to-impossible to deploy in sufficient numbers to make it a major threat. The community thus found it natural enough that the Russians should come along with a fresh design, one which was presumably smaller and easier to transport and deploy than the SS-6, possibly even an ICBM capable of being launched from an underground silo.

At any rate, by the early spring of 1961 the missile analysts had rolled up their sleeves and plunged into an examination of all the data on this new system. It was not long before there was general agreement within the intelligence community that the new ICBM, designated the SS-7, was indeed smaller and more portable than the SS-6, had a payload of about 4,500 pounds compared to one double that size for the SSA and burned

"storable" propellants rather than liquid oxygen.

Third ICBM?

Any smugness on the part of the analysts was dissipated, however, soon after 9 April, 1961. On that day, and again 12 days later, and in the succeeding months, the Soviets launched ICBMs from Tyuratam which were neither the SS-6 nor the SS-7, but another new vehicle of yet another design, later called the SS-8. Why were the Russians doing this? Why had they started development programs on two new ICBMs almost simultaneously? What was there about the third ICBM that distinguished it and justified the expense of developing it?

One group of analysts came up with a plausible hypothesis. The Soviets already had a large bird in the SS-6. The SS-7 was much smaller. The SS-8 therefore must surely have been a move in the opposite direction—to a booster larger still than the SS-6. It could have a dual mission, to serve as a carrier for a truly huge nuclear payload of tens of megatons, and as a booster for space payloads larger than those which could be orbited by the SS-6. Some confirmation of this line of thought seemed to come from the fact that the trajectory data obtained on a few early SS-8 shots were of very good quality, and their backtracks ran very close to the known location of the SS-6 launcher at Tyuratam. Photographs of this facility had shown a massive firing platform at the edge of a huge excavation, and all experts agreed that the facility could probably handle boosters considerably larger than the SS-6. So it all seemed to make a pretty good story—here was a new big missile, a mission for it to fulfill, and a facility large enough to handle it.

The rest of the intelligence community, however, had reached no firm conclusion. The major effort on the part of most analysts was to examine the telemetry records to try to deduce the characteristics of this new missile. Telemetry is of course essential in such an enterprise, but it is not easy to use it to determine the size of a missile. The situation is analogous to trying to deduce information about an automobile from readings of the instrument dials on the dashboard and nothing else. Any competent engineer could determine from these readings that the vehicle was powered by an internal combustion engine

and not by a reciprocating steam engine, but it would be very difficult to decide whether the engine was Volkswagen-size or Cadillac-size.

The next milestones in the SS-8 story were reached in the fall of 1961. In October the Soviets fired two missiles to long ranges into the Pacific Ocean. For one of these firings a brief span of optical data was obtained during the time the incandescent re-entry vehicle was dropping through the atmosphere. Shortly thereafter, during the October revolution celebrations, Khrushchev started talking about his "global rocket" and Marshal Moskalenko said that "for the Pacific trials, Soviet scientists have developed rockets that could deliver 100 million tons" (apparently referring to the yield of a nuclear warhead).

Some scientists working under contract to the Air Force were able to combine the optical data with data telemetered during re-entry to calculate the drag of the re-entry vehicle as well as other ballistic parameters related to size and shape. The net results of these calculations indicated a nose cone weighing in the neighborhood of 25,000 pounds. A re-entry vehicle that large could very nicely carry a bomb in the 100 megaton class.

This conclusion seemed to support the "big missile" synthesis of the available data on the SS-8. The Russians had started with an ICBM too clumsy to be deployed (the SS-6). They needed and had developed a smaller missile, the SS-7. Now they needed a very large, efficiently designed ICBM to carry very large bombs. Khrushchev and Moskalenko had advertised that they had such an ICBM a half-year after the start of the flight test program, presumably at about the time the development program was seen to be a success. The optical data gave a measurement of the re-entry vehicle size, and it looked to be very large indeed.

Doubts about all this were beginning to emerge, however, in the rest of the intelligence community. It was observed that there were some remarkable similarities between the propulsion telemetry of the second stage of the SS-8 and that for an upper stage of another space vehicle, the so-called "Venik" stage, used by the Soviets in 1961 as part of an interplanetary vehicle which launched their Venik probe. The significance of this association was that the Venik-stage engine was firmly estimated by the intelligence community to have a thrust of about 65,000 pounds, and this was much too low a value to be compatible with a payload in the neighborhood of 25,000 pounds.

Other analysts pointed out that the firing rate of the SS-8 seemed to be too rapid to be compatible with a very large rocket. The intervals between several of the tests seemed to be too short to be reasonable for such a rocket—in April, 1961, the third SS-8 launch came only six days after the second launch, and in June the fifth SS-8 came off the pad only three days after the fourth one. Even more perplexing was the fact that the first orbital flight by Gagarin in Vostok I took place only three days after the first SS-8 launch on the 9th of April. Was it after all reasonable to assume that the Soviets could prepare and launch this vehicle from the same pad which had been used to launch a totally *different* vehicle only three days earlier?

Some scientists under contract also raised doubts about the validity of the analysis of the re-entry vehicle data. They pointed out that the analysis was based on the assumption that the re-entry vehicle was conical in shape with a hemispherical tip. If the nose cone were in reality more complex in form, such as the cone-cylinder-sphere shape favored in this country, then the rest of the analysis could not hold water.

Battle Joined

By the winter of 1961 the controversy had started in earnest. In some ways it came to resemble the sort of debate that peppers much scientific and scholarly literature. "A" publishes a paper giving his reconstruction of some little known event. "B" sends in a letter to the journal applauding "A's" efforts, but nevertheless pointing out that his reconstruction is somewhat naive in certain areas, and proceeding in the politest possible way to demolish "A's" thesis completely. Stung, "A" sends out a tart response attacking "B's" development. When "B" receives this he gets pretty hot under the collar and determines to squash "A", even if it means devoting all his time to the debate. By this time, the argument has attracted "C", who proceeds to propose a theory which is altogether different from those presented earlier. Meanwhile "A" and "B" have long since lost their objectivity, and have reached the point of considering the argument a personal crusade.

During 1962 each side performed exhaustive analyses of every scrap of data concerning the SS-8, and each side kept finding bits of evidence to

reinforce its case or to negate that of the other side. Unfortunately, the volume of data available was too small to permit any but very tentative conclusions after making a number of unverifiable assumptions. Nevertheless, as the year 1962 wore on, positions on each side hardened considerably, and the SS-8 sizing problem became the focal point of a major analytical effort.

On one hand, it was argued that the Soviets had a requirement for a very large ICBM, and that the analyses which came up with indications of a small SS-8 were based on unverifiable assumptions, were subject to many errors, and could therefore be discounted. Opponents of this view admitted the weaknesses of each of the analyses leading to a small SS-8 conclusion, but felt that there were enough different indicators, all pointing the same way, to permit high confidence in their judgment on the question.

Typical of the arguments which took place was the one which centered about the examination of the pressure decay of the SS-8 second-stage engine. Contract analysts had observed that the time it took for the pressure in an engine chamber to drop from its operating level to zero seemed to be proportional to the size and thrust of the engine. They collected data on a wide variety of US engines, as well as on some Soviet engines whose thrusts were known, and found that a plot of shut-down time against thrust showed a relatively smooth curve, running from 0.09 seconds for the 16,000 pound thrust Agena chamber to 0.54 seconds for the 1,500,000 pound thrust Apollo booster engine. Now, numerous measurements from telemetry of the SS-8 second-stage engine shut-down time showed it to be always between 0.16 and 0.18 seconds, and entering these values on the curve gave a thrust range for the engine between 45 and 100 thousand pounds, i.e., a *small* engine.

The advocates of the "big missile" hypothesis countered this one by pointing out that there was no physical law which governed the relationship between shut-off time and thrust, that it depended on the design of the valves used to terminate propellant flow to the engine, and that if one wanted to shut off a large engine rapidly one could do so easily. As proof they displayed some actual captive test records of an Atlas thrust chamber which had been shut down in a fraction of the normal time by substitution of a new valve design. And so it went.

Various other points of view were put forward. Telemetry analysts found a few very tenuous indicators that the SS-8 was a small missile. Still

another group was unconvinced by either side, and maintained that the data were inadequate to support any conclusion. They pointed to the fact that the SS-8 displayed certain anomalous characteristics not typical of any ICBM seen hitherto. They felt that whether the SS-8 was big or little, it was certainly a different kind of missile, and that if greater efforts were given to understanding the "why" of these anomalies, then perhaps the mystery would clear up. XXXXXX analysts XXXX XXXXX XXXX XXXXX XXXXX XXXX XXXXXX XXXXX XXXXXX XXXXX XXXX were concerned about some of these same peculiarities, and kept suggesting in a very tentative way that the SS-8 was not really an ICBM, but rather a new space launch vehicle, and only that!

Thus by early 1963, when the Board of National Estimates put out a Memo to Holders of the previous Soviet strategic weapons estimate, the community had reached a standoff, and the memo said in effect, "We believe that the U.S.S.R. is developing a high-yield warhead ICBM (the SS-8). Evidence is insufficient to resolve the question whether the SS-8 is large or small. If it is small, the SS-8 has a gross weight of about 160,000 pounds and its re-entry vehicle carries a warhead of about 3,500 pounds. If it is large, then the gross weight is about 660,000 pounds and the re-entry vehicle carries a warhead weighing about 17,500 pounds."

Arbitration

Obviously, this was a terrible way to have to write an estimate, and during 1963 pressure was applied to resolve the issue by convening some high level panels which presumably could get all the facts laid out, do some head-knocking, and reach a judgment. There were in fact three major meetings at which the issue was debated. First there was a meeting held under the auspices of the Guided Missile and Astronautics Intelligence Committee (GMAIC) of the US Intelligence Board. This took place in the spring of 1963 on "neutral ground" in Huntsville, Alabama and involved a three-day debate between the protagonists before the members of GMAIC. Nothing much was accomplished—neither side would give an inch.

For the second major meeting, held in the summer of 1963 in Los

Angeles, a group of six eminent civilian scientists was empaneled under the chairmanship of Dr. Marvin Stern, then a Vice President at North American Aviation Corporation. This group heard all the evidence during a week-long session, and came out with some conclusions which pleased neither side, but which at least made a start in the direction of resolving the argument. The Stern Panel said, in effect, that they did not believe the SS-8 was as large as the Air Force suggested, even though they agreed that a Soviet requirement for a vehicle that large probably existed. They also cited indications that the second-stage engine was small, probably in the Venik class, and if so, the payload weight of the SS-8 could only be four to five thousand pounds.

A sidelight of the Stem Panel session was that they looked at SS-7 information as well, and they decided that the data on this ICBM was really not much better qualitatively or quantitatively than that which was available on the SS-8, and there was no strong basis for being so sure the SS-7 was small. However, the intelligence community had been *expecting* to see a small ICBM when the SS-7 test program was begun, and therefore no debate occurred on the point. Indeed, if the SS-8 test program had started before the SS-7, then there might very well have been a great debate on the size of the SS-7.

The third major meeting of 1963 was a meeting of the Hyland Panel in September. Chaired by Lawrence Hyland, the General Manager of the Hughes Aircraft Co., this group had been acting in an advisory capacity to the USIB for a number of years. The meeting was timed to take place a little before formal consideration of a new Soviet strategic weapons estimate by USIB. Although other subjects were discussed, the major focal point was the SS-8. Dr. Stern participated and presented the prior findings of his panel, and briefers from Air Force, CIA, and other agencies ventilated all the old arguments as well.

The result was that the Hyland Panel concurred in the previous finding that the SS-8 was small. By this time, the Army had also decided that the SS-8 was small, and the new estimate draft reflected these judgments.

Thus, in mid-October 1963 the USIB approved a new Soviet strategic weapons estimate in which the SS-8 was described as having about the same payload capability as the SS-7 (i.e., a small missile). The Air Force and DIA took exception to this in a footnote, insisting that the evidence did not exclude the possibility that the SS-8 carried a nose cone

weighing 10,000 pounds or a little more—in effect, a retreat, but not total surrender by the proponents of a big SS-8.

From this point on, the SS-8 controversy gradually died down. It had become apparent by the end of 1963 that the SS-8 was being deployed by the Soviets in only token numbers compared to the numbers of SS-7 ICBMs being fielded, and this meant that the question of the size of the SS-8 was becoming somewhat academic. Furthermore, in November, 1963, and April, 1964, the Soviets began flight testing two new ICBMs, the SS-9 and the SS-10, and the study of these new systems naturally preoccupied the analysts.

The final episode came in November, 1964. For their annual October Revolution Parade, the Soviets introduced a new missile which they described as an ICBM (See photograph) and which was given the name "SASIN" by NATO. A comparison of the size and shape of the SASIN with the estimated characteristics of every known Soviet ICBM made it perfectly clear that the SASIN could only be the SS-8, and that its re-entry vehicle weight had to be between 3,000 and 4,000 pounds. The "big missile" advocates threw in the towel at last, and estimates written in 1965 and since have indicated no disagreement on the SS-8.

Postscript

Two observations suggest themselves about the SS-8 story, one concerning the analysis process, and the other the use of high-level panels. Reduced to essentials, the argument was between one group which insisted that the most important consideration was the Soviet requirement for a new weapon system, and a second group for which indications from the data without regard to a presumed requirement were the most important factors. In this instance, the latter approach was clearly the better one, and this author is inclined to think this is generally the case. Even if the data seem to point in a direction contrary to preconceived notion, the analyst usually is better off to pursue his leads from the data as objectively as he can.

Second, here was a case in which an outside panel performed a definite service. When two strong-willed groups divide over an issue and debate it over a long period of time, it is too much to expect that either side is

going to be converted easily by reviews of its own or the other side's arguments. An objective group needs to be called in to arbitrate. Such a group should be composed of individuals whose judgments will command respect. It is equally as important to give such a panel enough time to allow it to dig into the data. This is not possible in a session lasting only a day or two. Moreover, the panel members should be shielded from distraction by other matters during their deliberation. This was the situation for the panel headed by Dr. Stern—they stayed in session for a whole week, and all the members dropped virtually all "outside" activities during this time. And the deadlock was broken.

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