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Highlights in the development and exploitation of advanced strategic photo reconnaissance.

THE NPIC AND ITS WORK

Arthur C. Lundahl

I shall try here to sketch the origins of the National Photographic Interpretation Center as it evolved from a PI effort set up in CIA, tell something of how it operates, and illustrate some of the material it has to work with.

Photographic intelligence is a relatively new field. It got its main start in World War II, where it piled up an enviable record of accomplishment. At the conclusion of the war technical survey teams went into Germany and Japan with the specific purpose of determining how good our PI effort had been. These were the famous U.S. Strategic Bombing Intelligence Surveys, which after many months of study came to the conclusion that between 80 and 90 percent of all of our intelligence in World War II came from aerial photography and that this intelligence was around 85 per cent accurate. At the conclusion of the Korean war, similarly, an Operations Evaluations Group report said that 85 per cent of the intelligence there came from aerial photography.

It is rather surprising, in the light of this record, that as late as 1952 there was no PI effort worthy of the name in CIA, no organized,

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instrumented, regularized program of photo interpretation. In early 1953, however, a Photographic Interpretation Division was established in the Agency's geographic intelligence component. Because I had then been at the Navy PI Center for some eight years and after the war had converted it from an exclusively military activity to a combined military-civilian organization, with all the paper work and planning involved in setting up a new outfit, I was asked to come over to organize the CIA effort. We started out with a very small group that year, and from the very beginning we were almost completely overwhelmed by clandestine requirements: In planning for parachute drops, getting agents across beaches, landing supplies, blowing up radio stations, and other such missions, photography was needed to pick out the right spots and times. Thus we were largely engaged in the support of clandestine activities through 1953 and 1954.

The U-2

At the end of 1954 I was summarily relieved of all my duties and told to report to the Director's office. There I met a remarkable man, Richard M. Bissell. He was one of the driving geniuses behind an unprecedented airplane, one that was going to function as no plane had ever functioned. This plane, which was to get pretty famous -- or notorious, depending on how you look at it -- in May of 1960, was one of the most fantastic accomplishments of our time. It went from a gleam

in the eye to a flying machine in nine months, and without benefit of any wind tunnel trials. It would have blown security to put it in a tunnel anywhere, so the numbers that came off the slide rule had to be right. The fact that the plane has operated so well is a high testimonial to the designers and the engineers who built it.

Mr. Bissell pulled back the drape and showed me that this was coming, and it was my job to make sure that the unprecedented plane had some unprecedented cameras to go into it. It didn't do you any good to get up there if you couldn't do anything with the view when you got there; you had to be able to record the intelligence on the ground. For most of calendar year 1955 I was galloping around these United States to various camera manufacturing depots and subcomponent manufacturers examining specifications, accepting some and rejecting others, browbeating and encouraging them to do better, so that this wedding of camera and plane would be the best match possible and ready for consummation with the onset of operations in early 1956.

It was conceived from the beginning that the take from this effort would be very great indeed, and that some kind of large factory would have to be set up to store and process the film. The 2,000 square feet of space we were currently occupying at M Bldg. would be nowhere nearly large enough. As I was moving about the country, my executive officer was busy with the staffing-out operation and getting the space

the job called for. The space we got was in the Stuart Building, 50,000 square feet of floor area. We developed from the start a practice of working closely with the military services. We brought to this plant, alongside the CIA staff, a large cadre of Army personnel, a fair number from Navy, and a smaller group, mostly liaison officers, from Air Force.

Initially this project was given a code name, and I had chosen Automat, having in mind a place like Horn and Hardart up in New York, where you can roll in any time, day or night, and get your hamburger and custard pie. The photography was going to be rolling in night and day, Saturday and Sunday, Labor Day and Christmas, and that is what it did. In 1956 we rammed our way into this plant and were functioning at high blower from then on. By 1958 our numbers had grown from around 60 to about 225, and the overtime was going out at a mad rate. I think we spent a total of 200,000 hours of overtime in the Stuart Building alone. In August of that year we were renamed the CIA Photographic Intelligence Center and raised to Office status.

The National Center.

In the fall of 1960, after the fateful loss of one of our planes near Sverdlovsk, the Joint Study Group which had been reexamining the capabilities and infirmities of the whole U.S. Intelligence structure issued its Report, a document about as big as a Sears, Roebuck catalog.

At its end were some 33 recommendations, one of which was that a national photographic interpretation center should be established as soon as possible. This recommendation was introduced into the USIB agenda in December, and the debating began.

The participants agreed that there should be a national PI center, but there were considerable differences on the point of who should control it. The question was discussed in four sessions of the USIB that month without resolution, and in January 1961 it was passed up to the National Security Council. On 18 January, in the last NSC meeting President Eisenhower chaired before he went out of office, NSCID 8 was cast and signed, providing that a National Photographic Interpretation Center should be established, that CIA would run it, logistically support it, direct it, and maintain it, and that the military services would be invited to participate to an extent commensurate with their interest. In time of war, however, control of the Center would shift to the Secretary of Defense; and with the advent of the Defense Intelligence Agency this latent control is exercised through General Carroll's office.

After this action Mr. Dulles, in his usual magnanimous style, offered the military services the option of providing the deputy director for the Center and so set off a new debate over which military service would do so first. General Graves Erskine, as the Defense Department USIB member, resolved this one in favor of Army on the basis of its strong

participation ever since Project Automat was launched. Army therefore furnished my first deputy, to serve for two years. The present deputy is naval Captain Pierre N. Sands. But the CIA nominee for the NPIC directorship itself has to be approved by the Secretary of Defense; my nomination by Mr. Dulles was approved by Mr. McNamara, and I consider myself, although I am paid by CIA, to stand at the apex of an inverted equilateral triangle, equally responsible to the Secretary of Defense, or to General Carroll acting for him, as to the Director of Central Intelligence.

As we began functioning under our new charter, the President's Board of Consultants on Foreign Intelligence, headed by MIT President Killian, made a couple of ad-site surveys and was much disenchanted with the quarters in which we had to work. Reporting to the President, it urged that this important national asset be relocated as quickly as possible. Plans were in fact already under way to relocate us, with a target date of 1 August 1963; but under the President's encouragement Mr. McCone undertook to get it done by 1 January 1963. The move began at 0600 on that New Year's Day, and within 72 hours we were completely tranplanted to our new quarters in building 213 of the Naval Weapons Plant.

In this plant, with 400,000 sq. ft. of floor space, we have an extremely fine collection of equipment and materials. It is the best

equipped PI center, at least in the Western world, at the present time. I don't know what the Russians have, but they have had to be working if they've got some of the things that we have operating for us. The staffing, too, has proceeded in rapid fashion: with about 760 on board now, we are projecting a T/O of 1,000 people by the end of this fiscal year. We conduct our own in-house PI training, area familiarization programs, and so on. The very existence of this considerable activity is classified Secret.

The NPIC organization, aside from the indispensable administrative and support components, a reference staff to handle the myriads of collateral intelligence documents the PI men use, and a crackerjack of a publications shop, has four principal elements. The Operations staff works 24 hours a day seven days a week, receiving thousands of cables a week and sending out sometimes less, sometimes more, depending upon what the situation is. The Photo Analysis group consists of Army, Navy, Air Force, and CIA photo interpreters working together and dedicating their efforts to the national PI objectives. These are backed up by the photogrammetry people. Photogrammetry is the science of extracting quantitative information on real objects from their photographic images, figures on the size, shape, position, and orientation of any kind of object or phenomenon imaged in any kind of photography -- aerial, terrestrial, submarine, periscope, underwater, facsimili, TV screen, or

anything else.

But my Assistant for Plans and Development, [redacted], spends 50X1

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1 See his article, "Technical Factors in Aerospace Photography," in Studies VI 4, p. 1 ff.

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most of the millions we spend every year, because you need all kinds of sophisticated optical-mechanical hardware for the exploitation of photography. You need new kinds of rectifiers and viewing devices, coherent light sources, mazer emitters, all kinds of things which you have to keep working on if you're going to keep up with this business. In photo intelligence, as in many other fields, you don't stand still; you go forward or backward. There was a time after the war when we were spending millions for sending out airplanes and hundreds of thousands for cameras, a towering mountain of expenditures on photo reconnaissance; but at the end of the process, down in the last hall of the building, the PI's sat leaning over two-dollar stereoscopes trying to read a million dollars worth of information out of them. It was like having a chain with links made of raw steel, except down near the end you found some made of wet kleenex. This is what our R&D effort has been trying to get rid of.

Nowadays the photo interpreters look through a $17,000 Richardson-type stereoviewer, or each of them has at his left elbow a stereo-microscope that comes at about $800, or they have on-line mensuration

equipment whereby you can bring your cross hairs into coincidence on something, punch the real time into a 490, and get back bearing or length or width or height or whatever you're after. These are the frontiers that you have to keep probing if you're going to stay on top of the kinds of problems given us in these times. Most of this hardware comes out of Plans and Development.

The Take

When President Eisenhower gave his TV talk in 1960 about our plane brought down near Sverdlovsk, he gave as an example of its take the photograph in Figure 1, made from 72,000 feet over the San Diego Naval Air Station. Looking down on the parking lots, you see the 8-inch-wide white lines that mark the separations between the cars, the center line of the road, the lanes where the pedestrians cross, and many other details with dimensions on the order of a foot, a little more or less depending on atmospherics, from something approximating 14 miles up. This was the kind of tool created to deliver the greatest amount of information in the history of U.S. intelligence. It has come in in torrents, with tremendous effect on the decision makers and policy planners. I shudder to think where the United States would have been today in its estimative processes were it not for this take. While all kinds of fictitious things -- bomber gaps and missile gaps and other folklore items -- were cropping up in the newspapers, depending upon what side of the election

or what side you were on, we had some fairly solid information about the real situation. What we had is sampled in the accompanying illustrations.

The U-2 delivered to us thousands of square miles of coverage per sortie, and it raised the whole level of the PI business by several orders of magnitude. In World War II PI was the handmaiden of battlefield intelligence, then broader tactical intelligence, then technical and target intelligence -- Ploesti, oil, ball bearings, etc. But in the late 50's and early 60's photography became a key ingredient of national intelligence, strategic intelligence, policy intelligence. Some highlights of its performance in this role are discussed below.

Tyuratam

In Figure 2 you see the Soviet guided missile launching complex at Tyuratam on the shores of the Aral Sea, 45°55' north, 63°18' east. Back in 1957 we watched them starting to construct this first great space-event and ICBM launching area. That wineglass-shaped hole in the ground is some 900 feet long, 500 feet wide, and 160 feet deep. It has a concrete pad 160 feet square and a 90-foot steel tower on the edge of it. You see the double security fencing, the rail line coming up, and various support, fueling, interferometer, and other devices around it. It is from here that the Soviets have fired their shots into the Pacific, their Venus probes, their Lunik shots, the Titov and Gagarin flights, and

all the rest.

They weren't content with just one big pad and all its supporting installations; over to the left of it they built themselves another one. At the B pad the security fences are in, the excavation done, and the blast pit and the control bunkers being built. This one hooks around on a bearing of 315°; the other is on a bearing of 090°. In the early days of missile launching you lifted them off as close to 090° as possible to take advantage of the Coriolis kick; but when your boosters get more powerful you can aim them more nearly on northerly orbits and lift them over the pole. In fact you can even aim them slightly against that kick, as the B pad does, if you have enough booster.

The R&D bases are probably the most important things we cover in the Soviet Union, because there is where the missiles, nuclear weapons, etc., pass from a gleam in the eye to hardware on the ground, still two or three years away from a deployed threat in the field. We have learned a great deal from watching them, and these efforts are paying off in more ways than I could hope to enumerate. We don't want to get into a substantive discussion of missiles or Atomic Energy or BW or anything but to illustrate the methodology, what the PI's get inthe form of the pictures, what they create from it, and what it means to the national estimators.

Figure 3 is a composite sketch of the Tyuratam area. You see the Syr Darya river, Tyuratam village on it, and the rail line that comes out some 25 miles into the desert. Near launch area A, the big hole in the ground, is the launch support complex -- personnel, storage, instrument control center. Beyond, launch complex B is a third, launch complex C, and they have continued to add details to this base. Toward the bottom is storage construction in support of Tyuratam airfield -- a main water storage and tank area, a communications area, a propellant production area. This diagram is much simplified; some of the later illustrations are more complicated and show something of the myriads of details that photography is capable of providing.

Kapustin Yar

Figure 4 pictures another place the Soviets are pretty proud of; this is Kapustin Yar, at the big bend where the Volga hooks around south of Stalingrad. Here is where they fire their short and intermediate missiles -- 350, 650, 950, 1100, 2000 miles -- on which they have been busily working in R&D for many years. The surface-to-air missile launch complex with the herring-bone pattern is the prototype of those they deployed in a double ring around Moscow at 25- and 50-mile radius, beginning in the early fifties. Then they stopped building these

SA 1's because they were too heavy, too cumbersome, too expensive, and designed for mass bomber raids, not the kind of war we would be fighting. They built another complex for developing the SA 2's and later a third for the SA 3's designed to fill the low-altitude gap between zero and a few thousand feet of elevation.

You see also the stakeouts for the electronics downrange tracking of the missiles, the main school, nuclear storage support, the main base support complex, launch complex E for surface-to-surface missiles, launch complexes A, B, C, and at a distance D, the back-up electronic ells, the main troop training complex F, and launch complex G. We even found the old V-2 launch site here, as indicated. The complete setup of this base would require scores and scores of pictures to cover in detail.

Figure 5 concentrates on the surface-to-air development and troop training sites. Prominent is that herringbone of which they built some 56 around Moscow. These fire from triple bays on the outboard ends of the ladder, lining up with the big Yo-Yo radar complex, all inside a security fencing.[2] In trying to find something that was better than the

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[2] For an account of the earlier identification of the deployed herringbone sites and their Yo-Yo radar, see Charles R. Ahern's "The Yo-Yo Story" in Studies VI, p. 11 ff.

SA 1 module they first tried various combinations at another site but finally settled on the SA2 complex, which you see is hexagonal, with six firing positions, backed up by Yo-Yo radar and of course security fenced.

When they were convinced that this is what they wanted they put three of them side by side for dry fire and two for live fire, and they encamped 3000 troops nearby for training. We counted and cubed up the tent spacing they had for their field exercise and pieced together how they came for school work down to the dry fire and live fire sites. When they had finished their training they were loaded aboard trains by organizational units, given their equipment and supporting elements, and shipped right to wherever they were going, their defense posts in the Soviet Union or in the Satellites.

Later on the engineers moved down the road and set up their first SA3's, the low-altitude surface-to-air missiles, in that splayed open H. The trajectories are low, no trees or objects ahead of them. These would probably be set up in places like the Baltic slot and where SAC would be trying to run in low. Farther down you see the main administration complex. The very big revetted buildings, it is supposed, are to store the new warheads for these surface-to-air missiles of the future, if indeed they are not already a part of the regular Soviet arsenal.

Figure 6 is one of the SA2 sites, seen from 71,000 feet. We picked up 24 of these around Cuba, starting in September of last year, ← Oct 1963 rimming the whole perimeter of the country. It's about 800 feet across. The six firing positions, in double revetments, have an open roadway connecting them. There are missiles on launchers in five of them; the sixth is open at the moment. In the center are the radar van revetments, with a stack out in preparation for firing. At the 120° separation two vehicles carrying missiles stand in bays. In reloading, these vehicles come out, go through the double-wall revetments, stop at the firing positions, swing open the turrets, and slide their missiles in on the launchers. Then they go on up the road to a nearby support complex, where we have seen up to 100 of these missiles in canvas covers on trailers waiting to perform their resupply function when called upon. On the periphery there's an athletic field, the Russian equivalent of a PX, some associative features of radar and guidance equipment, and the security wall.

This, then, is the second-generation surface-to-air missile site. From the data that we've been able to piece together around the world, from the sightings we've been able to make in the Soviet Union, and the

offloadings we've seen going on in Indonesia, Egypt, Iraq, Cuba, and elsewhere, the projected estimate is that there are probably in excess of 1,000 such sites scattered through the Soviet Union, the Satellites, and client countries around the world.

Figure 7 shows what launch complex E, surface-to-surface, at Kapustin Yar looked like in mid-winter: a lot of snow on the ground, triple security fences, security gate, main road in, big concrete pad about 230 feet on the side, loop road coming across, main control bunker, light poles for illumination for night firing, secondary control bunkers, radio control towers. This is quickly pieced together.

I should explain that our PI men don't work from a screen or from enlargements; they sit looking at transparencies, either on the big-screen Richardsons or on stereomicroscopes. With their rheostats they adjust magnification and illumination to optimum suitability for their individual eyes and then proceed to traverse their cross hairs for measurements and the other photogrammetric things I've described.

It is from this process that they develop the details that are beginning to appear in Figure 8. There's the pad, 230 by 230, the main control bunker, the secondary control bunker. They were laying out a projected second pad off to the left; there are varied tanks and radio towers. The light poles for night work are 70 feet high. You may wonder how we know these figures are right. The answer is very simple: we've

flown the U-2 over factories, depots -- Hanford, Oak Ridge -- and other places in the United States, obtained from the photographs of such places measurements of details on the ground, and then actually gone in -- with the cooperation of the range manager -- and got the blueprints of the place or measured them ourselves; and the dimensions determined from photography have been very, very close to those obtained by ground inspection.

Figure 9 is launch complex D, way off by itself at Kapustin Yar. We think they are experimenting with air breathers in here. You see the way it looked in 1957, with the rail line looping up to a very complicated kind of firing pad. Then they continued to add more pads until they had run them out almost a mile. By 1959 the complex had been expanded in two other directions. This is typical of the dynamism of the Kapustin Yar activity on short and intermediate range missiles.

Vladimirovka airfield in Figure 10, which is also at Kapustin Yar down along the river, is a kind of Wright-Patterson of the Soviet Union. The strip is 8,200 feet. You can see the count of Bulls, Badgers, Beagles, Faggots, Farmers, Flashlights, Crates, Cabs, Colts, Skreeks, and Hounds, the main missile production complex, air-to-air and air-to-surface missiles, the main airborne missile assembly and loading complexes. For both offensive and defensive armaments, they do a great deal of trial

fitting, prototype, and check-out and running here.

Sara Shagan

Another place we've been much interested in is Sara Shagan on the shores of Lake Balkhash. Here is where the Soviets have been working most energetically on antimissile missiles. In Figure 11 you can see two types of firing pads -- one like a depressed roulette wheel and then the rectangular pad farther down. This is in an impact area: they apparently fire at this place from Kapustin Yar and as the missiles come whistling in try to lift off from these pads to intercept them. Otherwise we have no explanation for launching pads in a missile impact area.

Figure 12 shows the two pads, about 300 feet in diameter, microwave towers, buildings under construction, 21-foot radar dishes, and then actual vehicles' tracks going up to some of the launcher-erectors and the trackout of radar vans etc. We've made a couple of conceptual constructions of what the pad looks like, as in Figure 13. Many of the photo interpreters are skilled in sketching through the stereoscope, ~~and~~ it's surprising how many of our consultant scientists can't read blueprints, so that frequently we have to make these perspective sketches to give them the idea of what we're after. This shows the dishing in and what is probably a blast deflecting plate underneath the launch set up in it. Probably storage and other materials are pulled out underneath

on the side where you see one opening in the wall. 300 feet in diameter makes it just about the size of a big radio telescope like the one at Jodrell Bank.

Figure 14 shows a hen-roost type of building, 890 feet long, with a big phase radar array looking to the west, in the direction from which the missiles come. There is a backscatter wall and all kinds of dishes and mounds and antennas. The whole Sara Shagan complex spreads over some 1600 sq. miles, and the collection of radars in it is fantastic. Of course that is what you would expect: If you have to get on your incoming target fast and get his range, attitude, altitude, and plunge angle in time to lift off at the right moment and have a chance for a hit, you need as much of the radar information, including interferometer readings and everything, as you can get.

The diagram of Figure 15 shows more methodology. As you can see, they get all kinds of details -- buried water lines, power houses, tanks, the 350-foot support building, the mound, or low wall, for the backscatter, other mounds, tanks, lines, and poles. These all have to be pinned down. The PI men identify these things, measure the dickens out of them, and draw up all kinds of engineering intelligence blueprints like these. Analysts take this material and massage it with all kinds of collateral-- interrogations, defectors' reports, national estimates, FBIS broadcast items -- rejecting facts which are inconsistent with the photography,

confirming others, and whipping together a tight mélange which then goes up into the estimative process for the benefit of the decision makers.

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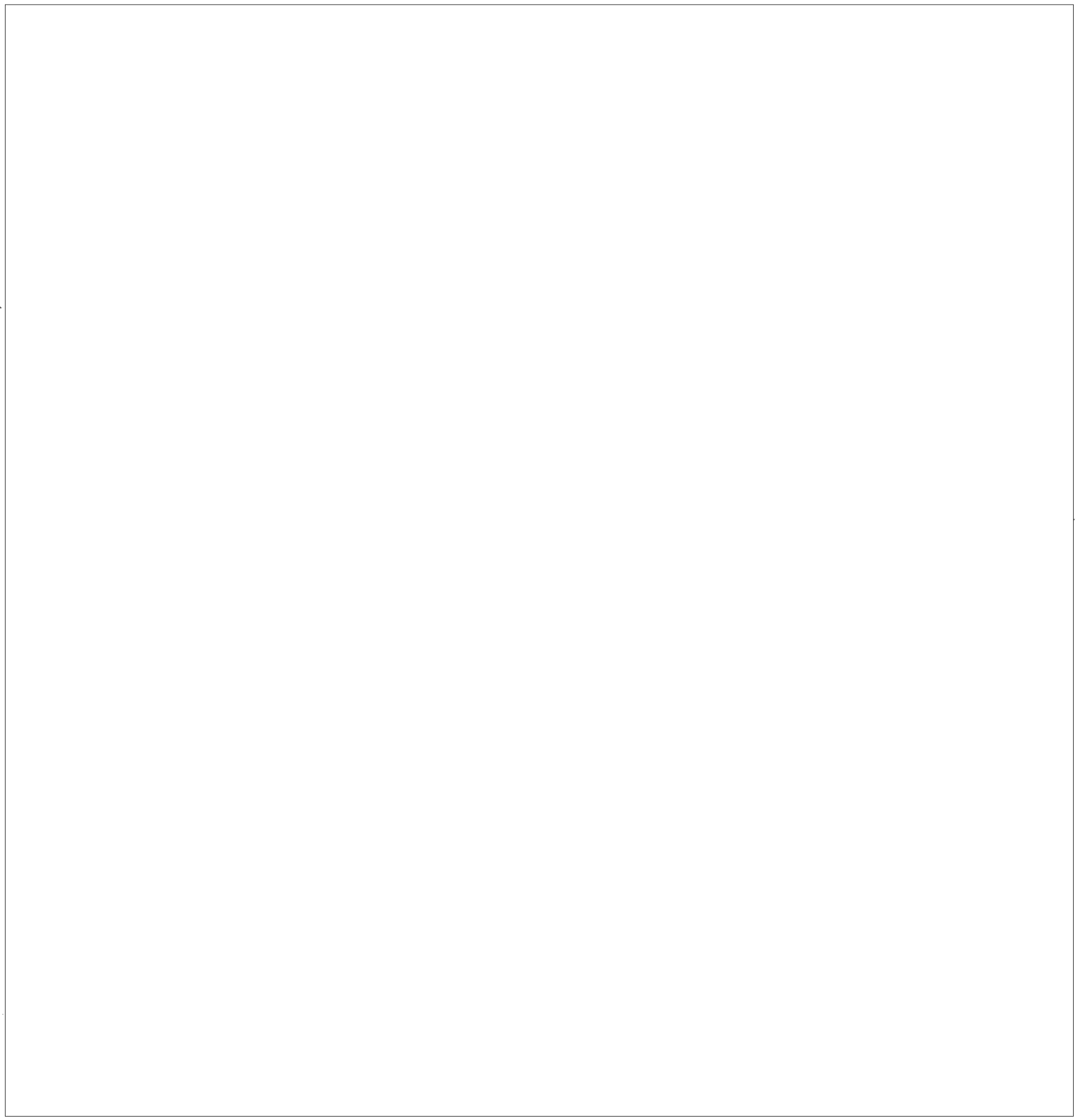

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This, then, is the kind of raw material and the kind of analytic processing the NPIC was established to handle. It is true that in concentrating on the R&D bases I have not illustrated the evidence bearing directly on putative missile gaps and other matters of strength in being. But you can imagine how much simpler a thing it is to find and reckon up the deployed force once the prototypes have been identified in this detail. The development of this asset, beginning with Project Automat, has been one of the greatest breakthroughs in the history of intelligence.