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THE WHITE HOUSE
WASHINGTON

August 26, 1960

JOE:

Attached for your records is the report of the special panel which was the basis of the briefing by Dr. Land at the NSC meeting on August 25.

George

G. B. Kistiakowsky

~~TOP SECRET~~

OFFICE OF THE SPECIAL ASSISTANT TO THE PRESIDENT FOR SCIENCE & TECHNOLOGY

REPORT OF A SPECIAL PANEL ON SATELLITE RECONNAISSANCE

August 25, 1960

The concept of an artificial satellite orbiting around the earth has been associated, from the outset, with the thought that such a vehicle could be used to maintain a continuous reconnaissance and surveillance over any desired part of the globe. The original plan was to install a kind of television camera in the satellite and to transmit its images by radio techniques to a ground station where the signals would be reassembled into a photograph. With such equipment, a systematic search was to be made of the Eurasian land mass for airfields and other military installations large enough to be detected with the limited resolving power of such a system. By repeated observations it was hoped that changes would be detected with sufficient reliability to provide warning of imminent attack.

The appeal of this fundamentally straightforward approach lies in its relative political unobtrusiveness; in the apparent power of television techniques for making observations almost instantly available; in the prolonged utilization of satellites in their orbits; and in the freedom from the logistic intricacies of recovery techniques. At first sight, this "electronic readout" appears to be the fully modern approach to reconnaissance. It has deserved, and indeed has had the most careful study. As a result, we have now arrived at a clear understanding of the technological problems which remain to be solved. The initial SAMOS development project was aimed at the electronic solution of these problems; we shall shortly discuss the difficulties.

Several years ago, it was realized that orbiting satellites might be used for the detection of ballistic missile attack in a much simpler and more direct method than television or photographic observation. While the hostile missile is being launched, its engine is a very powerful source of infrared

radiation, and this radiation can be detected, above the atmosphere, from satellites many hundred miles away. The exploitation of this early-warning scheme is going forward as Project MIDAS; it has been separated from the reconnaissance project (SAMOS) and will not be discussed further in this paper. As a consequence of this separate development, the warning function is no longer a primary requirement for SAMOS.

Meanwhile, a much more urgent reconnaissance need has been pointed out by the U. S. Intelligence Board. The overriding intelligence requirement at the present time is information on the operational status of Soviet missile launch sites. This requires photographs of very high resolution--high enough to enable a skilled photo-interpreter to recognize and identify the objects of interest in a missile launch site.

The exact resolution performance required for this purpose need not be discussed here. Its technical specification is complicated and often controversial. One must realize, for example, that a system which will resolve 20 feet on the ground will not permit a photo-interpreter to describe an object 20 feet in length.

Up to now, there has been only one source for high-resolution photographs of the Soviet missile installations, and that source has been eliminated with the grounding of the U-2 aircraft. Can we substitute a satellite as the observing vehicle and obtain comparable results? More specifically, can we look to SAMOS to yield results of the necessary quality within a short time?

Unfortunately, as far as electronic readout is concerned, the answer is NO.

The essence of the problem is that a photograph which contains the amount of detail that is required to know the state of readiness and kind of activity at a missile site must be made up of a fantastically large number of bits of information--a number so large that there is not time enough to transmit all of these bits of information from satellites to earth while the satellite is over our own or friendly territory. It is to be expected during the next ten years that the elaboration of satellite technology, the ease of keeping many satellites in orbit, and improvements in our electronic arts, will ultimately make it feasible electrically to transmit detailed information about a given point on the earth. But what we must emphasize here today is that it is not feasible now, and it is not likely to be feasible in time to give our country the kind of reconnaissance it needs at once. Therefore, while we recommend continued research on these electronic readout programs, and the occasional

orbital flights which are now planned, we must warn that we cannot rely on the electronic readout approach for military purposes and urge that higher operational priority be given to other Air Force developments which we are about to discuss.

Physical recovery, in the air or in the sea, of a satellite that has completed a number of revolutions in orbit has become feasible. The improvement of recovery techniques is going forward in the DISCOVERER project. One can therefore consider the possibility of using advanced photographic techniques which are capable of very high resolution, and of recovering the exposed photographic film on or near the surface of the earth. The subsequent processing and evaluation of the film can then be performed under the same favorable conditions that are used in the best aerial photography.

While this approach may superficially appear clumsy and pedestrian when compared with electronic readout, a detailed analysis will show its performance to be distinctly superior in providing the kind of detailed information that is required for the study of operational missile sites. In fact, we are convinced that this primary objective of satellite reconnaissance can be realized most promptly and most effectively by the physical recovery of film exposed in a high-resolution convergent stereo camera system. The principles and techniques of this kind of photography are now well understood. Therefore, if timely action is taken, we can expect to have an adequate photographic payload by the time we have mastered the techniques for recovery.

Time is short. We should acquire information on Soviet missile launch sites while they are under construction, in order to counter the deception and concealment that can be used in a completed site. It will take a year and a half at best to fill the present gap in our reconnaissance ability. And we can expect useful performance in 1962 only if we clearly establish high resolution photography as the first goal of the U. S. satellite reconnaissance program.

We are not unmindful of other objectives associated with SAMOS. Photographic surveys of broad areas, in which extensive coverage is obtained at the expense of reduced resolving power, have important uses. The detection and recording of electromagnetic transmissions by means of the proposed "F" payloads will provide valuable information, especially in areas of technical intelligence, of new aspects in communication links, in missile defense systems, in navigational aids.

But we do not consider these objectives comparable in importance to the task of getting, at the earliest possible date, high-resolution photographs that will provide information about the operational status of missile sites, with

detail nearly as good as that from the U-2. We therefore recommend a carefully planned program, with simplified management, and with primary emphasis on:

(a) High resolution stereo photography

(b) Recovery techniques

Mindful of the urgency of this need for detailed photography, the Air Force has greatly modified the initial SAMOS development plan. A number of well conceived photographic recovery systems are now under study and evaluation. These designs fall into two distinct categories:

1. A system to achieve maximum coverage with ground resolution adequate to identify missile sites under construction, and

2. A system capable of photographing a large number of selected installations with the higher resolution required for evaluation of the operational status of a missile site.

We are convinced that with straightforward good management in the utilization of components and technology now potentially available, the first of these systems could be placed in operation by late 1962; the higher resolution system becoming operational about one year later. We therefore urge a resolute concentration of effort on these two systems and a clear decision to assign to this task a higher priority than to all other aspects together of the SAMOS program.

Since we must now rely upon the physical retrieval of satellite photographs it is necessary that increased efforts be made to improve the reliability of recovery techniques. Recent achievements in the DISCOVERER program are most encouraging. An alternative procedure, unproven operationally, but most appealing in concept, involves the use of a drag brake mechanism to effect reentry. The applicability of this technique to the SAMOS recovery operation should receive serious consideration.

Until recently, the operational aspects of recovery have been greatly complicated by the obvious requirement for safety to restrict these activities to the ocean areas. As a result of our increased confidence in the precision of the recovery operation, the Air Force is now studying the feasibility of effecting recovery over land. Since this would significantly increase the

probability of success of the recovery operation, we heartily recommend the support of Air Force efforts in this area.

PROCESSING AND EVALUATION

The reconnaissance "take" of the proposed systems is recovered as a set of latent images on photographic film. The intelligence yield that will be extracted from these latent images is critically dependent on quality factors in the chemical processing of the film and in the subsequent analysis and interpretation of the finished photographs. We cannot emphasize too strongly that much of the detailed information captured in the latent image can be irretrievably lost unless first-rate work is done in the processing laboratory and in the interpretation center.

In the purely technical domain, we must point out that the achievement of optimum image-quality calls for the closest possible interaction between individuals concerned with emulsion design and manufacture and individuals concerned with processing techniques. If these two activities were to be organized as separate and independent enterprises it is most unlikely, in our view, that the results would be the best obtainable.

A full awareness of these factors led to the special organization of processing and evaluation that was used in the handling of the U-2 films. Our experience with the superior results obtained under that arrangement leads us to recommend firmly that the same pattern be followed in preparing the output of the proposed satellite reconnaissance systems. We further recommend that this output be distributed by a centralized community laboratory.

WEATHER

In aerial photo-reconnaissance operations, the state of the weather over the target has long been a primary consideration. For satellite reconnaissance operations, the sensitivity to weather is in some respects even worse. If the target is obscured by clouds on the first pass, the satellite may have later opportunities to observe the target. But the times of subsequent passes over the target are fixed by the orbit parameters, and the situation is less flexible than the scheduling of aircraft. Moreover, the weather over the great majority of Soviet targets is very bad indeed, and the opportunities for good photography are scarce.

The program outlined in this discussion can succeed only if it is closely integrated with the weather services that will be associated with the TIROS project, with the Air Force's [redacted] system, and with other sources of weather data that may come into existence. Because of the short reaction intervals that are necessary here, these arrangements will be difficult to establish, and we recommend early attention to planning.

RECOMMENDATIONS

Our analysis of the investigations already carried out by the Air Force leads us to the conclusion that from the array of important sutides a few can now be extracted and integrated into a single simple and powerful program to give us the reconnaissance we need. Therefore, our recommendation is that the following selected components of the Air Force satellite reconnaissance program be now assembled into a program of very high priority.

1. A recoverable satellite-payload for high resolution convergent stereo photography.

2. To be recovered for the time being at sea.

3. To be recovered as soon as feasible on land.

4. To carry in some of the satellites camera and film competent to identify with certainty missile sites both in construction and after completion.

5. To carry in other satellites camera and film competent to study the state of readiness, type of activity, and type of missiles.

We recommend emphasis on the development of more advanced recovery techniques, particularly for land recovery.

We recommend that electronic readout techniques be given lower priority but be continued as a research project and that the extensive program for a ground-based electronic readout system be cut back very substantially and promptly.

Also, the so-called "F" payloads for gathering electromagnetic intelligence should be given lower priority than that assigned to photography.

We further recommend that this program be managed with the directness that the Air Force has used on occasion, with great success, for projects of overriding priority. We suggest that this can best be accomplished by a direct line of command from the Secretary of the Air Force to the general officer in operational charge of the whole program, with appropriate boards of scientific advisers to both the secretarial level and to the operational level. The general officer in command would look to associated military boards for support in the execution of his plans. We recommend this extraordinary type of organization to execute the program because we are convinced that the situation presents an unusual combination of urgency and inherent amenability to a direct approach.

In addition, we recommend that the same organization as was used in the handling of the U-2 films be used for chemical processing of the recovered film and that the output be distributed by a central community facility.

We also recommend that this program be closely integrated with the weather services that will be associated with the TIROS project, with USAF's [redacted]ystem and other sources of weather data.

PANEL ON SATELLITE RECONNAISSANCE

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