

*Simulation of assumed enemy effort  
to plot Minuteman silo positions.*

## SPY MISSION TO MONTANA

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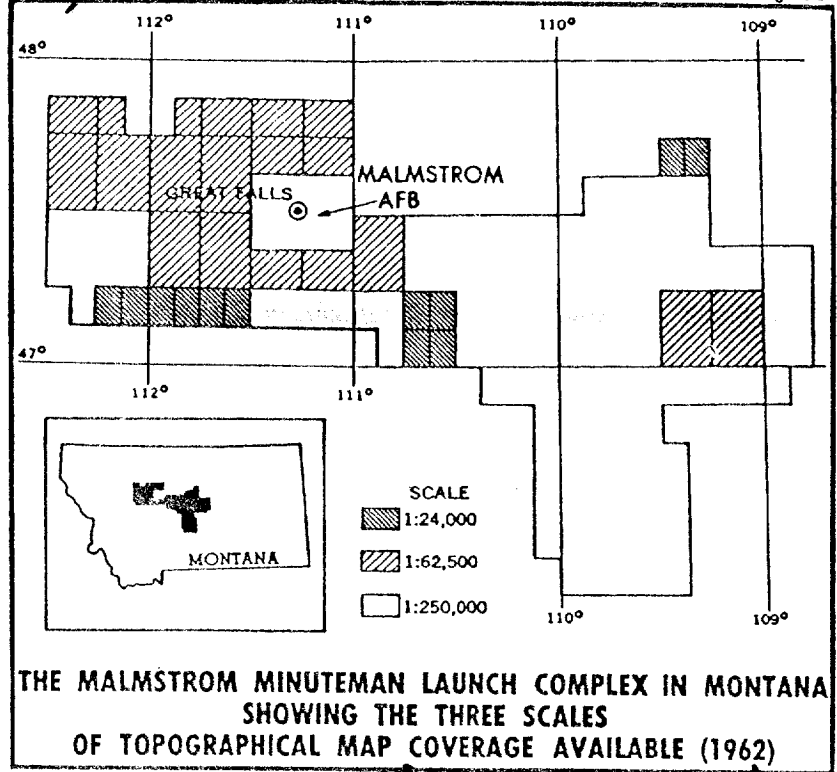
As the flight out of Salt Lake City headed northward toward Butte and Great Falls, the three of us viewed the desolate salt wastes and changing surface patterns below with due geomorphological respect but also with some apprehension. Our mission during the next ten days would take us into the equally strange and sparsely settled terrain east of the Rockies in Montana where a Minuteman missile complex was being installed. We were about to undertake a ground survey of Minuteman sites, making hurried observations with small geodetic instruments such as a covert agent might use to ascertain more or less precisely their locations.

The time was late in July of 1962, shortly before the first missile was placed in its silo east of Great Falls. The world had already heard the USSR's trumpeting of the "pin-point accuracy" of its ICBMs "anywhere in the world." In fact, it was important then, as now, for the Soviet as well as the U.S. missilemen to identify, assess, and if feasible reduce the many sources of error and uncertainty that make it quite impossible to achieve "pin-point accuracy." One uncertainty that can be responsible for an appreciable part of a missile's miss distance concerns the precise position of the target on its local geodetic datum.

The locations of topographic and cultural features in any area of interest can ordinarily be obtained from existing large-scale maps, say the standard U.S. topographic map series at scales 1:62,500 and 1:24,000. Missile launch sites, however, are purposely excluded from these. The Soviets, consequently, though they presumably have in hand the best large-scale maps and geodetic data covering the United States, can obtain the coordinates of missile sites only by determining, through photography or direct observation, their positions with ref-

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Figure 1



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FIGURE 1

erence to neighboring features that are shown on the maps.<sup>1</sup> Our simulation of possible clandestine field observations was intended to reveal how well the USSR could by such means place the sites on U.S. maps and so determine their coordinates on the North American Datum of 1927.

<sup>1</sup>They could also get the boundaries of the sites by searching county title records and then locate the silos within these boundaries by observation or by obtaining the engineering drawings for the installations (marked merely Official Use Only). Experimentation with this method yielded results within about the same range of accuracy as the field observations herein described. But it seemed a method less likely to be used in view of the risk of agent exposure, since such a search of land records would be reported by the county to the Air Force and the searcher subjected to investigation.

*Official Help*

The survey by our three-man team, two from CIA and one from Army Map Service, had been laid on by agreement between CIA and the Strategic Air Command and 341st Strategic Missile Wing at Malmstrom Air Force Base near Great Falls. On arrival at Malmstrom we reported to the Deputy Commander of the Site Activation Task Force and discussed with him and a few other officers of the command our planned procedures. Only a few at Malmstrom were witting of our mission, and the simulation of covert activity called for us to avoid recognition and to rent a car in Butte to use during the survey.

The Boeing company, the prime contractor for construction of the complex, was still mainly responsible for security; none of the sites had been officially turned over to the Air Force. We were briefed on the security measures in effect. It seemed quite probable that our unscheduled and furtive use of surveying instruments in the vicinity of the sites might arouse someone's suspicion to the point of challenge. Just what the security response might be was both of special interest to the Air Force and of personal concern to the three of us. At least we were given badges authorizing our presence around the complex that we could use in the event of detention by local police or Boeing security patrols.

The Malmstrom Minuteman complex embraces an area of more than 6,000 square miles in central Montana, from 60 miles west to 120 miles east of Great Falls (see Figure 1). The land surface within the area is generally rolling and unforested, with scrub-covered buttes on the horizon in the west. The complex was planned to accommodate the deployment of 150 missiles in hardened silos; these were grouped into 15 flights, each having 10 missile sites situated around a control center. Individual sites were spaced five to eight miles apart and connected by underground communications lines to their control centers.

We were offered a preliminary reconnaissance by helicopter over portions of the complex where we planned to make observations. We accepted on the grounds that this would give us no real advantage over a Soviet agent, who could use the commercial flights in and out of Great Falls which traverse the launch complex at fairly low level. The air reconnaissance proved very helpful in showing us some

standard characteristics of the sites and enabling us to anticipate some problems we would encounter in making observations from roadsides in various types of terrain.

Some characteristics stemmed from criteria used in the original selection of the sites—proximity to well-surfaced existing roads, remoteness from populated places, and suitability of soil and terrain for deep construction. They were often on low hills below the crest, for drainage and perhaps some blast protection. They were generally 100 to 200 feet from existing roads in order to minimize new road construction, but in several instances the access roads were more than 500 feet long. The curves in these had to be of large radius to accommodate the missile delivery van.

The sites were all two to three acres in area, rectangular with the longer dimension running north and south, and fenced against human or animal intrusion. The arrangement of the concrete emplacements within the sites was uniform at all, with the silo to the south and west of center. A conspicuous feature was two commercial power poles, one carrying a large transformer, at the edge of each enclosure (see Fig. 2).

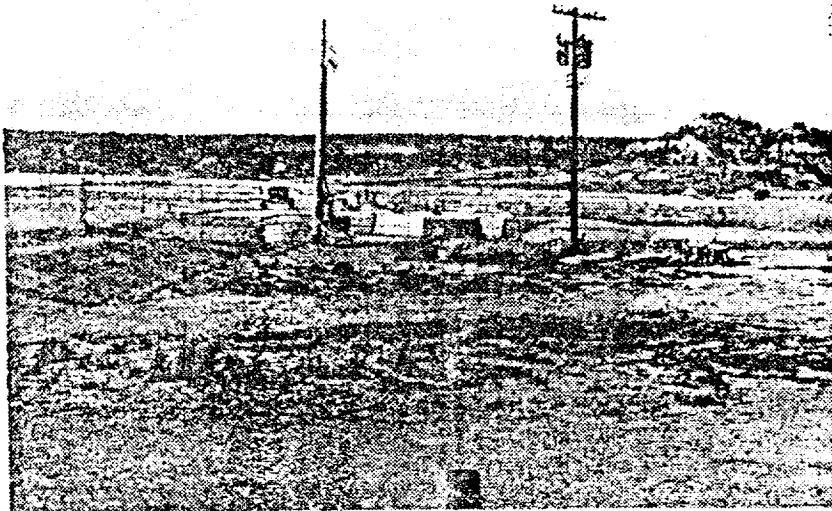


FIGURE 2. A typical Minuteman site, uncompleted, as viewed from the roadside. The transformer pole is often discernible from several miles away.

*The Survey: Planetable*

We began our field survey on the day after the helicopter flight. In the course of eight days we traveled about 1,500 miles in our rented car and made observations at more than 50 sites, concentrating on those that were farthest along in construction. We estimated that a sample of this size would be large enough to determine the error characteristic of different methods of observation and different scales of map. Small portions of the area had been mapped at 1:24,000 and perhaps a third of it at 1:62,500 (one inch to the mile), but the largest scale available for the remaining two-thirds was 1:250,000. **Our two independent methods of observation were, first, using a telescopic alidade and planetable to draw lines of position, and second, measuring bearing angles with a Brunton compass from observation points referenced by readings from the car odometer.** Two of us worked with the instruments while the third man drove the car, made odometer readings, took photographs of the sites, and kept watch for approaching cars.

The telescopic alidade is essentially a small telescope mounted on a parallel straight-edge, by which the line from observer to sighted target can be marked on a map on the planetable. We decided to make it a consistent practice to sight upon the transformer pole whether at short or long range, since other features of the site were often hidden by intervening terrain. The car was slowed down as we approached a site to give us time to select favorable observation points. These had to be identifiable on maps—preferably road intersections, stream or rail crossings of the road, or junctures between a section line and a road, but sometimes points fixed by odometer readings from such junctures. At a typical observation stop the planetable was quickly set up by the roadside, leveled, and aligned with the road so that the map on it was correctly oriented. After a careful sighting upon the transformer pole, a line of position was drawn on the map through the observation point.

At least two such lines of position were of course required, from different observation points; generally three or four were obtained for each site unless intervening terrain cut off further possibilities. The fix determined by the intersection of the lines of position was always plotted in the field before leaving a site. When there were only two such lines, odometer readings and a visual estimate of the distance from the country road to the site helped in plotting the fix.

The alidade method worked satisfactorily with maps on the plane-table at scale 1 inch to a mile or larger. The observer always found it frustrating when the best available map was at scale 1:250,000.

We took reasonable precautions to avoid suspicion. We did not refrain from making observations in front of a site just because men were at work there on the surface, but we tried to limit our time at any observation point to ten minutes, and we always waited for an approaching vehicle to pass us before getting apparatus out of the car. Local inhabitants were curious at times about what we were doing there, possibly more because of how it might affect them and their land than in suspicion of subversive activity.

#### *The Brunton Compass*

This instrument is a pocket-sized transit equipped with a compass needle and a circular scale for reading horizontal angles, that is the bearing of any object on which it is sighted. Our observations with it entailed much the same procedures as with the telescopic alidade except that the raw data—angle measurements and position determinants—taken in the field were not reduced until weeks later after our return to Washington. The Brunton was attached to a collapsible tripod and carried assembled in the car. At identifiable roadside stops it would be set up and leveled and then usually sighted successively upon the transformer pole and a remote segment of the road. The angular difference between the road and pole bearings, later laid out from the road on a map, would give a line of position for the pole. Usually more lines of position were obtained by this method than with the telescopic alidade. The Brunton was used at all stops and was particularly suited for close-in observations from points on either side of the access road. At distances greater than a mile the sighting was too uncertain to be reliable.

Although most of the Brunton measurements were thus of angle differences independent of magnetic declination, some, for instance when road bearing was equivocal, were based upon compass direction at the point of observation. The magnetic declination in the area could be read from maps, and the value applicable at any point could be obtained by interpolation. This value, moreover, was regularly checked along long straight stretches of road.

Angles were measured on the Brunton to the nearest half degree. Setting up the instrument, sighting it, and recording the angles required between five and ten minutes. Because it was most effective at close range, this method required more odometer readings than

the telescopic alidade. Odometer readings, interpolated to the nearest fifty feet, were taken at all road intersections in the vicinity of a site, at stream crossings, and at the point in the county road directly in front of a site. The odometer had been checked for accuracy between roads of known one-mile separation.

#### *Evaluation*

At stops for food and lodging in the course of the eight-day survey we ran several times into members of the Air Force's 1381st Geodetic Survey Squadron. (Not wishing to be queried regarding our activities, we refrained from conversation with them.) They were engaged in making a precise geodetic determination of missile site locations relative to the North American Datum of 1927. Geodetic control had previously been extended to the general vicinity of the sites from existing triangulation points by the U.S. Coast and Geodetic Survey. As the sites neared completion the 1381st GSS was extending the horizontal control from the nearest C&GS triangulation points to the axes of the silos.

The official determination of the geodetic coordinates of the silos was thus made by the 1381st GSS, and it was with their results that we would compare our own in order to ascertain the errors in our hasty observations. This comparison could not be made until months after our return to Washington, when we had completed our plotting of fixes for the Brunton observations and the 1381st GSS had completed its data reduction for the sites we visited.

Inherent errors in the maps contributed a substantial portion of the error in our fixing of site locations. All maps, regardless of scale, contain cartographic errors. Symbols are exaggerated to achieve legibility; the crowding of symbols in congested areas necessitates some shift from true position; and every measured distance is affected by draftsman's skill, by paper shrinkage, and by alignment of the printing registry. Cartographic error runs to about 300 feet on well-made maps at scale 1:250,000 and to 75 feet on those at 1:62,500. Of other major sources of error, we calculated inaccuracy in plotting fixes, also dependent on map scale, at about two-thirds again as large as cartographic error, 125 feet at scale 1:62,500. Observational errors probably ran another 125 feet regardless of map scale.

The deviation in the geodetic positions of the silos as determined by our survey from those determined by the 1381st GSS was as follows for areas mapped at the two principal scales (this total error is not

the sum of contributions from the various sources but the square root of the sum of their squares):

	Map Scale	
	1:62,500	1:250,000
	Error in feet	
50 percent assurance (half of all fixes within this range of error) .....	200	600
90 percent assurance (nine-tenths of all within this range) .....	365	1,100

The observational component of these ranges of error could without doubt have been considerably reduced by repeating observations many times and averaging.

The Brunton compass method gave slightly better results than the telescopic alidade. Certainly the Brunton seemed, because of its compactness, ease of operation, and easy concealment, more like the kind of instrument that a covert agent would employ.

In estimating Soviet capability to position U.S. launch sites by such methods, there are other considerations that have to be taken into account. We found that many new roads had been constructed in the area, not shown on the latest printings of U.S. topographic maps. The covert agent would have to have some knowledge of geodesy and mapmaking to assimilate such recent changes. By and large, however, a Soviet clandestine surface operation, by making repeated observations, should be able to locate the sites within approximately the magnitudes of error indicated above.

Our field trip ended without mishap. Although we thought on several occasions that our car was being followed, no one ever stopped us for questioning. The fact that the contractor still had responsibility for security in the area, with the primary concern of protecting his materials from theft, probably accounted for our being unmolested. As our plane headed eastward from Great Falls at the end of the survey, a fellow passenger, an employee on the construction project, remarked that several people down there at the sites had been shot, presumably because the local inhabitants sometimes resented intrusions on their property. This information vindicated, as the last missile site dwindled from our view, the premonitory sense of danger with which we had approached the ten-day Montana venture and left us relieved that our survey was over.