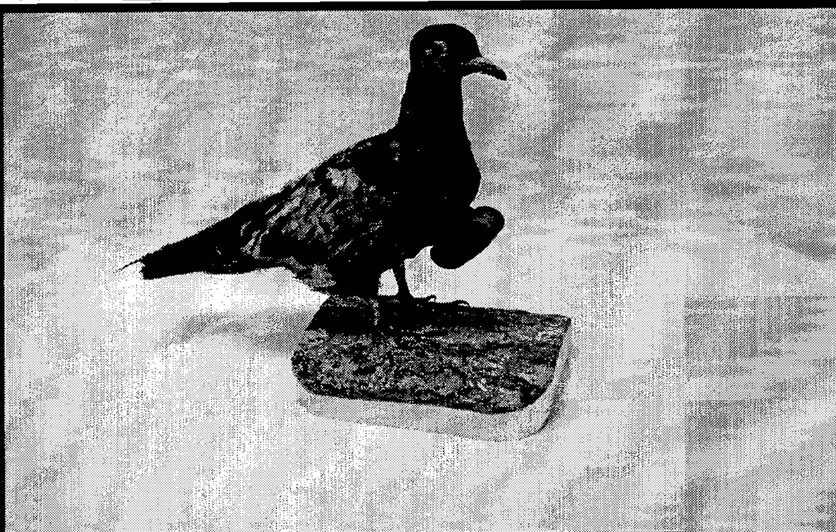
CIA MUSEUM

Pigeon Camera



Approved for Release: 2019/07/30 C01306921

SENDER WILL CHECK CLASSIFICATION TOP AND BOTTOM

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CENTRAL INTELLIGENCE AGENCY

OFFICIAL ROUTING SLIP

TO	NAME AND ADDRESS	DATE	INITIALS
1	[redacted]		
2			
3			
4			
5			
6			

	ACTION		DIRECT REPLY		PREPARE REPLY
	APPROVAL		DISPATCH		RECOMMENDATION
	COMMENT		FILE		RETURN
	CONCURRENCE		INFORMATION		SIGNATURE

Remarks:

Attached is a paper with answers keyed to the questions in your BOB paper. It is rough but I thought you wouldn't mind having it in this form. If you need anything more, [redacted] let me know before COB 3 July as I will be out from then until 24 July.

[redacted]

FOLD HERE TO RETURN TO SENDER

FROM: NAME, ADDRESS AND PHONE NO.	DATE
C/MB/SOD [redacted] Hqs	6/28/67

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FORM NO. 237 Use previous editions
2-61 (40)

SECRET

27 June 1967

1c. The operational requirement for this development program is twofold: 1) Development of a means for covert delivery and recovery of surveillance/reconnaissance equipment, and 2) development of an efficient means of delivery of [redacted]

1d. The DDP.

1e. Program progress has been satisfactory to date and it is anticipated that a limited operational capability will be in hand before the end of calendar 1967.

1f. Currently the surveillance/reconnaissance capability is of higher priority than the [redacted] capability. Both of these capabilities are desired for world-wide contingency purposes.

1g. The Agency has taken the lead in development of this type system. Obviously the capability is desired as soon as possible; however, the current timing of program development is entirely satisfactory.

2e. The estimated operational date for a limited capability is prior to the end of calendar 1967.

2f. The program is phased to initially provide a limited animal capability. Continued development is expected to increase the level of this capability.

2g. Demonstration of the initial limited capability is scheduled during August 1967. Timing for the higher levels of capability is not now firm.

2i. A subsystem of the program which has use in other RD&E programs is [redacted] hardware development.

2k. Future program integration is expected to be similar to that in the past as the program in its entirety is oriented toward the development of a true operational capability; not RD&E for the sake of RD&E.

2l. Obviously there are countermeasures which may be taken against both the surveillance/reconnaissance [redacted] phases of this system. Such countermeasures might include (but not necessarily limited to) sonar detection of the presence of the animals, explosive interference with the performance of their mission and undoubtedly others. The point here though, is that there is no existing reliable system to accomplish the aforementioned missions. This animal system appears to offer considerably more ~~than~~ reliability than any of the existing systems.

GROUP 1
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downgrading and
declassification

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3a. In accomplishing the surveillance/reconnaissance mission submarines, aircraft and swimmers can all play a part. A [redacted] might include a surface or submarine vessel (or possibly an aircraft) and swimmers. Again it should be noted that reliability of a swimmer system is relatively low.

3b. Other collection means are not being rejected. However, they are in need of improvement.

3c. Not applicable.

3d. There are no parallel backup or redundant animal programs.

3e. Reduction of funding can be expected to result in delay in successful attainment of each level of capability.

4a. There are no specific targets programmed for the animal capability at this time. However, the boat in use in the RD&E program does have operational usefulness should it be desired and the potential user is now familiarizing personnel in the capabilities of this program.

4b. As currently envisioned an operational program, as it is expected to be demonstrated in August, would cost in the neighborhood of $200,000 a year to maintain. This would include personnel salaries, equipment expenses, training, a prorated share of the costs of the Key West operational base.

4c. There are risks in an operational program of this nature such as animal health problems and less than 100% system reliability. It is felt, however, that these risks are far less than those inherent in any man-swimmer program.

4d. These animals are found in nearly all the oceans and seas. Hence, there are no geographic limitations other than those which would also limit swimmer operations.

4e. Operational limitations are far fewer than those in a swimmer system. On the other hand, policy considerations ~~are~~ will play~~ing~~ a major role in operational activity.

4f. Security problems of an animal system will be far fewer than those of existing swimmer systems.

4g. [redacted]

4h. Processing will depend on the nature of the information collected.

4i. Any analytical requirements again will depend on the type of information collected.

4j. The animal system cannot be necessarily looked at as replacing existing collection programs. In many cases collection through the use of animals cannot be satisfactorily accomplished through other means. On the other hand, there is no intention to create unnecessary redundant capabilities. Therefore, all existing systems will have to be reevaluated as the animal system proves satisfactory.

5a. Coordination between the RD&E programmers and the eventual operators has been complete in every detail. The eventual operators are providing material and operational assistance in all aspects of the program.

5c. Coordination with intelligence producers has been accomplished throughout the RD&E aspects of this program.

5d. The coordinating mechanism within the DDP has been the Maritime Branch of SOD. Coordination within the DDS&T has been accomplished in-house.

6a. Program evaluation in the past has been a dual function of the RD&E programmers of the DDS&T and of MB/SOD of the DDP. This evaluation on the part of MB/SOD has been to assist the program in the context of a swimmer program.

6b. Future evaluation will continue as in the past.

3.3(h)(2)

3 August 1976

GENERAL

1. Work on this project has, to date, demonstrated the following:

A. Birds are capable of being trained to perform an operational useful task carrying an adequate payload.

B. Training can insert a specified "detour" leg into the birds' usual homing behavior.

C. The ability to translate the above behavior from a training location to a distant operational target area seems likely.

Therefore, the work proposed here is directed at increasing our understanding of the processes and best methods involved in A and B above. We further propose to devise methods, test, and if possible, demonstrate the behavior described in C, above.

CONDITIONS OF TRAINING

1. The prime condition of training will be that, once a training cycle (see below) has started, the sequence and methods will remain as constant as field conditions permit. The decision to change sequence or methods may be made between training cycles upon the mutual agreement

of Contractor and Sponsor's representative if results call for such changes. This condition is made not to restrict the freedom of methodological choice, but to ensure that data obtained during a given cycle of training will not be clouded by contaminating variations in procedures.

2. Data will be kept in written, systematic form on each bird and each training session and test. The actual data to be so recorded will be determined by mutual agreement of Contractor and Sponsor's representative but will include, as a minimum, that specified in the work statement. All data so gathered will be provided to Sponsor at the completion of the project and is made a deliverable item.

3. Insofar as conditions permit, clandestinity will be observed in all operations conducted in public view. it is, of course, impossible to meet this requirement in many of the training operations which will not take place in the actual clandestine operational mission but as a minimum, all training operations which have counterparts in the actual mission will be conducted under conditions of clandestinity.

4. Movement of the birds from the training base to the simulated operational sites (see below) will be by means of whatever [redacted] mechanisms are decided upon. Details of site selection of these simulated operational sites will be at the mutual agreement of Contractor

and Sponsor's representative. It is understood that these sites will be progressively farther removed from the training base site; the last such site being in the Washington, D.C. area.

5. A large pool (approximately 100) birds will form the initial population from which trained birds will be drawn. These birds will first be given an "aptitude" test for search-and-find behavior. Those which do particularly well will be assigned to training as "specialist" birds whose function is to lead in finding the target (see below). Other birds will be trained to carry a payload through the full mission sequence. At any stage of training, as individual birds show behavior which is inappropriate or detrimental such birds will be eliminated from the training. Through this process of retention of only the best field performers it is expected that the final pool of trained birds will be composed of about eight in each of the two categories to be described below. The best of these will be selected for performance in the last cycle which simulates, in the Washington, D.C. area, the full operational mission.

6. In all training flights the full-mission birds will always carry a simulated payload package whose weight and configuration will be that of the real payload. The "specialist" birds will not be so burdened since they will not be required to perform payload-carrying duty in the operational mission.

TRAINING PROTOCOL

BEHAVIORAL ANALYSIS

1. The task to be performed by the birds is, from the behavioral standpoint, composed of two essentially different kinds of acts. The first part of the sequence consists of a kind of search-and-find behavior over the relatively short distance of two miles. No burden is placed on the birds' homing abilities by this task since the target location is novel for both training trials and the operational mission. The common factors for all training trials and the operational mission are to be found in the shape of the target and its bearing from the release point. If the release point is designated "A" and the target is designated "B" this first part of the total behavior to be trained can be referred to as the "A-B" portion.

2. The second portion of the total task calls heavily upon the birds' homing abilities. Having found the target they must then abandon their search-and-find behavior and, using their homing skills, fly approximately thirty miles in a designated direction to the location at which they will be retrieved. If the final retrieval location is designated as "C", the second part of the sequence can be designated as the "B-C" portion.

OVERVIEW OF TRAINING PROTOCOL

1. The protocol described in detail below contains the following essential elements:

A. The training of two kinds of birds:

(1) "Specialist" birds that will be intensively trained solely in A-B behavior.

(2) "Full Mission" birds that will be trained in both A-B and B-C behavior.

B. The systematic movement of performance testing sites from one geographical location to another will be incorporated into the training procedures. The final operational mission would then be just one more repetition of the behaviors they have been doing all along. This will improve reliability and provide a basis for ~~quantitating~~ quantitatively predicting the probability of success for a given mission.

TRAINING OF "SPECIALIST" OR A-B BIRDS

1. The "Specialist" or A-B birds will be used in both training and the operational mission to increase the reliability of the A-B portion of the mission. These birds will be allowed out of the loft only to practice search-and-find behavior on a fixed bearing. They will receive food only at the target, whose location will be changed for each trial. Their sole experience in free flight will be

restricted to exhibiting A-B behavior; thus the designation "Specialists". In training, they will be retrieved at either the target or back at the release point, "A", to which, (it has been found) they will often return. In the operational mission the specialist birds will not carry payloads and thus are expendable after having performed their function of acting as leaders of the search-and-find portion of the mission. They are also used in helping to train A-B-C birds as indicated below.

<u>TRAINING OF FULL-MISSION (A-B-C) BIRDS</u>

1. The operational requirement for the A-B-C birds is that, they are to be transported to an actual target location to perform their mission in a setting with which they have only limited familiarity. The training protocol is designed to replicate the combined training and mission profile sequence several times over. This procedure has the double advantage of preparing the birds to perform in an operational setting and also allows us to obtain the statistics with which to make an estimate of the expected reliability with which the mission will be performed.

2. Several sites will be used. One, the base site, will be the main training site. Other sites, which can be at any location logistically permissable, will comprise a series of simulated operational sites to which the birds will be sequentially transferred for testing of the operational behavior. In the actual operational scenario the

true operational site would (to the birds) be merely one more of the same kind of training experiences they have become accustomed to. This sequential training protocol permits the replication of the "training/mission sequence" through as many cycles as time and resources permit. Detailed performance records will be kept so that improvement can be measured quantitatively. Reliability can then be predicted for any "next cycle" including the operational one.

3. Appendix I shows graphically the sequence of events to which the birds will be subjected. Note that the "specialist" birds will be introduced and removed to reinforce A-B behavior at appropriate points in the cycle. At all other times, the A-B birds' training continues uninterrupted.

4. A mobile loft (possibly a trailer) will be outfitted to serve as a portable "home", although several buildings may prove better. the distance from release to both the base site and the mobile sites will be identical to that to be used at the real operational location while all other aspects except an air conditioner entry port will be changed as much as possible to accustom the birds to change in all other aspects of the simulated "C" location.

RATE OF TRAINING

1. In animal training the time involved generally takes a subservient role to the number of training trials administered. The more complex the behavior and the higher the required level of experience, the more trials are necessary to achieve success. This principle is as true in human as in animal learnings; it takes more practice to play Tchaikowski's "4th Piano Concerto" than "Chopsticks". In general, simple behaviors can be learned by animals such as the pigeon in about 25 trials if conditions are as optimal as one finds in a laboratory. In the field where many factors cannot be controlled this number should be at least doubled.

2. If one extrapolates to the operational setting and tasks involved here, it is probably reasonable to assume AB behavior can be trained in some pigeons to a criterion of twenty consecutive perfect trials in about fifty sessions. BC behavior can probably be trained in about fifty trials and combined AB-BC behavior in about thirty additional trials. This is equivalent to a total of eighty trials since AB and BC training goes on simultaneously. Assuming 3.5 trials per bird per week, this means the training program takes about 23 weeks or approximately six months. Losses of birds or personnel could easily extend this to nine months. It should be both apparent and understood that this time requirement

is a system constraint imposed by the limits of the biological organism chosen: the pigeon. Human desires or demands will not be influential in reducing it.

WORK STATEMENT

1. Acquire and train according to the methods and procedures described herein, at least fifteen package-qualified birds to exhibit the behavior described below. Performance of the birds is to be at the highest level possible under the constraints of available time and resources.

Behavior To Be Exhibited: Birds will, upon release fly to a designated location at least two miles distant on a bearing to be designated prior to initiation of training (A to B). Birds will then continue, flying at least thirty miles on another designated bearing to a retrieval location, (B to C).

Conditions For Behavior:

(1) The bearings of the A to B and B to C legs of the flight path are to form an acute angle not to exceed ___ degrees.

(2) The birds will not have had more than ___ days of experience with the location of the final (test) retrieval location. This experience may include not more than ___ homing practice flights under simulated clandestine conditions.

(3) Full-mission birds are to perform the ABC behavior carying ___ gm. payloads.

2. Conduct a final test and demonstration of the behavior described above in the Washington, D.C. area under conditions to be specified prior to initiation of training.

3. Supply to Sponsor documentation including:

A. Training procedures.

B. Data on reliability of performance.

C. Environmental conditions for all training/test sessions.

D. Times of flight for each bird on each leg for all training/test flights and description of their departure/arrival behavior..

E. Weights and deprivation level for each bird for each training/test flight.

4. Maintain surveillance and search, as appropriate, for the bird and package lost during the last demonstration of the project phase now completed.

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ORD 1228-76

4 JUN 1976

MEMORANDUM FOR: Chairman, TACANA/TCT

SUBJECT : 25 June 1976 TACANA Test Demonstration

REFERENCE : DDO/SED Memo 7 May 1976, Title SE Comments on TACANA and OTS/SDB Memo 154-76 TACANA Program.

1. In response to OTS/SDB memo 154-76 issued by the TACANA/TCT Chairman, the TACANA program test to be completed on 25 June will exercise the following Avian capabilities:

a. Clandestine acclimatization.

b. A-B-C flight behavior with search from A to B and clandestine release at A.

Two other program tasks will be accomplished subsequent to the test to be completed on 25 June. These tasks involve investigating several retention times for the A-B-C behavior and the impact of a major location change (2500 miles) on operational behavior.

2. The procedures listed below will be followed in preparation for the 25 June test.

a. Present Avian training of A-B-C flight behavior, including clandestine release at A and search behavior at A for B, will continue. The training will include clandestine release at point A, which will be located two to three miles from target B, search-oriented flight to target B (in a direction that is opposite from the return flight to the home loft) landing on the target and obtaining pictures of the target and the target area, and, finally, returning 50 miles to the home loft located in [redacted] Oklahoma.

b. On approximately 28 May 1976, a collateral effort will be undertaken in [redacted] Oklahoma, to determine if the Avian assets can be acclimatized to a new geographical location on a clandestine basis. To accomplish this task,

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approximately ten additional birds will be moved from the [redacted] California to the Oklahoma training area via airfreight. These birds will be based in a simulated second-story loft and their only view of the outside world will be provided through screens mounted in the housing of an air conditioner. These birds will be acclimatized in the field. These procedures will include exercise releases and return to the home loft through the air conditioner until homing training is started. During homing training, the initial release distance will be at least one mile. However, at least one or two birds will be taken from the home loft after acclimatization and transported to a distance of 50 miles for their first release. Even though the birds are not expected to be able to perform such a task, it will be important to demonstrate the extent to which such an initial homing release is feasible.

3. The results of the acclimatization procedures and the operational A-B-C behavior (including Avian camera photographs of the target area) will be demonstrated 25 June 1976. This demonstration will be arranged to enable the NIO/SA and any other designated visitors to observe the test from the various A-B-C positions.

4. On the assumption that the 25 June test will be successful, a new training/test site will be prepared for the birds by the end of June (possibly [redacted] California). [redacted] and the COTR will travel to [redacted] to make a final determination of the [redacted] area interim test site. The birds will be transported to this new test site "black," acclimatized and trained to "home" by clandestine means, and tested on A-B-C behavior against a simulated target. Upon satifactory performance of this task, a short period of reinforced target training will be accomplished to strengthen the "flight-to-target" behavior prior to moving the birds to Washington, DC. The move to Washington will be completed during the first week of August.

5. We agree that the test procedure described in the TCT Chairman's memorandum can possibly provide a number of preliminary answers to questions regarding the retention time of the target search behavior. Therefore, the following test schedule will be adopted for activities following arrival in Washington, DC.

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Activities		Weeks	Cumulative Time Weeks
a.	Clandestine acclimatization	4	4
b.	A-B-C flight test Kit #1	1	5
c.	General bird maintenance	2	7
d.	Flight test Kit #2	1	8
e.	General bird maintenance	2	10
f.	Flight test Kit #3	1	11

Completion of the Washington full-scale test in this manner should enable us to develop some preliminary information on the impact that varying time lapse between training and performance can have on performance of the A-B-C task.

Donald Reiser
Acting Director of Research and Development

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3.3(h)(2)
3.5(c)

WORKING PAPER

A PROGRAM FOR PROVIDING HIGH-RESOLUTION OBLIQUE PHOTOGRAPHY OVER DENIED AREAS

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ABSTRACT

The Office of Research and Development with support from the Office of Technical Service and the National Photographic Interpretation Center has demonstrated the ability of homing pigeons to carry a small 16mm camera capable of obtaining high-resolution photography from over-flights. Furthermore, homing pigeons have successfully been taught to relocate to a new home. It is, therefore, feasible to relocate homing pigeons [redacted] for subsequent use to obtain timely photography of denied areas. The effort described here provides a program for the selection of birds, performance documentation, user training and involvement, and the demonstration of a simulated mission in the Washington, D.C., area in April of 1977.

PROGRAM OUTLINE

It is well known that homing pigeons will fly many hundreds of miles, often under adverse weather conditions, to return to their home lofts. Recent research by ORD has demonstrated the homing pigeon's ability to carry a sophisticated 16mm camera capable of taking high-resolution oblique photography. The purpose of the effort described here is to provide a scientific program for:

a. Selection of high-quality pigeons;

b. Training and documentation;

c. Testing of performance and flight path prediction accuracy;

d. Involvement and training of potential user;

e. Simulated missions in the Washington, D.C., area.

As seen in Figure 1, suppliers will provide birds to be sent to the OTS facility [redacted] These will be high-quality birds selected for homing and weight-carrying ability. [redacted] extensive training and flight path accuracy tests will be conducted with user involvement and evaluation. Selected birds will then be [redacted] by the user to Washington, D.C., to undergo simulated mission tests prior to being taken to operational sites. It is also seen in Figure 1 that a test at Anchorage, Alaska, is planned in order to measure changes in performance that may occur in transport to extreme northern latitudes (i.e., the Soviet Union).

As seen in Figure 2, there are three basic suppliers with controlled lofts in [redacted] The suppliers will obtain birds from various locations from Florida to Alaska, and some relocation testing will be conducted by trading birds between the controlled lofts prior to shipment [redacted] Figure 3 shows the scale of miles [redacted] Overflight accuracy tests will be conducted using small DF transmitters on the birds and DF receivers located at various points along the flight path home. A light aircraft will also be fitted with a DF

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Figure 1: Program Outline

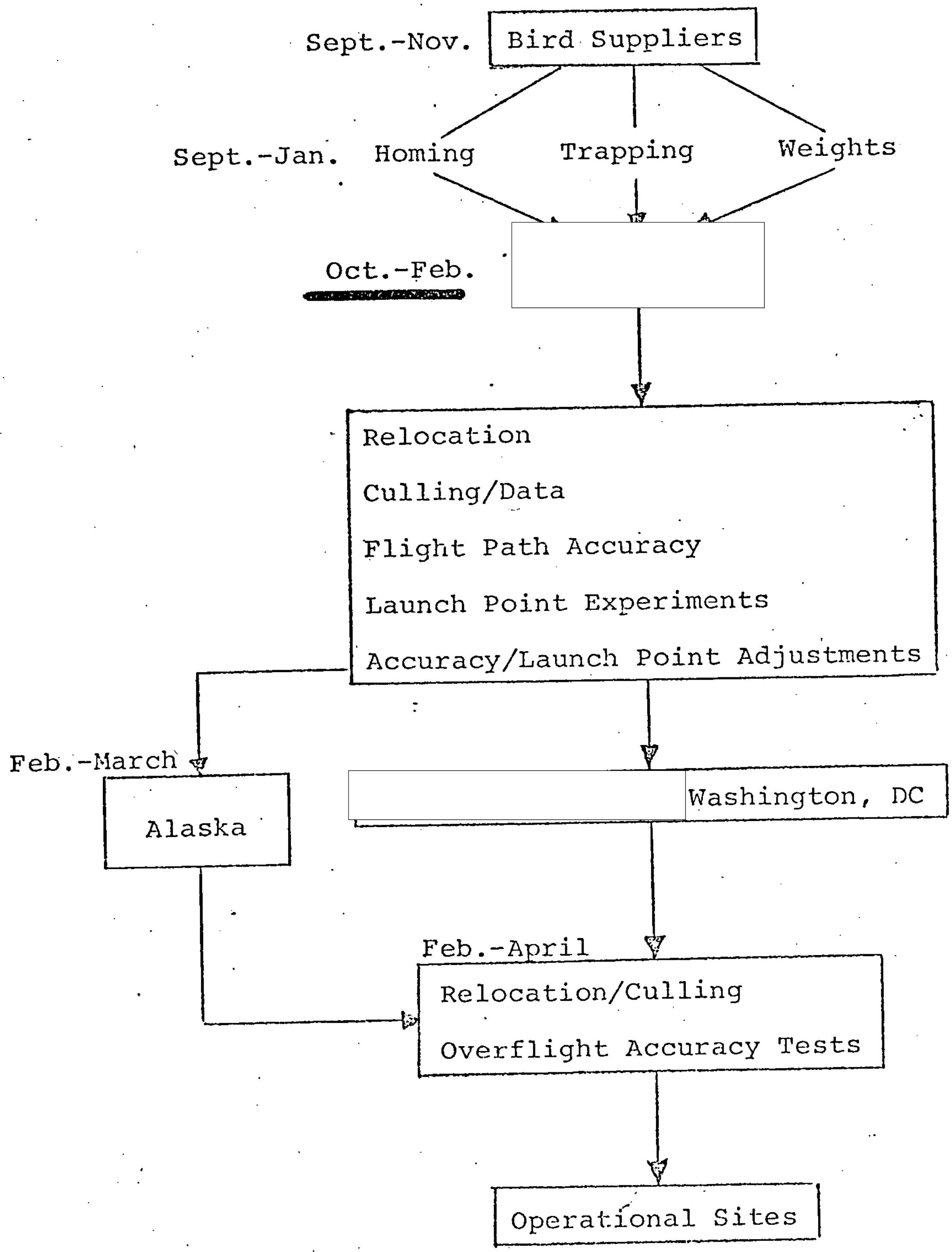

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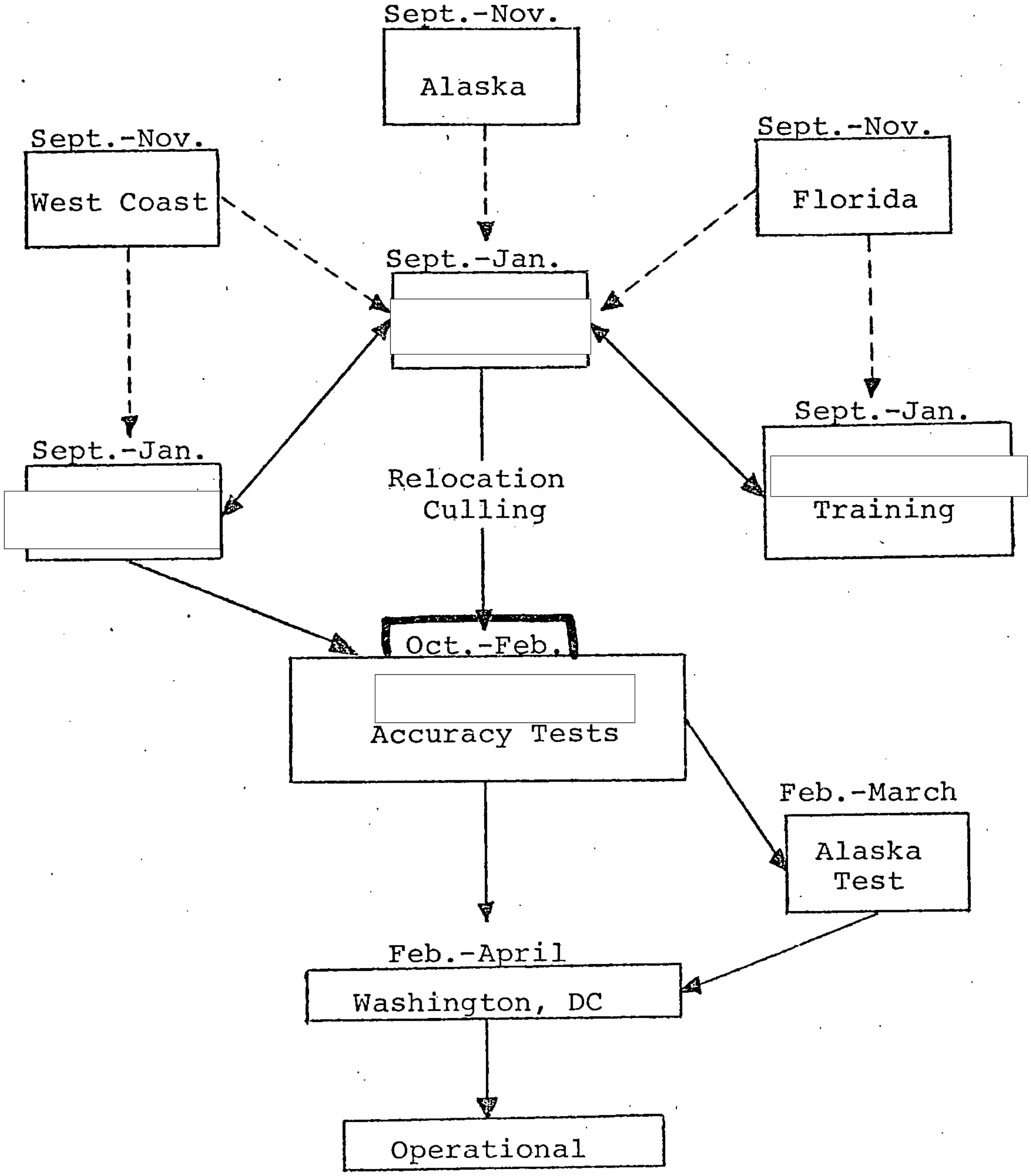
Figure 2: Suppliers



*Controlled Lofts

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receiver to assist in flight path measurements. Bird-carried cameras will also be used to establish flight paths in some cases. Figure 4 shows the loft location [redacted] A command post on top of the lab tower will provide communication for coordinating the field tests.

Table 1 shows the expected transitional quarter costs ($108,000), and Table 2 shows the expected costs for FY-77 as $135,000 of which $70,000 is for ORD and $65,000 is for OTS. Neither office has currently budgeted for these FY-77 costs.

OTS SUPPORT

During the T.Q. two basic activities will take place: A pigeon loft and facilities will be constructed [redacted] ($3,000)$5000; and basic training for handlers will take place in [redacted] For FY-77, the first birds will arrive [redacted] in early October and will continue to arrive through February 1977. [redacted] will provide feeding and exercising of the birds twice daily on a seven-day-a-week basis plus homing flight training at least three times a week. Complete records will also be kept. It is felt that the number of birds at any one time could be as large as 100, and that two full-time handlers will be required to perform this service ~~and to~~ assist in flight path accuracy tests to measure performance. The [redacted] FY-77 costs, including the salary for two hired handlers, is estimated at $25,000.

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TABLE]

ORD T.Q. CONTRACT COSTS

CONTRACTOR	ITEM COST $	SUB TOTAL	RUNNING TOTAL
[redacted]			
Materials & Supplies (Bird Lofts/Training)	500		
Purchase of Birds	3,000		
Aircraft Rental $15/hr (100 hrs.)	1,500		
Labor	3,000		
Travel	2,000	10,000	10,000
[redacted]			
5 Cameras at $2,000 each	10,000		
Purchase of Birds	3,000		
Labor and Repair	7,000		
Travel and Field Support	5,000	25,000	35,000
[redacted]			
4 DF Receivers at $825 each	3,300		
Eight 1-gr. Transmitters at $50 each	400		
Three 6-gr. Transmitters at $65 each	200		
Commo Equipment for Field Tests	3,000		
Refit of Aircraft	1,600		
Labor	4,500		
Travel	3,000	16,000	51,000

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TABLE 1 (CONTINUED)

ORD T.Q. CONTRACT COSTS

CONTRACTOR	ITEM COST $	SUB TOTAL	RUNNING TOTAL
[redacted]			
Drawings & Doc. (New Camera)	4,000		
Purchase Birds [redacted] & West Coast)	4,000		
Labor	7,000		
Travel	5,000	20,000	71,000
[redacted]			
QRC Support	4,000	4,000	4,000
[redacted]			
Building Supplies	2,300		
Labor	700	3,000	78,000
[redacted]			
Specialized Relocation Training		30,000	108,000

already committed need not be restated.

[redacted] owl

KH-8 Targets on [redacted] basel.

[redacted] to sign reports ASAP.

Tuesday

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TABLE 2 A

ORD FY-77 CONTRACT COSTS

CONTRACTOR	ITEM COST $	SUB TOTAL	RUNNING TOTAL
[redacted]			
Building Supplies	500		
Feed	500		
Two Bird Handlers	21,000		
Transport, Shipping, Misc.	1,000		
Labor	1,000		
Boat Rental	1,000	25,000	25,000
[redacted]			
QRC Support	38,000	38,000	63,000
ELMENDORF AFB (ALASKA)			
Building Supplies	1,000		
Labor	4,000		
Gen. Support	2,000	7,000	70,000

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TABLE 2 B

OTS FY-77 ESTIMATED COSTS

CONTRACTOR	ITEM COST $	SUB TOTAL	RUNNING TOTAL
[redacted] – 10 + 20? Two stage effort ??			
30 Cameras ($2,000 each)	60,000	60,000	60,000
Construction of Lofts and D.C. Test Support	5,000	5,000	65,000
TOTAL FY-77 COSTS			$ 135,000

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Four OTS personnel, capable of conducting operational missions, will be given preliminary training [redacted] (about one week) and participate in (or direct) at least three or four simulated mission tests [redacted] These personnel will also require training in handling and loading of the camera equipment. Five prototype cameras will be provided by ORD for design verification and initial tests [redacted] OTS should provide a total of 30 cameras (at an estimated cost of $60,000) to support the majority of tests at [redacted] Washington, D.C., and the ~~first operational mission~~.

OTS will assess the operational quality of tests at [redacted] and provide [redacted] to the Washington, D.C., area. OTS will be responsible for conducting all tests in the Washington, D.C., area as well as the handling of birds and the maintenance of cameras. ORD will provide assistance, consultation, and analysis during the entire program. OTS may participate in (or direct) the test at Elmendorf AFB in Anchorage, Alaska, to verify performance at extreme northern latitudes.

Two OTS officers now at [redacted] and [redacted] have been identified as having previous experience in handling birds.

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PROGRAM MANAGEMENT

During the previous feasibility stage of this program, the voluntary involvement of NPIC provided technical evaluation and experimental direction which considerably improved the photographic product. It is strongly felt that this final phase of development will require the involvement of OSI, OWI, and SE as well as that of OTS, ORD, and NPIC in order to ensure a product of maximum intelligence value. It is recommended that the Technical Collection Team (TCT TACANA) be continued, and include [redacted] (NPIC), to properly advise and assess the efforts of the program manager (Dr. Charles Adkins) and the OTS team member during the course of this program. Figure 5 shows the recommended program management structure.

As a matter of policy, humane disposition of all culled birds will be observed at each of the controlled lofts. However, [redacted] for the bird loft [redacted] and the use of birds in the tests at Elmendorf AFB in Anchorage, Alaska. It is expected that some assistance will be required for the initial contact, [redacted] and arrangements with Elmendorf AFB.

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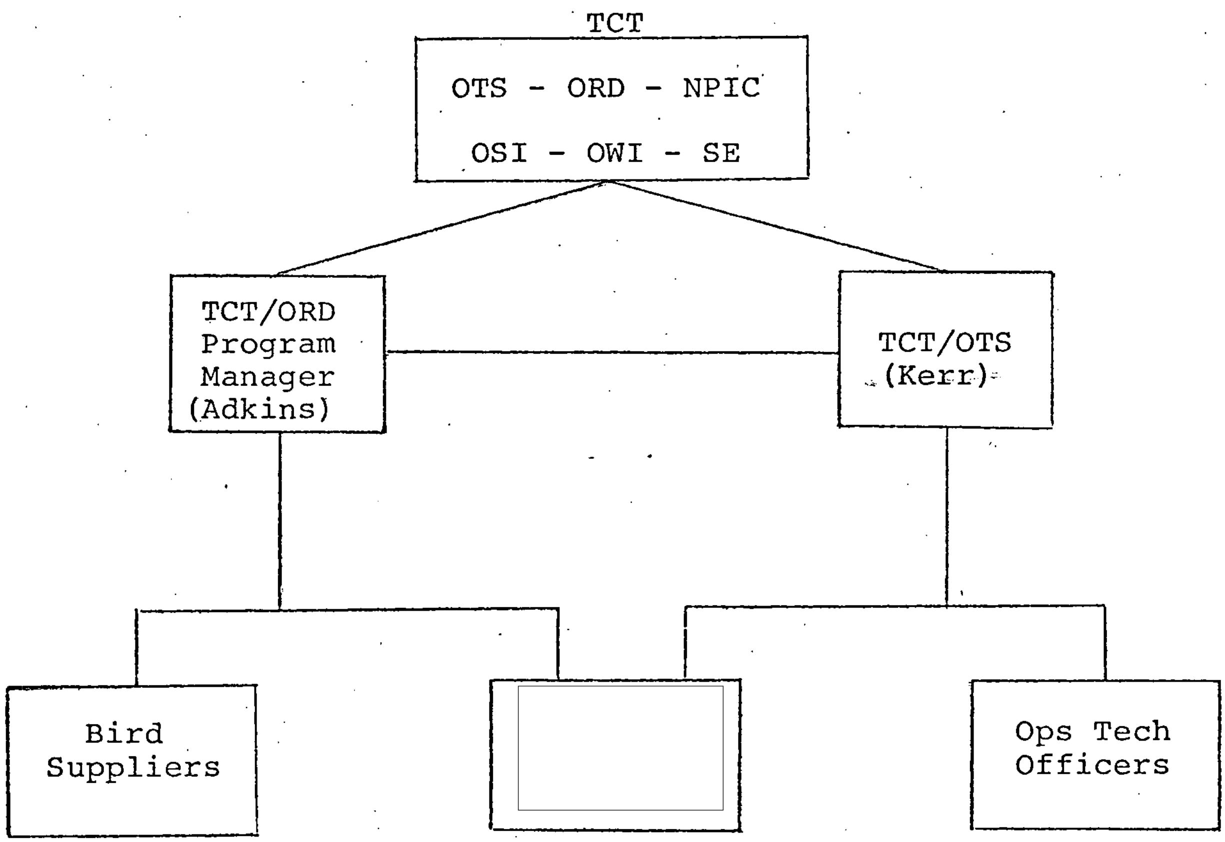
Figure 5: Program Management Structure



OSR SUPPORT

A computer search was performed by the personnel office to locate Agency employees familiar with homing pigeons. A [redacted] was found who works in the publications Branch of OSR. His supervisor is [redacted] Chief, Publications Staff. [redacted] was interviewed, with [redacted]s permission, and was found to be quite knowledgeable in the raising and training of homing pigeons. A summary of his experience is enclosed. [redacted] was quite enthusiastic about participating in the program on a full-time basis. I suggest that Mr. Noel E. Firth, Director, OSR, be approached to consider the temporary reassignment of [redacted] to this program for the period of one year. [redacted] could be responsible for the loft designs, the training of bird handlers and operational personnel, and could supervise the selection and training of birds. [redacted] contribution to this program will be invaluable.

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WORKING PAPER

A PROGRAM FOR PROVIDING
HIGH-RESOLUTION OBLIQUE PHOTOGRAPHY
OVER DENIED AREA

September 7, 1976

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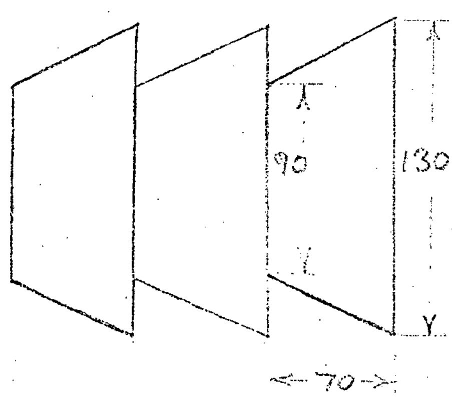
1. This system offers several unique photographic capabilities. High resolution of about one inch, combined with short range oblique target coverage, provide excellent target interpretability. Mensuration can be accomplished to an accuracy less than ~~one~~ two-tenths of an inch given a large object of known dimensions (from KH-8) in the field of view. [redacted] The TACANA system can be clandestinely employed at times when there are no US photo satellites overhead; moreover, the system can be used at a time which optimizes lighting conditions for a particular target. The system is not susceptible to usual cloud cover conditions and can operate well under the low light/low sun angle conditions encountered at typical high latitude Soviet targets.

2. The attached figures illustrate the TACANA systems photo capability in terms of target coverage and resolution relative to existing satellite systems. TACANA's two and one-half mile strip of photography consists of at least 200 contiguous or overlapping frames each measuring about 70 feet in track and 90 to 130 feet cross track as shown below:



AVIAN PROGRAM BACKGROUND INFORMATION

For several years, the Office of Research and Development has carried out various endeavors to attempt to train diferent species of birds in the task of carrying out intelligence collection for support missions. The work and types of birds employed were diverse and ranged from attempts to train hawks to fly to specifically recognizable targets over flight paths encompassing dozens of miles to the training of ravens to deliver small packages. A clandestine operation was carried out some time in the past in Europe in which an audio eavesdropping device was delivered by a bird to a designated outside window sill. This operation was not successful because the audio device would not pick up a conversation from the desired target. The bird delivery portion of the project was successful. From this background research endeavor it has been learned that the homing pigeon is the best avaian species to work with.

Within the past year, the program efforts have involved experiments with homing pigeons to determine if they could be trained to overfly to an otherwise inaccessible target location after release. An important factor in this training was the requirement for the target location to be away from the normal homing flight path so that the pigeon would purposely have to locate the target area and fly over it prior to taking a course to its home loft. Special light-weight cameras were successfully developed which permitted the obtainment of excellent high resolution photography (1" to 2" resolution). While the feasibility of this type of targeting and the utilization of homing pigeons for this intelligence collection application (designated as A-B-C flight) was established, certain problems in its utilization became evident. Specifically, it was determined that the length of training required to make the homing pigeons perform in flying from their release point A to their target B, prior to heading to home C, was excessive, making it operationally unattractive. Secondly, the reliability of the birds carrying out the A-B-C mission upon release was rather low, perhaps in the 25% region.

It was determined, after investigation by analysts, that a number of cases exist in which direct overflight for a homing pigeon in an A-C mission, that is, released from point A and fly directly home, would result in a high probability of overflight over an important target area from which valuable high resolution photography would have a significant impact. The feasibility and performance of the lightweight bird cameras having been established, when coupled with the natural homing instinct of select and trained homing pigeions will result in a capability to carry out missions of the A-C type with high probability of success.

The balance of this paper addresses the program direction, manpower, and costs that would be required to bring the program to a level of demonstrable operational capability by the Spring of 1977. The effort to reach this desired state of capability would involve participation of ORD, OTS, NPIC, OWI, OSI, and other Agency support complements. A funding level of $105,000 will be required to bring the program to the proposed Washington demonstration in the Spring of 1977.

PROGRAM OUTLINE

It is well known that homing pigeons will fly many hundreds of miles, often under adverse weather conditions, to return to their home lofts. Recent research by ORD has demonstrated the homing pigeon's ability to carry a sophisticated 16mm camera capable of taking high-resolution oblique photography. The purpose of the effort described here is to provide a scientific program for:

a. Selection of high-quality pigeons;

b. Training and documentation;

c. Testing of performance and flight path prediction accuracy;

d. Involvement and training of potential user;

e. Simulated missions in the Washington, D.C., area.

As seen in Figure 1, suppliers will provide birds to [redacted] These will be high-quality birds selected for homing, trapping and weight-carrying ability. At [redacted] extensive training and flight path accuracy tests will be conducted with user involvement and evaluation. Selected birds will then be [redacted] by the user to Washington, D.C., to undergo simulated mission tests prior to being taken to operational sites. It is also seen in Figure 1 that a test at Anchorage, Alaska, is planned in order to measure performance at extreme northern latitudes.

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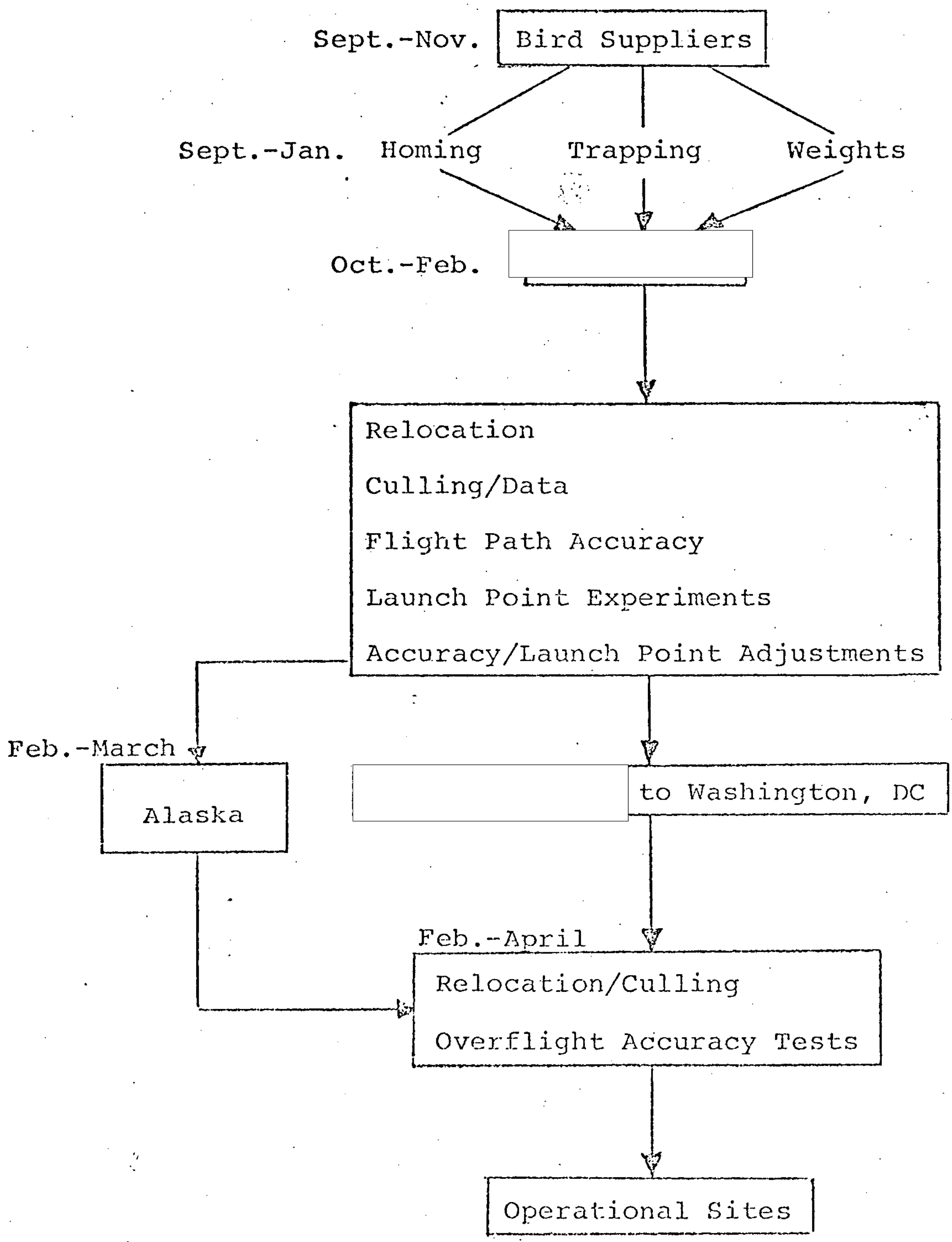
Figure 1: Program Outline



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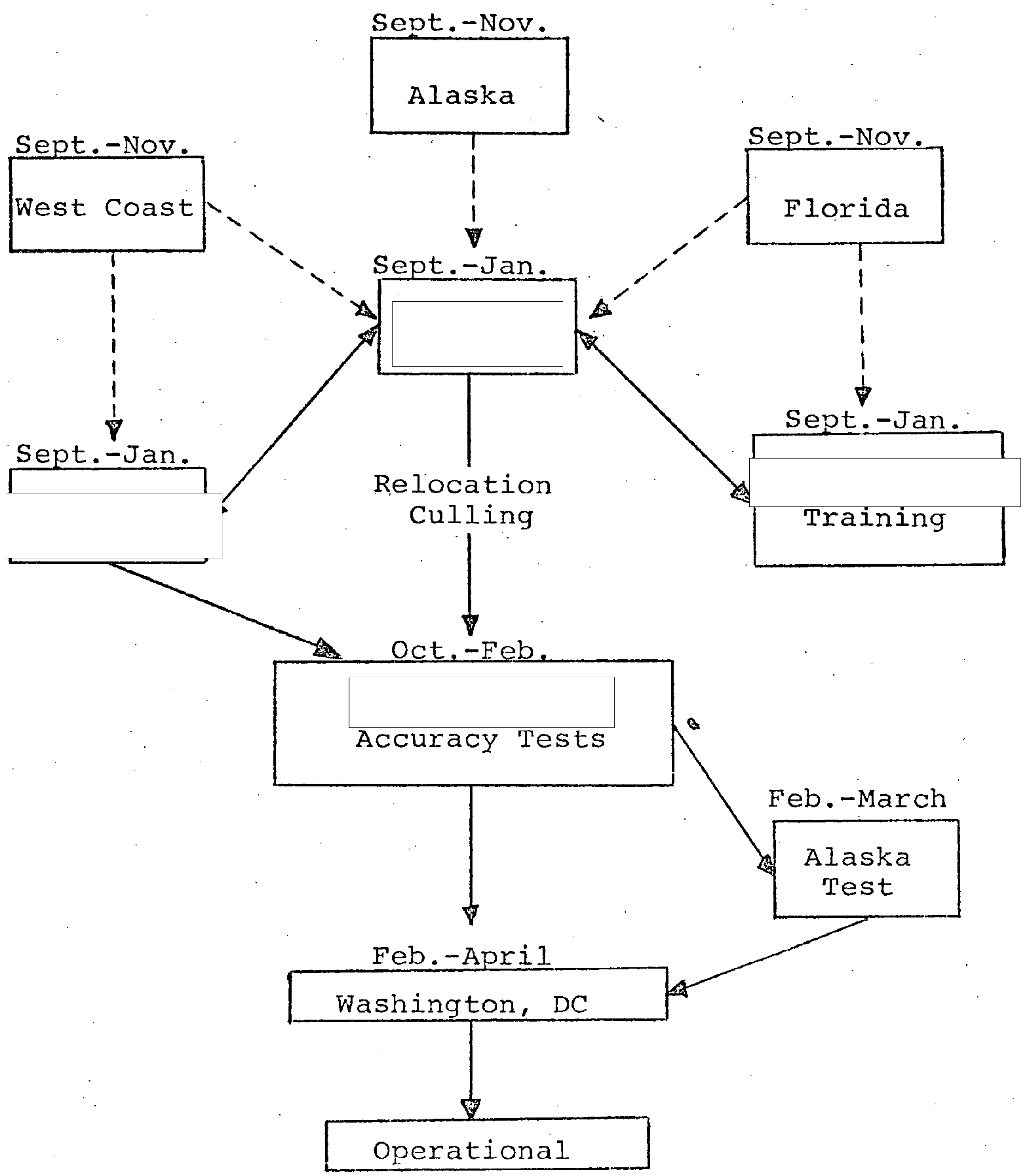
As seen in Figure 2, there are three basic suppliers with controlled lofts [redacted] The suppliers will obtain birds from various locations from Florida to Alaska, and some relocation testing will be conducted by trading birds between the controlled lofts prior to shipment to [redacted] Figure 3 shows the scale of miles around [redacted] Overflight accuracy tests will be conducted using small DF transmitters on the birds and DF receivers located at various points along the flight path home. A light aircraft will also be fitted with a DF receiver to assist in flight path measurements. Bird-carried cameras will also be used to establish flight paths in some cases. Figure 4 shows the loft location at [redacted] A command post on top of the lab tower will provide communication for coordinating the field tests.

Table 1 shows the expected transitional quarter costs ($78,000), and Table 2 shows the expected costs for FY-77 as ($105,000) of which $70,000 is for ORD and $35,000 is for OTS. Neither office has currently budgeted for these FY-77 costs.

OTS SUPPORT

During the T.Q. a pigeon loft and facilities will be constructed at [redacted] ($3,000), and ORD will provide basic training for handlers and interested parties at both

Figure 2: Suppliers



*Controlled Lofts

TABLE 1

ORD T.Q. CONTRACT COSTS

CONTRACTOR	ITEM COST $	SUB TOTAL	RUNNING TOTAL
[redacted]			
Materials & Supplies (Bird Lofts/Training)	500		
Purchase of Birds	3,000		
Labor	3,000		
Travel and Field Support	3,500	10,000	10,000
[redacted]			
5 Cameras at $2,000 each	10,000		
Purchase of Birds	3,000		
Labor and Repair	7,000		
Travel and Field Support	5,000	25,000	35,000
[redacted]			
4 DF Receivers at $825 each	3,300		
Eight 1-gr. Transmitters at $50 each	400		
Three 6-gr. Transmitters at $65 each	200		
Commo Equipment for Field Tests	3,000		
Refit of Aircraft	1,600		
Labor	4,500		
Travel	3,000	16,000	51,000

(Continued)

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TABLE 1 (CONTINUED)

ORD T.Q. CONTRACT COSTS

CONTRACTOR	ITEM COSTS	SUB TOTAL	RUNNING TOTAL
[redacted]			
Drawings & Doc. (New Camera)	4,000		
Purchase Birds [redacted] & West Coast)	4,000		
Labor	7,000		
Travel	5,000	20,000	71,000
[redacted]			
QRC Support	4,000	4,000	75,000
[redacted]			
Building Supplies	2,300		
Labor	700	3,000	78,000

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TABLE 2 A

ORD FY-77 CONTRACT COSTS

CONTRACTOR	ITEM COST $	SUB TOTAL	RUNNING TOTAL
[redacted]			
Building Supplies	500		
Feed	500		
Two Bird Handlers	21,000		
Transport, Shipping, Misc.	1,000		
Labor	1,000		
Boat Rental	1,000	25,000	25,000
[redacted]			
QRC Support	38,000	38,000	63,000
ELMENDORF AFB (ALASKA)			
Building Supplies	1,000		
Labor	4,000		
Gen. Support	2,000	7,000	70,000

TABLE 2 B

OTS FY-77 ESTIMATED COSTS

CONTRACTOR	ITEM COST $	SUB TOTAL	RUNNING TOTAL
15 Cameras ($2,000 each)	30,000	30,000	30,000
Construction of Lofts and D.C. Test Support	5,000	5,000	5,000
TOTAL ORD AND OTS FY-77 COSTS =			105,000

[redacted] For FY-77, the first birds will arrive at [redacted] in early October and will continue to arrive through February 1977. [redacted] must provide feeding and exercising of the birds twice daily on a seven-day-a-week basis plus homing flight training at least three times a week. Complete records must also be kept. It is felt that the number of birds at any one time could be as large as 100, and that handlers will be required to perform this service and to assist in flight path accuracy tests to measure performance. The [redacted] FY-77 costs, including the salary for handlers is estimated at $25,000.

OTS operations personnel, concerned with operational missions, will receive preliminary training [redacted] (about one week) and participate in (or direct) simulated mission tests at [redacted] These personnel will also receive training in handling and loading of the camera equipment. Five prototype cameras will be provided by ORD for design verification and initial tests in [redacted] at [redacted] It is felt that OTS should provide 15 cameras (at an estimated cost of $30,000) to support the majority of tests at [redacted] and Washington, D.C.

OTS will assess the operational quality of tests at [redacted] and provide [redacted] to the Washington, D.C., area. OTS will be responsible for conducting all tests in the Washington, D.C., area as well as the handling of birds and the maintenance of cameras. ORD will provide assistance, consultation, and analysis upon request. It is suggested that OTS will wish to participate in (or direct) the test at Elmendorf AFB in Anchorage, Alaska, to verify performance at extreme northern latitudes.

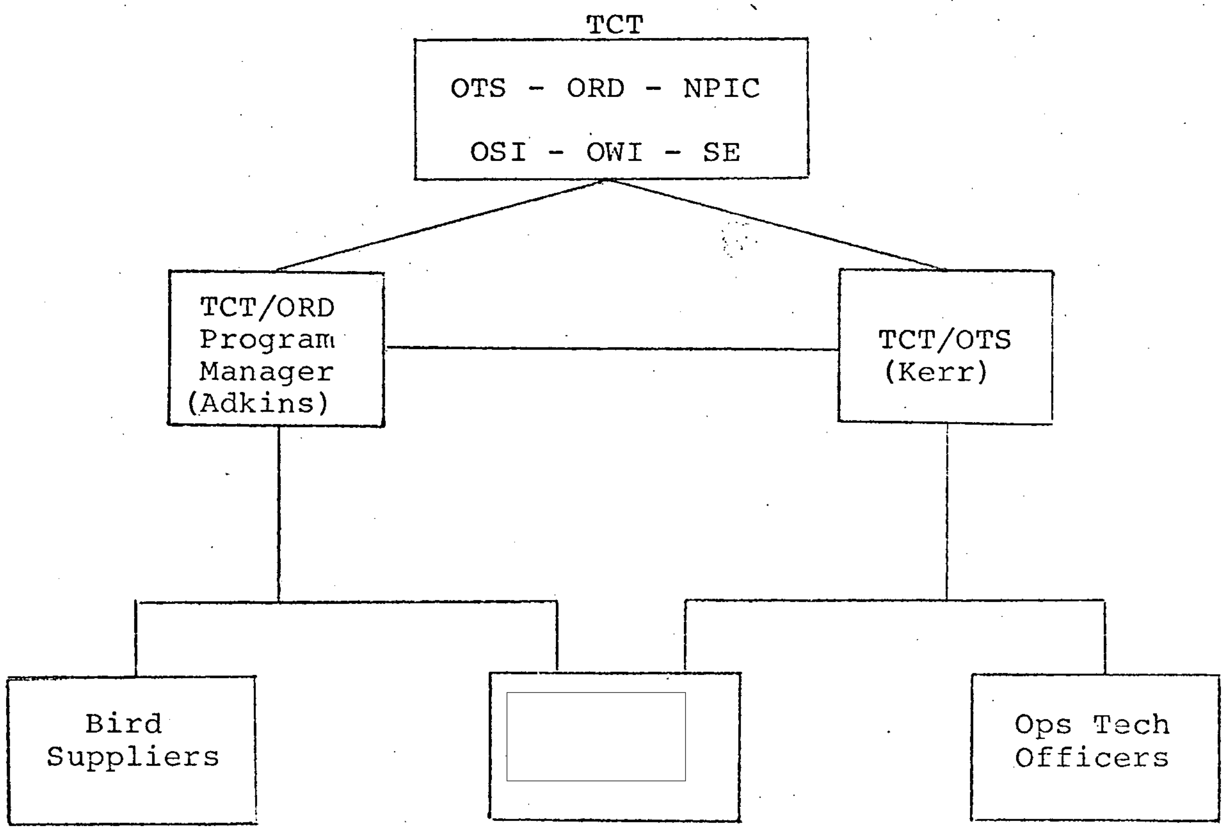
Two OTS officers now at [redacted] have been identified as having previous experience in handling birds.

PROGRAM MANAGEMENT

During the previous feasibility stage of this program, the voluntary involvement of NPIC provided technical evaluation and experimental direction which considerably improved the photographic product. It is strongly felt that this final phase of development will require the involvement of OSI, OWI, and SE as well as that of OTS, ORD and NPIC in order to ensure a product of maximum intelligence value. It is recommended that the Technical Collection Team (TCT TACANA) be continued, and include [redacted] (NPIC), to properly advise and assess the efforts of the program manager (Dr. Charles Adkins) and the OTS team member during the course of this program. Figure 5 shows the recommended program management structure.

As a matter of policy, humane disposition of all culled birds will be observed at each of the controlled lofts. However, [redacted] for the bird loft at [redacted] and the use of birds in the tests at Elmendorf

Figure 5: Program Management Structure



AFB in Anchorage, Alaska. It is expected that some assistance will be required for the initial contact, [redacted] and arrangements with Elmendorf AFB.

OSR SUPPORT

A computer search was performed by the personnel office to locate Agency employees familiar with homing pigeons. A [redacted] was found who works in the publications Branch of OSR. His supervisor is [redacted] Chief, Publications Staff. [redacted] was interviewed, with [redacted] permission, and was found to be quite knowledgeable in the raising and training of homing pigeons. A summary of his experience is enclosed. [redacted] was quite enthusiastic about participating in the program on a full-time basis. I suggest that Mr. Noel E. Firth, Director, OSR, be approached to consider the temporary reassignment of [redacted] to ORD for the period of one year. [redacted] could be responsible for the loft designs, the training of bird handlers and operational personnel, and could supervise the selection and training of birds. I believe that [redacted] contribution to this program will be invaluable.

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6.2(d)

~~S E C R E T~~

3 June 1976

MEMORANDUM FOR: Secretary, TACANA/TCT
[redacted]

SUBJECT : Acclimatization Restrictions

Attached herewith are restrictions on acclimatization procedures, per your request.

[redacted]
Chairman, TACANA/TCT

Attachment:
as stated above

~~S E C R E T~~

E2 IMPDET
CL BY [redacted]

1. Birds should not be exposed to daylight except through air conditioner and a small number of chinks and cracks, etc. This simulates ops situation where only a small window will be available for the birds to see out from.

2. Birds should be put into and removed from cage only from a door in the rear of the cage. At no time should handlers approach from air conditioner side. In ops situations, the air conditioner would be in full view of hostile eyes.

3. Birds may be allowed to fly free from air conditioner, that is released by opening the air conditioner top door. However, they should be observed without any cues from trainers except from within the cage via the air conditioner.

4. Note: all controlled releases should be limited to two-three birds and should be accomplished clandestinely. The first controlled release should be from a minimum of one mile away. If this does not work, determine minimum time/distance first release. Anything less than a mile places serious strains on ops considerations.

5. There should be no more than three-four additional controlled releases, from distances greater than one mile. Tests should be run to determine if fewer releases will suffice, as each release presents problems perhaps greater than an ops release.

6. After controlled releases for acclimatization purposes, two-three birds at a time should be taken to full target distance and released. Full homing behavior should indicate acclimatization.

7. Some ops limits are listed below:

a. The aperture to sunlight for birds is limited.

b. Trainer/handler must operate at all times from inside cage.

c. Releases will be done by persons with very limited training.

6.2(d)

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ORD #4104-72

7 July 1972

MEMORANDUM FOR: C/DDS&T/ORD/BSD

SUBJECT : Animal Delivery Systems

1. The bird delivery project which was initiated and developed by ORD/BSD and brought to the operationally suitable stage by TSD is to be terminated at the end of the current contract, 31 July 1972.

2. This unique package delivery and emplacement system was used in one audio operation in the past. While the emplacement of the audio transmitter was a complete success, the intelligibility of the audio was not acceptable because of ambient noise levels. Since that time, the system was seriously evaluated for use on several other targets but in each case the possibility of obtaining an acceptable quality of audio was considered to be too low to be of value.

3. This project has been reviewed with the area divisions and TSD operations branches. No projected targets can be found which would utilize the concept. The lack of targets coupled with the cost of maintaining the carriers for an additional year has led to the decision to terminate the project. Should a target become available where only such a carrier would solve the delivery problem, it is hoped that the project can be reactivated within a reasonable period of time.

Sidney Gottlieb
Chief
Technical Services Division

CLASSIFIED BY

WARNING NOTICE
SENSITIVE INTELLIGENCE SOURCES
AND METHODS INVOLVED

EXEMPT FROM GENERAL DECLASSIFICATION SCHEDULE
OF E. O. 11652. EXEMPTION CATEGORY:
5B(1), (2), (3) or (4) (circle one or more)

~~SECRET~~

TITLE: Animal Emplacement & Surveillance | CONTRACTOR: [redacted] | COST: $7,500

ORN NO.: Amendment #1 ORN#650304 | MONTH TO LET: June 1974

3.3(h)(2) 6.2(d)

SUB-CATEGORY/ELEMENT: Collection/Emplacement Systems | PROJECT: Behavioral Activities | COSATI: 05-J

SECRET (When Filled In)

DESCRIPTION: The purpose of the project is to obtain close-in photography of the Square Pair Radar system. Bird will be released from a boat beyond the 12-mile limit, fly to target transporting miniaturized camera pre-programmed to obtain required photography with the bird at rest on a designated portion of the antenna, and return to release boat.

BACKGROUND: Funds in the amount of $15,000 were transferred to DDO/SOG for summer 74 test operations. An amount of $7,500 will not be utilized in the summer test. This amount has been returned to ORD. It is intended that the remaining $7,500 continue to be used in the bird program to support the R&D activity cited under GOAL.

GOAL: To provide partial support to the bird photoreconnaisance system in the following areas: bird release boat modification; simulation of the SA-5 Square Pair antenna system; evaluation of bird transport across international boundaries; and procurement of additional birds as back-up vehicles.

TYPE OF WORK: Research FIELD OF WORK: Animal Studies

COORDINATION: OWI [redacted]; OTS (D. Boston); SB/DDO [redacted]

E2 IMPDET CL BY 007622

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IDEA	PROP. SOLICITED	PROP. IN HAND	PROP. IN HAND/UNBUD.	BB IN PROCESS	CONTRACT

ISSUE DATE	FAN NO.	DIVISION CHIEF	PROJECT ENGINEER
6/20/74	4162-6503	[redacted]	[redacted]

TITLE	ORN NO.	CONTRACTOR	COST
Animal Emplacement & Surveillance		[redacted]	$7,500

FORM 12-72 2885 USE PREVIOUS EDITIONS

PROJECT ACTIONS

(13-35-42)

3.3(h)(2)
6.2(d)

SPECIAL STUDY OF
SELECTED COLLECTION SYSTEMS

Animal Emplacement

~~TOP SECRET~~ SENSITIVE

~~TOP SECRET~~

UNCLASSIFIED when blank — T SECRET when attached to Top Secret D ment — Automatically downgraded to SECRET when filled in form is tached from controlled document.

TOP SECRET

CONTROL AND COVER SHEET FOR TOP SECRET DOCUMENT

DOCUMENT DESCRIPTION		REGISTRY	
SOURCE	DD/ORD	CIA CONTROL NO.	196449/1
DOC. NO.		DATE DOCUMENT RECEIVED	
DOC. DATE	18 August 1967	LOGGED BY	
COPY NO.	5		
NUMBER OF PAGES	2		
NUMBER OF ATTACHMENTS	1		

ATTENTION: This form will be placed on top of and attached to each Top Secret document received by the Central Intelligence Agency or classified Top Secret within the CIA and will remain attached to the document until such time as it is downgraded, destroyed, or transmitted outside of CIA. Access to Top Secret matter is limited to Top Secret Control personnel and those individuals whose official duties relate to the matter. Top Secret Control Officers who receive and/or release the attached Top Secret material will sign this form and indicate period of custody in the left-hand columns provided. Each individual who sees the Top Secret document will sign and indicate the date of handling in the right-hand columns.

REFERRED TO	RECEIVED			RELEASED		SEEN BY		
OFFICE	SIGNATURE	DATE	TIME	DATE	TIME	SIGNATURE	OFFICE/DIV.	DATE
DD/ORD (Subj. File)								

NOTICE OF DETACHMENT: When this form is detached from Top Secret material it shall be completed in the appropriate spaces below and transmitted to Central Top Secret Control for record.

DOWNGRADED		DESTROYED		DISPATCHED *(OUTSIDE CIA)*	
TO		BY *(Signature)*		TO	
BY *(Signature)*		WITNESSED BY *(Signature)*		BY *(Signature)*	
OFFICE	DATE	OFFICE	DATE	OFFICE	DATE

FORM 26 USE PREVIOUS EDITIONS.

~~TOP SECRET~~

GROUP 1
EXCLUDED FROM AUTOMATIC DOWNGRADING AND DECLASSIFICATION

(40)

18 August 1967

MEMORANDUM FOR: Deputy Director for Science and Technology
Assistant Deputy Director for Science and Technology

SUBJECT : Animal Program

1. The attached report and supporting documents were prepared in response to a Bureau of the Budget request which was subsequently cancelled. You asked that we forward the draft study for your information and background. I have reviewed both the report and the program carefully since its inception and must state that the role played by the various elements of the Agency throughout this three-year period has been erratic and inconsistent. It is greatly to the credit of the technical officers involved in these projects that they were able to surpass the technical objectives of the program.

2. For the record, it should be noted that the objectives of this program were developed in response to the DD/P's letter to the DD/R in 1963. There has been a recent decision on the part of management to discontinue this program. We have taken the appropriate steps to comply, although you should know that in my view the concepts and objectives as stated in 1963 are even more valid than they were at the time the program was initiated.

3. I hope you will have the time to read at least portions of this report because I believe it indicates the Agency's inability, at least in some areas, to define its requirements or indeed to make use of R&D once it is developed. Obviously this represents the worst kind of waste in terms of manpower and money.

TS 196449/1
Copy 5 of 7

SUBJECT: Animal Program

4. I would like to discuss this program with you at your earliest convenience since we must undertake phase-out operations as quickly as possible. I would also like to use this as a basis for policy guidance with respect to other programs in the life sciences which I hope are still consistent with the objectives of the Director. I have marked with a red tab the memoranda in the annex which I believe will be of the most interest to you.

Stephen L. Aldrich, M. D.
Deputy Director
of
Research and Development

Attachment
TS 196449

Distribution:
O&1 - Adse. (Cys 1 & 2)
1 - D/ORD (Cy 3)
1 - C/BSD (Cy 4)
1 - DD File (w/a) (Cy 5)
1 - DD Chrono (Cy 6)
1 - ORD Chrono (Cy 7)
ORD/DD/S&T:SLAldrich:pjk/2652 (18 August 1967)

ORD 5439-67
14 September 1967

MEMORANDUM FOR THE RECORD

SUBJECT: Animal Programs Review

1. Col. White, Mr. Duckett, Mr. Karamessines, Mr. [redacted] and I met to discuss the future of the animal programs. Mr. Duckett pointed out the concern which John Foster had expressed and indicated the political implications this may have. I reviewed the current status of the three programs very briefly and reinforced the view that the original justification for undertaking these programs three years ago was as valid today as it was then, that the technical objectives have been met on time, and that I was concerned that the operational elements had not had adequate exposure to these programs and therefore could not make a judgment that they had no operational usefulness. Col. White raised the question of a joint DOD/CIA animal program, heavily funded by DOD as an alternative. I indicated that they were already sharing costs on OXYGAS and would shortly take over total funding of KECHEL. I felt that such an arrangement could be worked out but that we would, of course, have less operational and technical control of the program.

2. Mr. Karamessines volunteered to designate a committee of two or three senior DD/P officers who would be available to me for two or three days for a visit to the appropriate sites and to see the demonstrations. He added that this did not include TSD. I told him I had no objection to TSD attending and that indeed [redacted] was the only one who had seen these systems

SUBJECT: Animal Programs Review

in a field environment. After completion of the field demonstrations which are to be undertaken within a month, there will be a follow-on meeting with Col. White.

Stephen M. Aldrich, M. D.
Deputy Director
of
Research and Development

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ORD 5478-67
15 September 1967

MEMORANDUM FOR: Director of Planning, Programming, and Budgeting

ATTENTION :

SUBJECT : Animal Programs

1. This memorandum is in response to your questions regarding the animal programs. Current CIA FY 1968 funding for animal programs is as follows:

a.	OXYGAS (Dolphins)	296 K
b.	AXIOLITE (Birds)	100 K
c.	KECHEL (Dogs and Cats)	207 K
	Total	603 K

2. ARPA has notified us in writing that it is their intent to transfer 200 K in FY 1968 to the OXYGAS project. This is intended to augment our own funds and to support primarily ARPA objectives (for example, sonar discrimination). In addition, the recent exchange of letters between Dr. Foster and Mr. Duckett would indicate that ARPA intends to provide us with an as yet unspecified number of dollars for KECHEL. My estimate is that it will be about 200 K in FY 1968.

3. With respect to manpower required to manage animal programs, we require two full time individuals to monitor all of the animal programs including ARPA's portion. However, due to illness we have had to get by with about one man year of monitoring. The portion of time which can be directly attributed to ARPA monitoring is probably less than 20%.

4. A number of factors may change this picture. If ARPA funds KECHEL at the 200 K level, we will not have to expend most of the 207 K currently budgeted. The OXYGAS project is funded,

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SUBJECT: Animal Programs

with the exception of about 50 K, up through December at which time we will have the operational demonstration. If it is determined at that time to continue OXYGAS, we will combine the ARPA 200 K and the remainder of our 296 K and proceed. If the decision is not to continue OXYGAS, I don't know what ARPA will do but I suspect that we will require less than 100 K of the 296 K to phase it out. AXIOLITE should stand at 100 K which we expect to spend. To some extend, these decisions would be dependent upon:

a. The DD/P survey of KECHEL and AXIOLITE to be undertaken within the next month.

b. A decision as to whether we wish to undertake some sort of joint animal program activity in a more formal sense with ARPA. In the latter case, it might be possible to divert any savings from OXYGAS and KECHEL to such an agreed program. Perhaps we could use some of these funds to cover our obligation for FY 1969.

5. As I have indicated to you verbally, ARPA has on several occasions indicated they would like to have a joint ARPA/CIA animal program. In the light of the recent decisions of the phasing out of the animal programs, I have discouraged further discussions on this. This, of course, could be reopened if this seems desirable after our meeting next month with the Executive Director, the DD/P and the DD/S&T.

6. With respect to management, ORD has in all cases been the technical manager on jointly funded programs. We do meet periodically with ARPA, however, for planning purposes, review of tasks, progress reports, and site visits. It has been ARPA's expressed desire that we have the total technical management of these programs to avoid confusion for the contractors and because we have the technical capability.

/S/

Stephen L. Aldrich, M. D.
Deputy Director
of
Research and Development

Distribution:
O&1 - Adse; 1 - DD/S&T; 1 - D/ORD; 1 - C/BSD; 1 - DD File;
1 - DD Chrono; 1 - ORD Chrono
ORD/DD/S&T:SLAldrich:pjk/2652 (15 September 1967)

[redacted] SECRET

DD/S&T# [redacted] 70-69

3.3(h)(2)
3.5(c)
6.2(d) 9-0984

PPB 69-0232

Executive Registry
69-1404

13 March 1969

MEMORANDUM FOR: Executive Director-Comptroller

VIA: Deputy Director for Plans

SUBJECT: Animal Studies Projects

REFERENCES:

A. Briefing for Executive Director-Comptroller by DD/S&T/ORD (Dr. Aldrich and Mr. Chernack), 6 February 1969

B. My 11 February 1969 Visit to Contractor's Facility to Observe Current Actions on Animal Program

C. Our Recent Discussions with Respect to Current and Future Programs in Animal Studies

1. A recommendation for your approval is contained in paragraph 4.

2. The DD/S&T program relating to the utilization of trained animals has provided useful information to the DDP/TSD. Currently the program involves the development of an operational capability for emplacement of audio and other devices using a trained crow as the transport and action vehicle, and the development of several cats for operational evaluation as an audio surveillance vehicle. The work with crows is directly related to specific DDP operational requirements, and it is planned that TSD will provide funds in the amount of $70,000 in FY 1970 for continuation and improvement of this trained animal capability.

3. Additional R & D support by DD/S&T/ORD would continue to contribute information of value to DDP/TSD in providing more

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GROUP 1
Excluded from automatic downgrading and declassification

optimized systems, as well as new system concepts for Agency applications. I understand that there are no funds programmed for R & D support of the trained animal program by DD/S&T/ORD for FY 1970.

4. I think a modest level of forward looking R & D activity designed to improve the guidance systems and operational versatility of various animals should be maintained. I, therefore, recommend that you approve such a DD/S&T/ORD research effort for FY 1970.

Original signed by
Sidney Gottlieb

Sidney Gottlieb
Chief
Technical Services Division

CONCUR:

/s/ Thomas H. Karamessines 18 MAR 1969

Deputy Director for Plans

The recommendation contained in paragraph 4 is approved:

[redacted] 1969

See ExDir memo of 2 May '69

Executive Director-Comptroller

6.2(d)

Carl E. Duckett
Deputy Director for
Science and Technology

Date ____________________

DDP/TSD:SGottlieb:vm (13 March 1969)

Distribution:
Orig. & 1 - Addressee
✓2 - DDP (w/held)
1 - C/TSD
1 - ER
1 - DD/S&T
1 - D/ORD

Animal Studies

DD/ST# 1790-69

2 May 1969

MEMORANDUM FOR: Chief, Technical Services Division

THROUGH : Deputy Director for Plans

SUBJECT : Animal Studies Projects

REFERENCE : Memo dtd 13 Mar 69 to ExDir-Comp fr C/TSD, same subj

1. This is in response to referent and records my understanding of the agreements we reached when Messrs. Karamessines, Duckett, and Clarke met with me on 9 April to discuss this general subject.

2. Your plans and recommendations for the crows are entirely satisfactory. I would like to be briefed in due course on the operational results of this effort.

3. With regard to the dolphins, no CIA money is to be provided during Fiscal Year 1970, and to the extent that ARPA wishes to fund this program we will continue to administer it as we have in the past. I understand that there will be a demonstration on or about 15 July following which fundamental decisions will be made as to follow-on work. I would also like to be briefed on this before the work is undertaken.

4. I have no objection to a modest expenditure in connection with the cats, but I would like to know more specifically what is proposed and how much money is going into the effort before it is undertaken.

/s/ L. K. White

L. K. White
Executive Director-Comptroller

Attachment
Referent

cc: DD/S&T

~~SECRET~~

3.3(h)(2)
6.2(d)

~~SECRET~~
~~EYES ONLY~~

7 October 1975

MEMORANDUM FOR: Director of Research and Development

VIA: Chairman, DDO Technical Requirements Board

SUBJECT: AVIAN Program

1. Based on the recent AVIAN Program demonstration at [redacted], SE Division, working with the NIO/SA, requests that ORD continue the program to fulfill a specific requirement. A step by step -by-step description of one possible scenario has been prepared and forwarded on 31 October 1975. Using this description we plan to have our station officers release pigeons near the target. The pigeons should over fly the target carrying cameras and return [redacted] for recovery of the cameras and film. We expect ORD to demonstrate a scenario in the Washington area that would closely parallel the field situation using the alloted ORD funds. We understand that ORD could use funds remaining in calendar year 1975 at two contractors for basic research on homing pigeons and commit funds programed for calendar year 1976 at one contractor to demonstrate the feasibility of the equipment to meet the requirement. SE Division will fund the actual operation using ORD furnished equipment.

2. We understand that any additional work on the Bird Camera would be funded by ORD and be an insignificant amount. We have elected to go ahead with a bird operation with the understanding that total costs for one more year's work to complete a system will be about $100,000 for equipment, i.e., trained birds with cameras, mock ups and photo slides of targets needed for training.

3. We are planning a timetable whereby the birds with cameras would demonstrate the capability in the Washington area by April 1976, and additional trained birds with cameras would be ready for the operation overseas by June 1976.

E2 IMPDET
CL BY [redacted]

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~~EYES ONLY~~

SECRET
EYES ONLY

4. Details of this request have been discussed between [redacted] of ORD, [redacted] of OTS, and [redacted] of SE Division.

[redacted]
Chief
Soviet/East European Division

cc:

NIO/Special Activities
DDO/Ops Staff ([redacted])
OTS/Operations
OTS/D&E

SECRET
EYES ONLY

 6.2(d)

~~S E C R E T~~

OTS/SDB Memo #271-75

17 November 1975

MEMORANDUM FOR: Director, Office of Research & Development

SUBJECT : AVIAN Program

1. Based on discussions with SE Division, OTS will support joint ORD/SED efforts to exploit the AVIAN Project. It is requested that an information copy of all correspondence on this program be sent to C/OTS/OPS, Attn: SDB.

2. [redacted] OTS/SDB, will be the focal point off[redacted]ched on ext. 3278 (Green 5321).

[redacted]

OTS/OPS/SDB

~~S E C R E T~~

E2 IMPDET CL BY [redacted]

3.3(h)(2)
6.2(d)

SECRET
EYES ONLY

17 October 1975

MEMORANDUM FOR: SE/IO/USSR

SUBJECT: AVIANS Project Evaluation

Following demonstrations and briefings on 7 thru 9 October 1975, by ORD and contractors [redacted] on the AVIANS project, the undersigned has prepared below his comments and recommendations vis-a-vis use of AVIANS techniques on specific intelligence collection efforts inside the Soviet Union.

As it is understood by the undersigned, the requirement can be summarized as follows: The AVIANS platform (bird) carrying a sequential camera, must perform low level aerial reconnaisance flight over a specified target area. The photographic results should be significantly better than that available from other sources at this time. The bird will be dispatched from an automobile located about five miles from the target area. The bird must then fly directly to the target area, accomplish the mission, and then proceed to the home base area approximately 50 miles away. The pre-mission training of the bird must be accomplished using only photographs and interior mockups (if required). Actual operational details re deployment and other phases to be outlined in detail later.

None of the demonstrations seen by the undersigned were totally applicable to the requirement outlined above. Several birds did make a photographic pass against a mocked-up antenna from a range of 1-3 miles, and other birds made short range (1 mile) overflights at low altitudes while photographing. Photographic product from these flights has demonstrated that it is within the capabilities of the camera system to obtain the desired results. However, the present camera is not reliable.

The demonstrations did show the feasibility of training birds to accomplish relatively complicated tasks similar, at least in part, to the scenario outlined above. The

E2 IMPDET
CL BY [redacted]

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EYES ONLY

SUBJECT: AVIANS Project Evaluation

contractors, when presented with the sterilized requirement as outlined, were quite positive that pigeons could be trained to do the job.

The undersigned feels that it is highly probable that the AVIANS project can produce an operational platform within one year. It appears slightly less certain that a reliable camera can be available in the same time frame. This subject is being investigated presently by ORD.

The undersigned recommends that a test situation be set up which is very similar to the situation described in the requirement outlined above. Specifically, it is recommended that the Agency facility at [redacted] be used as the target area, with the birds to "home port" at the Agency's South Building or Rosslyn complex. With these two fixed parameters, it is felt that a satisfactory and complete operational scenario can be evolved which would test the feasibility of this approach and, if successful, could provide a cadre of trained birds for the actual operation.

[redacted]
OTS/SDB

3.3(h)(2)

6.2(d)

~~SECRET~~

ORD-0789-76

12 May 1976

MEMORANDUM FOR: TCT

FROM: Charles Adkins, OTD/ORD

SUBJECT: Bird Camera Development

1. The final camera design has been completed and tested. This camera, Camera No. 3, has undergone extensive ground tests, including vibration, and was flown six times during the Oklahoma tests listed in Table 1. This camera, which uses the Minox lens, has a weight of 35 grams including timer, film, and batteries. The total flight weight, including harness, is 39.5 grams. A primary feature of this design is a focal plane flattener which permits accurate positioning of the film in the focal plane and a reduction in motor torque and probability of jamming. Furthermore, ultrathin base film works well in this design so that more pictures (200 black and white, 140 color) per roll are possible. The shutter speed has been shortened to 1/1400 of a second.

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E. 2 IMPDET CL BY

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SUBJECT: Bird Camera Development

2. The production schedule calls for five additional cameras (Cameras 4 through 8) to be made by 1 June 1976. About one week will be required for performance and reliability tests. By 15 June 1976 these five cameras will be ready for flight tests. By the end of June, six cameras of the new design (Nos. 3-8) and two cameras of the old design will be ready for demonstrational use.

3. A meeting was held with [redacted] Chief/APSD/NPIC, to discuss various films and processing techniques. Also at the meeting were [redacted] and [redacted] of the same division. The flight films and data sheets were left with them for review. Subsequently, a [redacted] of APSD called and a second meeting was held to discuss possible approaches for selecting films and processing techniques for both color and black and white. An additional meeting has been scheduled between NPIC and Kodak to get Kodak's recommendation. At this time, it is agreed that a series of tests will be conducted with the new camera and several film selections in order to determine the proper film and processing technique. Recommendations will also be made regarding trade-offs between shutter speed, film speed, and film resolution.

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SUBJECT: Bird Camera Development

These film tests and/or recommendations will be integrated into the camera tests in early June and verified by flight tests in the later part of June. Analysis of the flight tests to date by NPIC supports the original estimate of 1.5- to 2-inch resolution at 100 feet altitude.

4. The [redacted] lens has been assembled and tested in comparison with the new Camera No. 3 design. Both lens systems have field flatteners. The [redacted] lens is an F2.5 lens (about a stop faster), has about the same resolution in the center, and has slightly better resolution at the edge of the field of view. Its major advantage is the faster stop which would allow for faster shutter speed or resolution. As time permits, a camera will be designed for this lens and ground tests will be conducted to verify performance.

5. Table 2 shows the schedule for camera manufacturing, tests, and film selection.

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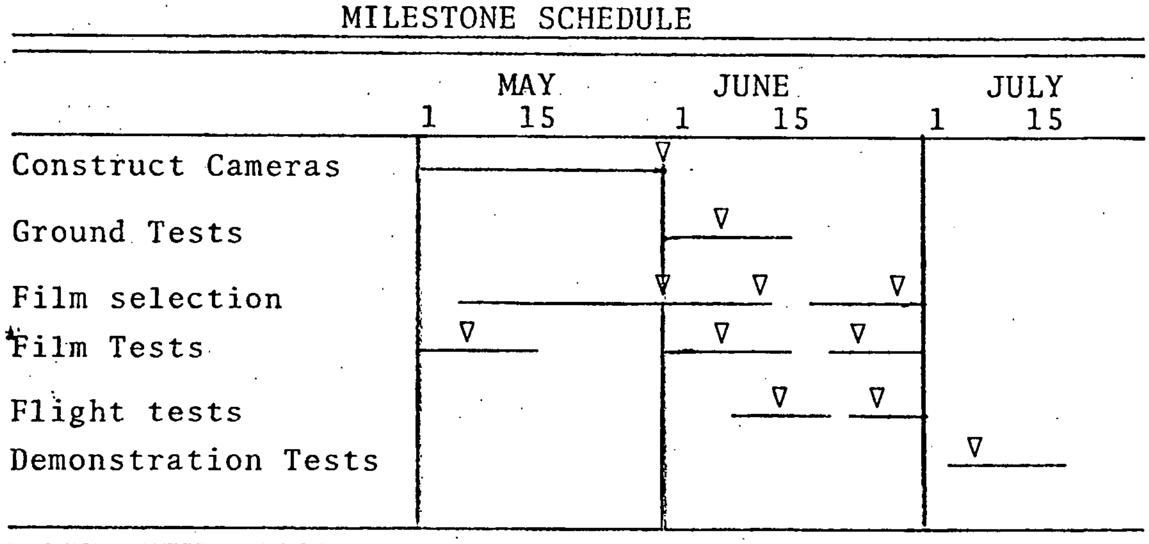
TABLE 1
FLIGHT TESTS

DATE	PLACE	NO. FLIGHTS	NO. FILM ROLLS
1/23/76	[redacted]	5	4
3/29/76		2	1
3/30/76		4	2
3/31/76		4	4
4/23/76	OKLA	10	5
5/1/76	OKLA	4	4
TOTALS		29 Flights	20 Rolls

TABLE 2
MILESTONE SCHEDULE



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ORD-5290-75

16 December 1975

MEMORANDUM FOR THE RECORD

SUBJECT: Bird Camera Program

1. On 4 December 1975 a meeting was held with [redacted] to review requirements and program scheduling for delivery of two cameras for ultimate test at the [redacted] facility in late April 1976. Review of the current cameras now being used determined that the shutter speeds were too slow to adequately compensate for image motion. It was decided to modify two cameras to use external battery packs for providing sufficient power to operate the faster shutter speeds and to take pictures at a rate of at least one or two per second. These cameras will be flown on birds in mid-January for the purpose of taking pictures of Air Force resolution charts which will properly calibrate image motion, bird altitude, shutter speed, and film selection.

2. A trip was also made on 8 December to the West Coast to coordinate efforts with [redacted] and to get preliminary estimates of the bird orbit altitude and orbit diameter. A bird harness currently used by [redacted] was obtained for redesign and for the purpose of fitting a camera fairing to reduce aerodynamic drag. The redesigned harness and fairing are planned to be ready for the mid-January tests.

3. A third trip was made to see [redacted] (an optical consultant) on 11 December. The purpose of this trip was to initiate the design of the lower F-number lens (larger aperture) which would permit the faster shutter speed for minimizing motion blurring. It is expected that the lens design will be completed by early February.

4. The results of the mid-January tests will be used to configure a final camera design to be completed in early February. Two cameras are scheduled to be constructed,

E2 IMPDET
CL BY [redacted]

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SUBJECT: Bird Camera Program

that will include the low F-number lens and some older backup cameras will include the lens currently being used. At this time, the new camera design will increase the film size from 9 mm to 16 mm in width. The film roll will be capable of taking 180 pictures at a rate of one picture per second for a total coverage time of three minutes. The field of view in the direction of motion will be roughly 30° and approximately result in contiguous pictures along the ground. The increased film width will result in almost a factor of two increase in lateral field of view and, therefore, increase the probability of photographing the target. In addition, this new design would increase the number of pictures by a factor of two which results in an overall increase in the probability of recording the target by approximately a factor of four.

5. This new camera design is scheduled for final construction and flight tests by the end of March. Final modifications and analysis should be completed by early April. The following is a list of line items which must be completed by mid-April:

a. Obtain ground resolution charts.

b. Design new harness and camera fairing.

c. Receive initial test cameras and loaded film cassettes.

d. Obtain fresh batteries from [redacted] and configure flight battery packs.

e. Perform ground tests of resolution charts and mechanical shake tests of cameras.

f. Conduct preliminary flight tests of resolution charts.

g. Finalize camera design and select film.

h. Receive low F-number lens from [redacted]

i. Build final cameras and test.

~~SECRET~~

SUBJECT: Bird Camera Program

j. Effect final modifications.

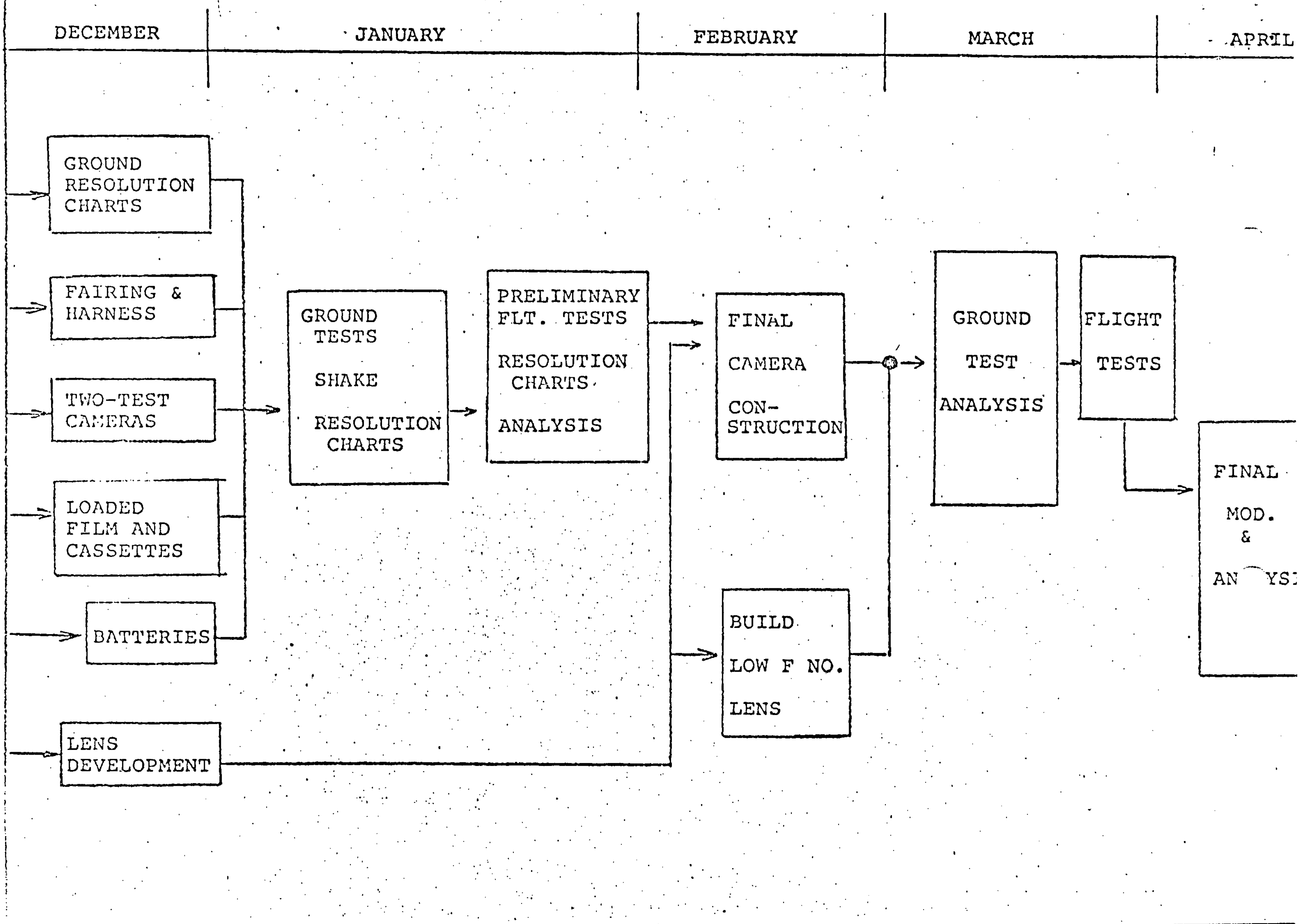
k. Conduct mission analog tests and analysis.

6. It is anticipated that a task order support contract will be required for the purchase of miscellaneous equipment, batteries, film, etc. The film must be loaded in a clean room with facilities for splitting the film to the proper format and checking the cassettes or film holders for adequate freedom of movement to prevent camera jamming. Also at this time, there are several battery candidates which must be investigated and tested for both reliability and current drain capacity. Large quantities of film must be processed rapidly from both the ground tests and the flight tests in order to meet the program schedule. Movie camera coverage is advised during both the ground-test and flight-test phases of the program. It is felt that a task order contract for the sum of $30,000 would be required for dealing with these miscellaneous tasks on a timely basis.

Charles N. Adkins
Operations Technology, ORD

Distribution:
O - C/OTD then file
1 - CEB/OTD Chrono
1 - OTD/ORD Chrono
1 - ORD Registry

OTD/ORD/DD/S&T/CNAdkins:kmc/2763


DECEMBER
JANUARY
FEBRUARY
MARCH
APRIL
GROUND RESOLUTION CHARTS
FAIRING & HARNESS
TWO-TEST CAMERAS
LOADED FILM AND CASSETTES
BATTERIES
LENS DEVELOPMENT
GROUND TESTS
SHAKE
RESOLUTION CHARTS
PRELIMINARY FLT. TESTS
RESOLUTION CHARTS
ANALYSIS
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CAMERA
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&

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6.2(d)

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ORD-0417-76

19 February 1976

MEMORANDUM FOR THE RECORD

SUBJECT: Bird Camera/NPIC Support

1. This memo covers the period between 5 February 1976 and 19 February 1976 regarding the progress for developing and testing a bird camera. Memos dated 16 December 1976, 5 January 1976, and 5 February 1976 describe earlier progress.

2. A dummy configuration of the latest camera and timer has been sent to [redacted] for testing compatibility with the bird and harness.

3. Camera #1, modified for image motion compensation, was received and tested against moving targets (resolution chart on a car) at distances of 50 and 100 feet and velocities from zero to 50 mph. The results of this test showed proper motion compensation. The negative aspects of the test were:

a. A small hairline crack in the camera case caused occasional fogging (about 10 percent of pictures).

b. In 1 or 2 percent of the pictures, the shutter stuck open causing over-exposure.

c. The center of the field of view was slightly defocused, whereas the edges (which are clamped) showed good focus.

The camera has been sent back to [redacted] for correcting these problems. At this time, the solutions to these problems appear to be straightforward.

4. There still appear to be problems in developing 3414 film per Kodak's instructions, especially with regard to pulling the developer to compensate for varied lighting conditions. Also, the supply of film in 16mm format is exhausted, and I feel that the film slicer is too risky an operation when

E 2 IMPDET CL BY [redacted]

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SUBJECT: Bird Camera/NPIC Support

used by people unfamiliar with the equipment. On 9 February 1976 a meeting was held with [redacted] of NPIC to discuss assistance in dealing with the above problems and also in obtaining good quality enlargments of selected negatives. The advice of NPIC at that time was for us to request assistance from OTS. However, on 18 February 1976, a second meeting was held with [redacted] of NPIC who suggested that NPIC could, and would, assist in a variety of areas. The following assistance and recommendations were offered:

a. NPIC will develop all film and make proper adjustments for varied lighting conditions.

b. [redacted] advised that we also conduct tests with 5069 film to permit good resolution under lower light levels and still use the fast shutter speed to minimize motion blurring.

c. NPIC will task Kodak to provide 16mm format film so that unnecessary handling and slicing in-house can be eliminated. [redacted] estimated that he may have some 16mm film delivered in about a week.

d. NPIC will provide good quality enlargments of selected negatives.

e. NPIC will provide technical assistance in determining resolution capability and does not necessarily require a resolution chart in the field of view.

5. At this time, I feel that all problems are fairly well in hand. A refitted camera is scheduled for delivery next week and tests will be conducted during the first week in March. Hopefully, NPIC will develop this film and provide

SUBJECT: Bird Camera/NPIC Support

advice on handling in the field and film selection for subsequent tests. The new F2.5 lens from [redacted] is on schedule for delivery in early March. It is expected that a simulated field test will be conducted in mid March at [redacted] facility near [redacted] Some film will be developed there so that any further camera problems can be dealt with directly by [redacted] I would estimate at this time that a second flight test will be in order for early April which will also test the new F2.5 lens system.

[redacted]

Charles N. Adkins
Operations Technology, ORD

Distribution:
- 0 - C/OTD file
- 1 - OTD/ORD chrono
- 1 - ORD Registry

OTD/ORD/DD/S&T/CNAdkins:amb(2763)

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NIO-2275-75

21 October 1975

MEMORANDUM FOR : Director, Office of Research & Development

SUBJECT : Bird Capability for Photography

1. Following the recent demonstration at [redacted] NIO/SA, at SE Division's request, attended a meeting with representatives from SE/COPS, SE R&R, SE/IO and OTS/SDP to discuss the actual operational value of the bird photographic system. At this meeting it was agreed that NIO/SA and SE/R&R would solicit and validate photographic requirements in the USSR for collection via your bird-borne camera; OTS/SPD [redacted] and SE/COPS [redacted] would discuss with ORD plans to improve the present camera system (which is not now reliable enough for an actual operation); and the office of SE/IO would draft a detailed scenario to be used as a basis for a realistic demonstration in the Washington area.

2. It was understood that ORD could run one more demonstration utilizing existing funds prior to 31 December 1975. You will receive a more detailed memo within the next ten days which will include a detailed demonstration scenario from SE Division. In the meantime, you may drop your ongoing program of training birds for long (25 miles) overwater flights. The central point of our interest revolves around your ability to train birds from photographs.

[redacted]

Barry Kelly
NIO for Special Activities

Copy: ADDS&T
D/OTS
SE/COPS
SE/R&R
SE/IO

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ORD 4762-66
27 October 1966

MEMORANDUM FOR THE RECORD

SUBJECT: Briefing of Admiral Taylor

1. On 26 October Mr. Chapman, [redacted] and I briefed Admiral Taylor and his aides Smith and McManus on the ORD program. The briefing lasted two hours and fifteen minutes. It covered approximately fourteen of the major programs in ORD. It is my impression that Admiral Taylor was very much interested in the substance of the briefing and was aware of some but not all of the projects. He asked unusually intelligent questions about those programs with which he was not completely familiar.

2. With respect to the Life Sciences, it turns out that he was the Admiral Taylor who was involved in the Moss Committee hearings and indicated in the course of our discussion that he felt much as we did about investigating the validity and reliability of the polygraph. He showed particular interest in the possible value of the EEG. On the animal studies, he wanted to know whether [redacted] people were aware of OXYGAS. I indicated that they were not but that Frosh and Admiral Gayler were aware of it and that we had been asked [redacted] He was particularly interested in the [redacted] of the dolphin, so I left a copy of the OXYGAS briefing book with him. He was interested in [redacted] and also the bird program. I gave him a brief rundown on our situation with respect to [redacted] He felt that a program to further define this area was essential and offered his assistance in backing it with the caveat that it would depend upon the funds. However, he

SUBJECT: Briefing of Admiral Taylor

agreed that we should separate the problem from the funds first. He was particularly interested in some material which he has read on territoriality and aggression. I told him I would send him a copy of "King Solomon's Ring" by Konrad Lorenz.

3. In summary, I felt that Admiral Taylor absorbed an unusual amount of material rather rapidly and has a broad philosophical background. As a result, I would assume that he will be able to play a helpful role in translating ORD problems to the front office.

STEPHEN L. ALDRICH, M. D.
Deputy Director
of
Research and Development

Distribution:
Original - Record
1 - C/MBSD
1 - C/BSD
1 - DD Chrono
1 - ORD Chrono
ORD/DD/S&T:SLAldrich:pjk/2652 (27 October 1966)

3.3(h)(2)

6.2(d)

SECRET

ORD # 2602-66
27 June 1966

MEMORANDUM FOR THE RECORD

SUBJECT : Briefing of Division D

REFERENCE: Project AXIOLITE

1. At the request of [redacted] Chief Scientist, TSD, I accompanied him to Headquarters this date to brief [redacted] Chief, Division D, DD/P, and some of his cognizant staff on the status with Project AXIOLITE. [redacted] was involved very closely with some of the activities and efforts which took place under the old TSD project called [redacted] [redacted] and some of his people had apparently gotten wind of Project AXIOLITE through conversations they have had with people from TSD, particularly Dr. Gottlieb.

2. I gave, per request, a short briefing on the objectives of the project and exhibited bird harness and the training aids that we use for the birds plus showed the film that we now have. An animated discussion session followed the short presentation and I am impressed with the interest shown in the potential applicability of bird emplacement platforms to missions and problems that confront Division D. There was certainly no lack of enthusiasm for the concepts upon which this project has been predicated.

3. In response to numerous questions, I gave them, although it was not scheduled, a very short thumb-nail sketch of our overall animal studies program taking care to be extremely discreet about the very sensitive items. There was almost as much interest shown in Project KECHEL as they had shown previously for Project AXIOLITE. Another quite animated discussion followed during which a large number of questions were answered. Subsequent to the more or less formal presentation, it was indicated to me that Division D would like very much to be kept in the communications loop on all these projects from the standpoint of being kept apprised of progress and problems and the potential solutions to problems. When they have

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GROUP 1
Excluded from automatic downgrading and declassification

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SUBJECT: Briefing of Division D

written their memorandum for the record covering this briefing this morning, it was indicated to me that they would hope to establish a fairly informal communications loop consisting of some designee of [redacted] from Division D, [redacted] from TSD, and myself.

4. My approach in talking to these people was strictly soft sell and I made, or I attempted to make, quite a point of the fact that these systems have been carried to the point of proof of feasibility but by no means were they operationally ready systems. This is particularly true with regard to Project AXIOLITE where no attempt has been made to generate operational hardware at all. This approach on my part apparently did not dampen their enthusiasm. On the contrary, they started immediately talking about what kind of sensor and payload package would be necessary for the types of missions they would hope to accomplish using bird emplacement.

5. Pursuant to instructions given me some time ago by Dr. Aldrich in which he indicated that I should deal more and more directly with DD/P components, I feel that this meeting this morning was well worth while. [redacted] expressed, after the meeting, his pleasure to me with the way the briefing, the question session, and the conclusions that had been reached sounded. As further developments accrue, you will be kept apprised of progress with these various DD/P components and in particular, Division D.

[redacted]

C/BSD/ORD

SECRET

 E-? TACANA 6.2(d)

Draft as far as LSR is concerned. We recommended changes which art B. acknowledged.

BRIEFING STATEMENT

TACANA

This statement pertains to a sensitive emplacement program known as TACANA. The descriptor, TACANA, when used in this connotation, is classified SECRET.

TACANA should be considered as a restrictive-access approval clearance for information regarding a unique emplacement technique. The information that is to be protected is as follows:

1. TACANA - A short-range emplacement system which utilizes a special vehicle for either reconnaissance or emplacement of stay-behind devices.

2. Methods of implementation which would tend to impair the security of the system, i.e., referring to the vehicle in connection with any specific operation or means of delivery.

3. The vehicle's capability for doing specific tasks and any operational scenarios designated.

The TACANA activity, therefore, should be regarded as a most sensitive endeavor of the United States intelligence effort. Restrictive security measures and controls have been established for TACANA. They entail a strict enforcement of the "need-to-know" principle. Access to TACANA information will be limited to an absolute minimum number of people.

Access approvals for TACANA information are granted only by CIA. A master index is maintained by OTD/ORD/DDS&T, and by SB/DDO. Participants who have a question regarding an individual's clearance status must verify the existence of the clearance prior to any discussion of TACANA.

C1 by [redacted]
E2 IMPDET

~~SECRET~~

3.3(h)(2)

6.2(d)

Executive Registry

68-1290

DD/ST# 921-68

ORD 1322-68

11 MAR 1968

MEMORANDUM FOR: Executive Director-Comptroller

SUBJECT: CHIROLOGY - Marine Mammal Program

1. The purpose of this memorandum is to provide you with a current status report on the CHIROLOGY (formerly OXYGAS) program and to request additional FY 1968 funds.

2. The objective of the CHIROLOGY program is to develop a prototype system for interdicting marine logistics support in a non-attributable way. Although this objective is specifically aimed toward DOD use, the subsystems will provide CIA with a capability to achieve intelligence objectives originally established under the OXYGAS project.

3. Program plan. The overall direction of CHIROLOGY is the responsibility of a steering panel which includes Mr. Richard Cesaro of ARPA, Mr. Everett Greinke of DD/R&E, Mr. Harris Stone of U.S. Navy OP-07 and Dr. Stephen Aldrich of CIA. The technical direction of the program is the responsibility of [redacted] Chief, Biological Sciences Division/ORD. Demonstration of an operational prototype system is planned on or about 1 April 1969, twelve months after initiation of contracts. A general breakdown of the timing and costs of the program are attached.

4. Agency relationships and objectives. As a consequence of our previous discussion on 27 December 1967, we intend to:

a. prove or disprove the feasibility of this system in the shortest time possible;

b. maintain maximum control in terms of Agency objectives; and

c. achieve this at the least possible cost to the Agency.

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ORD 1322-68

SUBJECT: CHIROLOGY - Marine Mammal Program

Toward these objectives, we have established security control of the program, funded the first six months of the animal training program, provided the support boat and crew (Special Operations Division/DDP), and have authority from ARPA to act as the technical program manager for this program. In order to take advantage of Navy resources, we are terminating the current host-tenant agreement through the Office of Naval Research to the Key West Naval Base and are implementing a memorandum of understanding with OP-07 of the Navy which, in effect, provides us with broader access to Navy resources and manpower and transfers the cost of this aspect of the program to Navy and ARPA.

5. Current Funding Problem. In order to comply with a DOD desire to have a systems integrator for the program and to accelerate the program, an increase in project funding is required from DOD and the Agency. ARPA will be able to provide only approximately \$350K in FY-1968 for the initiation of the systems integration. These funds must be supplemented by \$200K from the Agency for the payload and guidance subsystems and \$150K to extend the contract with the animal trainers. ARPA's contribution in FY-1969 to complete the integration and to complete the payload and guidance subsystems could go as high as \$650K, depending upon a negotiated price of the systems integration, guidance and payload contracts. However, at this time ARPA can program only \$450K in FY-1969. It is my recommendation that the Office of Research and Development reprogram \$150K to extend the contract with the animal trainers and that additional Agency funds in the amount of \$200K be allocated to ORD immediately in order that the payload and guidance subsystems may be initiated. By following this course of action, we will reduce the overall Agency commitment in terms of dollars (none are currently programmed for FY-1969) and will maximize our control at an early stage. Another option would be to delay the development of the payload and guidance systems until FY-1969. I believe this option would delay completion of the program by a minimum of four months and would, in the long run, require greater funding on the part of the Agency.

6. It is requested that we be permitted to proceed with the management of this program as outlined above and that the additional

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ORD 1322-68

SUBJECT: CHIRIOLOGY - Marine Mammal Program

200 K of FY 1968 funds be made available in support of this program. Agency funding in FY 1969, other than that provided by SOD/DD/P ($100 K), is not required in the present project plan. I will be happy to discuss any aspect of this program with you if you so desire.

[redacted]

Stephen L. Aldrich, M. D.
Deputy Director
of
Research and Development

CONCUR:

[redacted]

Deputy Director for Science and Technology — Date

APPROVED: Additional $200,000 will be made available from the over-all DDS&T allocation

/s/ L. K. White — 2 APR 196

HKW

Executive Director-Comptroller — Date

Attachments
- A. Management Organization
- B. Funding Chart
- C. Program Development and Milestones

Distribution:
- Orig & 1 - Addressee
- 1 - DD/S&T Registry
- 1 - TA/DD/ORD
- 1 - C/BSD
- 1 - DD File
- 1 - DD Chrono
- 1 - ORD Registry

ORD:SLAdrich:pjk/2652 (4 March 1968)
(Re-typed: O/DDS&T/Compt/[redacted]:ldj/4020 (11 Mar 68)

SECRET

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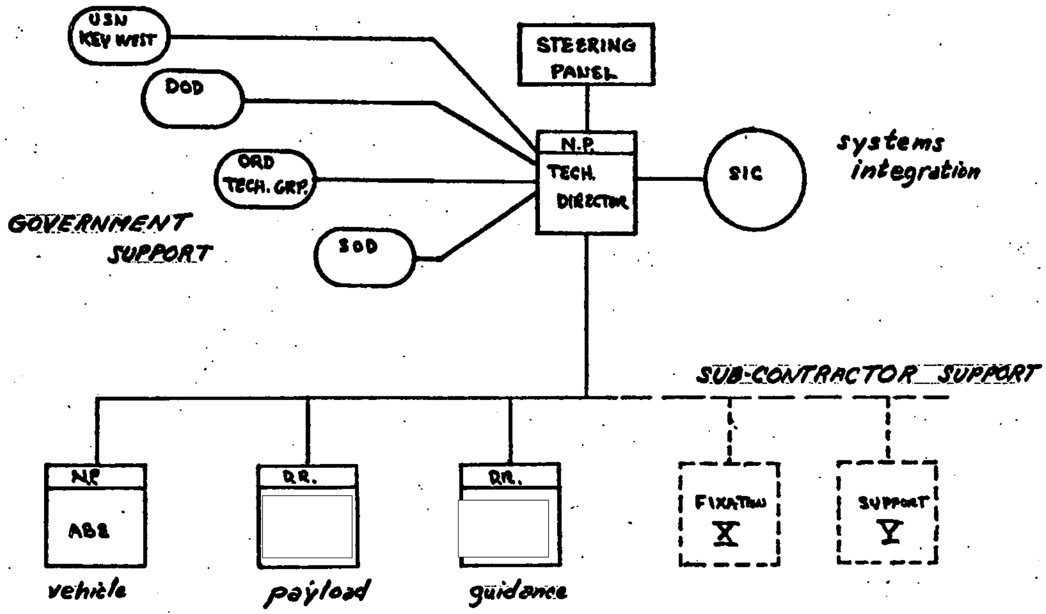
FUNCTIONAL ORGANIZATION CHIROLOGY



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CHIROLOGY FUNDING

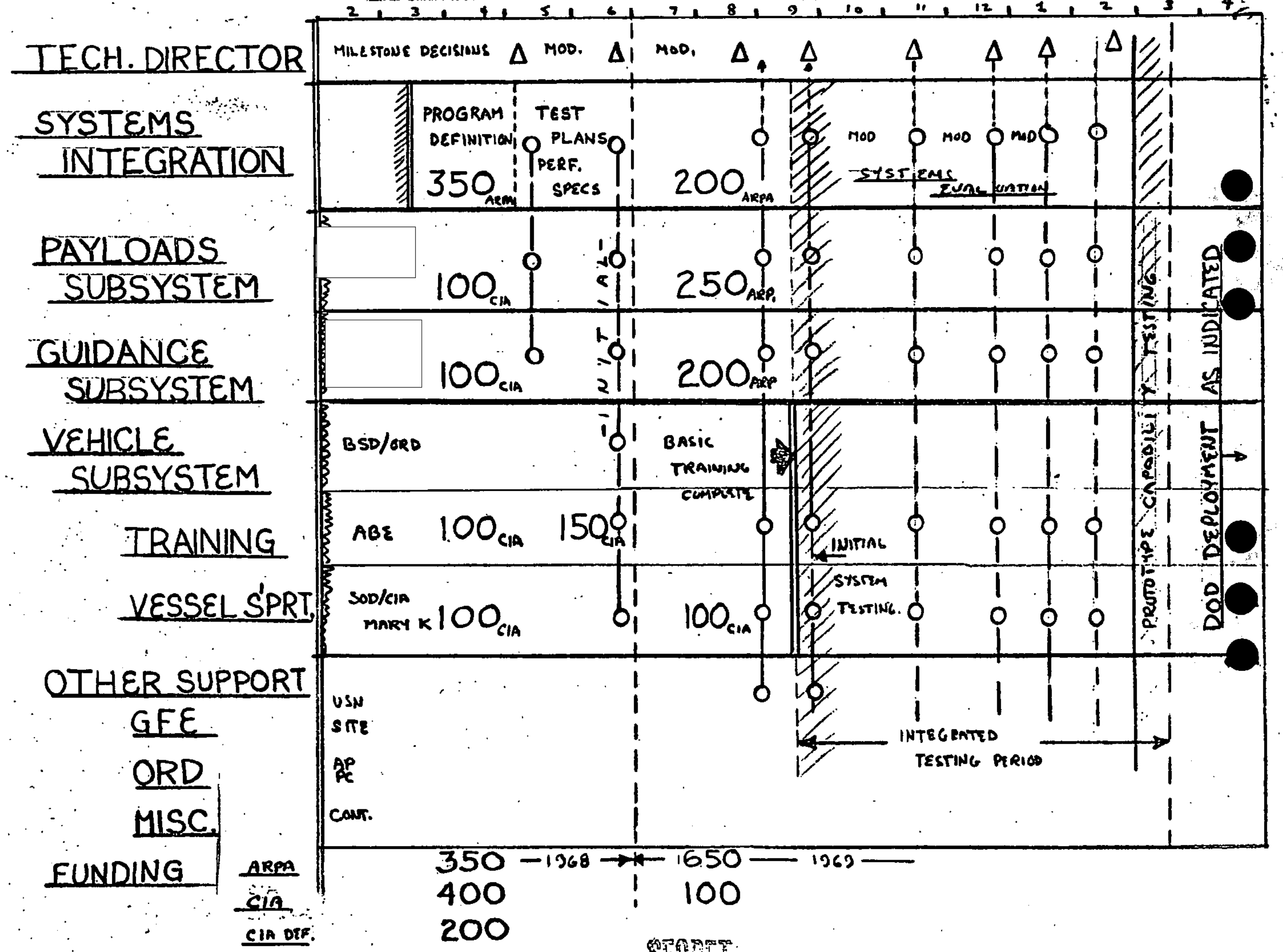
	FY 1968	FY 1969
SOD/DD/P (Maritime Support)	100 K CIA	100 K+ CIA
Animal Training and Support (200 K/year)	100 K CIA (6 mo.) 150 K CIA (9 mo.)	
Systems Integration (550 K/year)	350 K ARPA	200 K ARPA
[1] Payload (350 K/year)	100 K CIA	250 K ARPA
[2] Guidance (300 K/year)	100 K CIA	200 K ARPA
Support (ARPA, Navy)	GFE	GFE
Totals	900 K	750 K
ARPA	350 K	650 K
CIA	550 K	100 K

[1] This includes design and fabrication of the emplacement package, development of suitable non-explosive materials and ship fixation techniques.
[2] This includes tracking, mavigation and communication with the animal and his payload.

Funded FY 1968
To be reprogrammed in ORD FY 1968
Required from FY 1968 year-end funds

SECRET

TENTATIVE GANTT CHART - CHIROLOGY



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 6.2(d)

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LIMITED DISTRIBUTION

ORD #2783-68

22 April 1968

CHIROLOGY PROGRAM POLICY STATEMENT

The prime mission of the Chirology program has been defined as the underwater interdiction (emplacement and/or retrieval of payloads) of ships in motion or at rest at sea or in certain harbor situations. The ships referred to here can be considered as merchant ships as well as naval ships. Payloads for attachment or retireval are not connected with a destructive attack on the ship. The fundamental series of technological problems which this program is designed to investigate and demonstrate feasibility of are:

a. Long range remote electronic navigation and guidance of the porpoise. This includes the type of guidance system that best matches the man-animal interface.

b. The terminal guidance involving the animals' ability to be trained to target recognition of specific ship components or surfaces in an open loop fashion.

c. The specific elements involved with the payload package physical characteristics such as volume, weight, configuration, etc., and the attachment techniques required so that the animal can accomplish emplacement or retrieval.

d. Return of the animal to the launch or recovery point and support required in an open sea environment.

Methods of attachment and detachment, and specific parts of the ship to which the payloads are to be delivered should be considered in detail making use of an in depth study of the local properties and attributes of ship structure and configuration. It is understood that payloads to be retrieved should include items which are not necessarily emplaced by the porpoise.

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LIMITED DISTRIBUTION

ARPA-AS 68-94 #3

The above statements of policy and guidance have been discussed and agreed to by the members of the Chirology Steering Panel on 22 April 1968 in Room 3E 189, The Pentagon. Agreement is signified by the following signatures of the panel members:

[redacted]

Stephen Aldrich, MD — For CIA

Richard S. Cesaro — for ARPA

Everett Grienke — for DDR&E

Harris B. Stone — for Navy

3.3(h)(2)

6.2(d)

~~SECRET~~

ORD 2957-74

9 July 1974

MEMORANDUM FOR THE RECORD

SUBJECT: Contractor Site Visit, [redacted]

1. In general terms, the overall program is progressing as planned, within the limitation of current facilities and personnel. However, it was mutually agreed that the training activities should be accelerated. Obstacles to increased training activity are weather factors and limited commuting access to San Clemente Island. Additional training sites being investigated include the Naval Missile Center, Point Mugu; Anacapa Island National Monument (Department of Interior); private facilities in the Ventura County coastal region; and [redacted] In the interim period, prior to the acquisition of additional facilities, [redacted] will attempt to modify procedures so as to best utilize limited time and favorable weather conditions at San Clemente. Such procedures will include simultaneous boat transport of several birds with release of specific individuals for flights to target site at distances appropriate to their particular phase in the training program. Other methods of enhancing the utilization of facilities, favorable weather, and on-site personnel will be investigated.

2. Additional observations and subjects discussed during this visit included:

a. [redacted] has recently acquired a new bird housing facility in the [redacted] which includes five separate buildings with surrounding isolated terrain areas in which training for land operational scenarios may be accomplished. This

~~SECRET~~ E2 IMPDET CL BY [redacted]

new facility was inspected by the California Fish and Game Service representative who indicated that it was probably the best designed facility for care and housing of birds of prey in the country. Although the acquisition of this new facility was not considered at the time of contract negotiations, it will considerably enhance the research program.

b. [redacted] was contacted in regard to delineation of the work to be accomplished with the $7.5K additional funding provided by the partial return of funds from SOD which were to be utilized in support of the "summer cruise" operation. In spite of the 30 June deadline, [redacted] indicated that he would be able to modify the contract so as to incorporate the newly available funds into the R&D program.

c. Unfortunately the raven that has progressed to the six mile point in the training program was attacked by other birds and lost to the program. In spite of prolonged search on land and by boat, the bird could not be located after the attack. Such events are indeed disheartening but must be accepted as a calculated risk when dealing with living vehicles, and also accentuate the need for sufficient back-up birds. We do have an ample bird inventory which will soon be supplemented by the addition of three Peale Falcons and perhaps others, depending upon negotiations that are currently underway. However, bird availability does not negate the necessity for means of tracking the bird in flight over the twelve mile course. The Navy boat which was to be utilized at midpoint in the flight path was not delivered until last week, approximately two months after the promised delivery date. Utilization of a light beacon during the daylight hours does not seem feasible. [redacted] of OT/ORD is taking required action to utilize modified radar (transponder) equipment for bird tracking. As a supplement, [redacted] of LSR/ORD will attempt to assemble a simple radio beacon system, transportable by the bird and which will transmit over the 12 mile course.

ORD 2957-74

d. [redacted] has obtained a group of "band tail" pigeons which are very strong flyers and quite different from the domesticated variety. He has tested them with a 50 gram package and it appears that they have the capability for transport. In the near future [redacted] will evaluate these birds in terms of training and other factors required for a reliable vehicle. If these birds prove to be satisfactory many of our procurement and bird security problems would be eliminated.

e. Considering the fact that the use of birds for reconnaissance and emplacement vehicles has far greater operational application than for use against the SA-5 radar in the TACANA project, [redacted] is making some short film clips to demonstrate the feasibility and bird capability for meeting a variety of other operational requirements.

f. The hawks have completed training for the land based penetration project. During the next month an evaluation of this capability will be made utilizing a [redacted] and perhaps other denied areas, as covert photoreconnaissance targets.

3. As mentioned previously, a reasonable degree of program reliability will require a fairly large inventory of birds in various stages of training and maximum use of training time and facilities. This will necessitate the addition of one and perhaps two additional [redacted] personnel assigned to the program, which of course will proportionately increase the program funding support. As soon as definitive information is obtained regarding facility location and personnel requirements [redacted] will incorporate this information into the follow-on proposal.

[redacted]
LSR/ORD/DD/S&T

Distribution:
Original - Circ., LSR File
1 - OT/ORD [redacted]
1 - WCPO ([redacted]
1 - LSR Chrono
1 - ORD Chrono

LSR/ORD/DD/S&T [redacted]:mav:3658

~~TOP SECRET RUFF~~

6.2(d)

3.3(h)(2)

TCS-890732/76
Copy 1 of 3

MEMORANDUM FOR: [redacted] PAD/OWI

SUBJECT: Coverage Requirement

The attached requirement is forwarded as you requested.

[redacted]

Chief, Naval Systems Division
Weapons Intelligence

Attachment:
As stated

Distribution:
Orig - PAD/OWI [redacted] (w/att)
2 - C/NSD (w/att)
3 - TSSB/NSD Chrono (w/att)

OWI/NSD/TSSB/[redacted]/js (3 September 76)

HANDLE VIA
TALENT-KEYHOLE
CONTROL SYSTEM ONLY

WARNING NOTICE
SENSITIVE INTELLIGENCE SOURCES
AND METHODS INVOLVED

~~TOP SECRET RUFF~~

CLASSIFIED BY TKH-1
EXEMPT FROM GENERAL DECLASSIFICATION
SCHEDULE OF E. O. 11652, EXEMPTION CATEGORY:
§ 5B (1), (2), (3) or (4) (circle one or more)
AUTOMATICALLY DECLASSIFIED ON
Impossible to Determine
(unless impossible, insert date or event)

TCS-890732/76/a
NSD/OWI
3 September 1976

Requirement

We require close in photographs, of high resolution and suitable for detailed mensuration, of the following items of material and equipment at Admiralty and Sudomekh Shipyards, Leningrad, USSR:

[redacted]

Background and Justification

Both the Admiralty and Sudomekh Shipyards are major Soviet submarine construction facilities. The Admiralty Yard is now building V-class nuclear-powered attack submarines while the Sudomekh Yard is constructing the A-class, a nuclear-powered submarine with advanced design features. Satellite photography of these yards provides information on the configurations of submarines under construction. [redacted]

3.3(h)(2) 6.2(d)

~~CONFIDENTIAL~~

Not Sent

OTS/CB Memo #75-123
7 October 1975

MEMORANDUM FOR: OTS/COP

SUBJECT : D&E Role in Avian Training Program

REFERENCE : "Avian Demonstrations" Memo dated 27 August 1975 - ORD-3603-75

1. In the event that the reference demonstrations illicit a favorable response from the DDO operating divisions and some practical targets can be identified, OTS/CB will in all probability be responsible for the final development of the system. At this time, no FY-76 funds are budgeted for work in this area, although it was mentioned as a possible budgetary item in OTS/CB's planning paper if the ORD program was successful and if operational requirements justified OTS participation.

2. The avain training program involves the use of trained birds to perform some act, e.g. photography, sensor package emplacement, of operational significance in locations inaccessible to human agents. The present ORD Program is based on a requirement to photograph a specific portion of a Soviet SA-5 radar antenna. (This is a highly ambitious undertaking in that the bird would be required to fly a round-trip of about 30 miles i.e. 15 miles to the target, perch in a location which would permit collection of significant photographs and return to the launch point.) To my knowlege, the distance traveled by a trained bird to date is about 16 miles round-trip.

3. I have visited both of the ORD contractor's [redacted] during the past year for a first hand briefing on the state of the avian development. From these briefings and past experience, there is no doubt, in my opinion, that birds can be trained to perform emplacement, retrieval, and photography missions under a variety of scenarios. A survey

E2 IMPDET CL BY [redacted]

~~CONFIDENTIAL~~

of possible DDO operational use of trained birds was made about two years ago. Although some interest was expressed, the only requirement surfaced at that time was the above mentioned photography. In my opinion some worthwhile targets, which are more reasonably within the birds capabilities and easier to lay on operationally, need to be identified. Also in my opinion, OTS should be ready to take advantage of ORD developments and work toward one or more specific targets, if they are identified.

4. [redacted] OTS/CB is attending the referenced demonstration for DED. The main purpose of his participation is for technical briefing since he would be a prospective project engineer if OTS/CB got involved in this area.

[redacted]

M. David Boston
Chief, OTS/CB

3.3(h)(2)
6.2(d)

~~SECRET~~

ORD-2144-74

20 May 1974

MEMORANDUM FOR THE RECORD

SUBJECT: Discussion with [redacted], 9 May 1974, [redacted] California

1. [redacted] was taken to the sponsor'[redacted] office, and a review was made of TKH photography of [redacted] and the photos of the model of the Square Pair radar.

2. After a detailed study of the photography and the sketches sent there by [redacted], the following approach was suggested by [redacted] First, build the small antenna with the five helical elements in full scale (4' x 4 1/2') and reinforce training of the birds to it. Then, move this antenna from place to place. Subsequently, build a crude mock-up of the other elements of the radar on top of a van to train the birds for orientation in final picture taking.

3. A flashing beacon was purchased in [redacted] and [redacted] will verify its effect on the birds. If there are no ill effects (spoofing, etc.), then OTD will attempt to reduce the 6.3-ounce package to about 2 ounces (≈ 56 grams), mainly by a reduction in the weight of the batteries used to power the flasher. A brochure describing this flasher is attached. [redacted] is addressing this problem, and I am scheduling a meeting on 21 May 1974 with [redacted] and his staff.

4. The radar beacon was investigated and is available and compatible with the Decca Super 101 Radar on board our SOG boat in California; however, there are some minor problems. The radar beacon itself costs $750 to $1,000, and an HP receiver package compatible with the radar costs $2,500 (90-day delivery from time of order). [redacted] is gathering engineering field test results and I will get this on 24 May 1974. The

E2 IMPDET
CL BY [redacted]

~~SECRET~~

SUBJECT: Discussion with [redacted] 9 May 1974
[redacted] California

transponder receives at "X" band and transmits back at HF or VHF frequencies. At the present time, the boat's Decca Super 101 Radar antenna is being repaired after being damaged in a windstorm (repair time is five weeks from 8 May 1974). This unit should be checked out with our radar and would be a worthwhile backup to the flashing beacon. As an additional backup to this Ocean Applied Research (OAR) unit, [redacted] submitted a quote for the development of a similar beacon, and the development costs would be about $12,500 with a three-month delivery time. This quote is included for completeness; however, the OAR units are available and possibly a unit could be borrowed from [redacted] of the Navy undersea group in San Diego for test and evaluation. When this becomes available, an SOG man and I should check this unit out.

5. While determining the status of bird training, the subject of motor-sailer type boats was discussed. I told [redacted] of my concern about the size or color of the jib sail and asked whether or not the birds might be spoofed by it. [redacted] explained that the birds could adjust to it quite easily, but it would be worthwhile training them to it early as they would have to be retrained to land on a boat with sails. Since we will eventually be using sailboats, we should make provisions for getting boats with the same color jib for all boats used. I asked [redacted] to generate a list of questions he would like answers to during the rehearsal cruise. [redacted] and I will generate a list of questions for the SOG people to answer during the rehearsal phase as well as the log format desired by us.

[redacted]

Operations Technology, ORD

Attachment:
A/S

/. radar transponder tracking system developed
r contract with U.S. Navy in 1972)

OAR

ystem Description

The function of the system is to mark a flying animal n such a way that its range and bearing can be determined. system block diagram is shown in Figure 1. The system onsists of an X band radar set of standard design which s used to interrogate the remote package and to display he range and bearing, and a remote transponder capable of eceiving the radar's interrogation and responding. In his specific system the response to the radar's interro- ation is a short pulse of radio frequency not in the radar and (9350 MHz) but in the H. F. band. Tests for Phase I ere run with a response at 31 MHz, the center frequency of he radar's intermediate frequency amplifier. In operation 31 MHz receiving antenna is connected to the input of the adar I.F. amplifier so that the return pulse is displayed in the same manner that the normal radar return would be. Since the normal radar receiver is disconnected, the normal radar return is not displayed leaving the screen blank ex- cept for the transponder's signal.

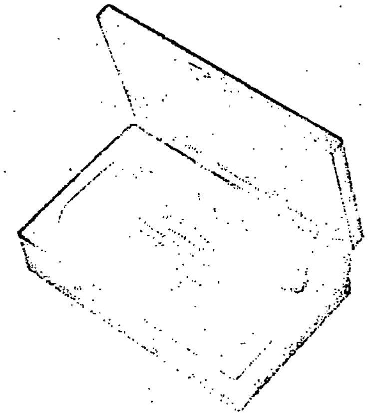
Transponder Design

A block diagram of the transponder is shown in Figure 2. It consists of an X band monopole antenna, a stripline matching network, a video preamplifier, a triggered pulse gneerator, and an V.H.F. 2-stage transmitter. A skematic of the transponder is shown in Figure 3. The battery stack supplies 3 volts for the video amplifier and 9 volts for the transmitter.

Radar Modifications

The radar ultimately furnished for this program is a Karr Voyageur Marine Model LN55. Mounts for the radar com- ponents were fabricated into one module so that the unit may be moved easily by two men. Electrical modification included analysis of the IF amplifier and disconnection from the X Band mixer; design of a matching network and band pass filter to connect a 150 MHz, 1/2 wave whip antenna.

Approved for Release: 2019/07/30 C06638336



DESCRIPTION

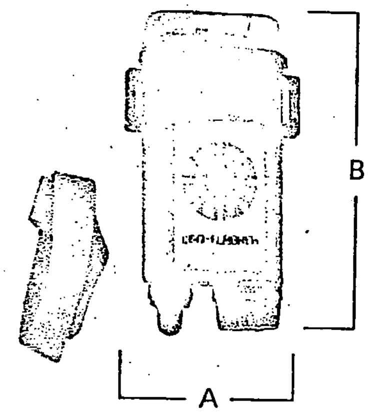
The Save Ur' Lif'r is a compact, self contained pocket sized, high intensity strobe flasher that is designed for the search and rescue of individuals who are lost on land or sea. It was designed to meet the very rigid test requirements of the Department of Defense and is mandatory equipment for all fliers.

It provides very brilliant flashes of strobe light, fifty times per minute, of approximately 500,000 peak intensity candlepower and can be seen for great distances.

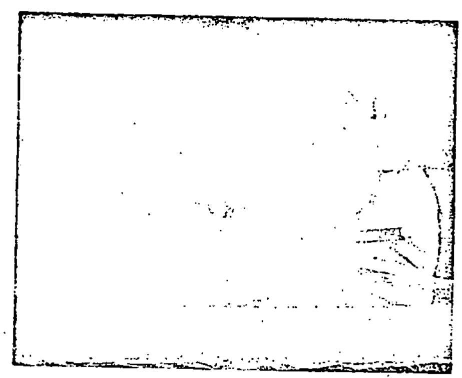
It is waterproof (operates submerged) – It is shock and vibration proof – It operates at both very low and high temperatures and has a special mercury battery that will provide up to 12 hours of continuous flashing.

The case is molded of high impact, bright, orange plastic and the reflectorized xenon lamp flashes through a clear plastic lens, giving wide angle visibility. The battery screws into the case for easy replacement.

It comes equipped with a woven loop to permit its being attached to a belt or other parts of clothing or a military type of carrying pouch is available at slight extra cost.



SAVE UR' LIF'R
Distress Marker Light
Model SDU – 5/E



ENGINEERING DATA

LIGHT INTENSITY (CANDELAS)		DIMENSIONS (INCHES)	
		A	B
Light, Peak Intensity	500,000	2½	4½
Flashes Per Minute	50		
Lamp	Xenon	Materials:	
Battery, Sealed	Mercury	Case	Orange Cycolac Plastic
Voltage	5.2 volts	Weight:	
Hours, Flashing	10	w/Battery	~~4~~ 6.3 oz.

BATTERIES (2.62oz) ≈ (73.5g)

SPECIALIST IN LIGHTING and COMMUNICATIONS

NEO-FLASHER ELECTRONICS INC. 11975 SHERMAN RD., NO. HOLLYWOOD, CA. 91605

7

May 3, 1974

U.S. Government
Washington, D.C.

Gentlemen:

The following information is submitted for the development of a miniature X-band transponder which will meet the following characteristics.

Input Frequency Range	9.415 to 9.475 GHz
Input Trigger Sensitivity	-40 dbm
Input Pulsewidth	.5 μsec nominal
Input PRF	1500 pulses per second
Output Frequency (Fixed)	150 MHz
Output	A pulse pair for every input trigger pulse
Output Pulse Code	A 2 μsec pulse followed by a 1 μsec pulse separated by a 2 μsec off period
Output Pulse Peak Power	100 mw +3 db
Output Frequency Stability	$\pm$ 1.0 MHz
DC Input Power	30 ma average max from a 5V. battery, battery end life 4V. DC
Input & Output RF Connectors	3 mm Female OSSM
DC Supply	Solder pins
Size	1x1x3 inches excluding connectors, 3 ounces

Prototype cost is $12,500 and delivery is to be three months ARO.

We have reviewed the proposed power budget and the results of our review are as follows:

[redacted]

U.S. Government
May 3, 1974
Page -2-

Assuming a transmitter power of 3 KW (+64 dbm) for the X-band transmitter and 24 db transmitter antenna gain, a 136 db path loss, and a 0 db receiver antenna gain, we note that at best we have -48 dbm left at the receiver terminal. Further assuming that the receiver will be designed around a biased hot carrier detector, we can only depend on a -52 dbm tangential sensitivity for the detector. Allowing a 2 db preselector loss and a 10 db signal to noise ratio being necessary for reliable operation, the calculated minimum input level required is -40 dbm. This gives us a discrepancy of 8 db which either has to be accounted for by obtaining an equivalent antenna gain for the transponder receiver or will result in the reduction of the operating range from 10 miles to 4 miles.

We have additionally examined the adequacy of the 100 mw peak output power at 150 MHz and concur that any reasonable superhet receiver and reasonable antenna should be adequate.

Should we be able to provide you with any additional information, please do not hesitate to contact us.

Sincerely,

[redacted]

Vice President

[redacted]

 6.2(d)

22 NOV 1965

MEMORANDUM FOR: Deputy Director, Research and Development, DD/S&T

SUBJECT : Dolphin Training Project (Project OXYGAS)

1. The DD/P Technical Requirements Board found the presentation of this subject which you made on 16 November 1965 valuable and interesting. We appreciate the briefing.

2. You asked that the Clandestine Services determine if there is a conceptual requirement which justifies Project OXYGAS. You stated that if the project were to be continued, a modified boat would be needed, and, in about eight to ten months, an operationally trained Clandestine Services officer should be assigned to the project to integrate with the system.

3. The Technical Requirements Board considers the effort to develop dolphins as emplacement and retrieval vehicles for use in clandestine operations warranted under existing conditions. It endorses DD/S&T's research and development efforts in this area. Barring some unforeseen circumstance, the modified boat and the operations officer needed to integrate with the operational aspects of the project will be provided by the Special Operations Division.

[redacted]

Chairman
Technical Requirements Board

GROUP 1
Excluded from automatic
downgrading and

6.2(d)

A HMEN

2? NOV

MEMORANDUM FOR: Deputy Director, Research and Development, DD/S&T

SUBJECT : Dolphin Training Project (Project OXYGAS)

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Chairman
Technical Requirements Board

16 FEB

CONTACTS AND EXPERTS IN BIOMEDICAL COMMUNICATIONS

PK (File)

Dr. Charles W. Shilling, M.D. Director, Biological Sciences Communication Project, The George Washington University

Dr. Charles Bernier, National Library of Medicine

Dr. Sumner O. Burhoe, Professor of Biology and Chairman of the Department, The American University.

Mr. Ralph I. Cole, Director of Institutes and Special Programs, Center for Technology and Administration, The American University

Dr. Ira Hansen, Professor of Biology, The George Washington University

Mr. Paul W. Howerton, Director, Center for Technology and Administration, The American University

Dr. Foster Mohrhardt, Director, National Agricultural Library.

Dr. John Parks, Dean of the Medical School, The George Washington University

Mr. Joseph W. Tyson, Associate Director, Biological Sciences Communication Project, The George Washington University

Dr. Larry Christianson, Director, Data Processing, Veterans Administration

Dr. Anne Summerfield, Systems Development Corporation

Dr. George Williams, Laboratory of Clinical Pathology, National Institutes of Health

Dr. Raymund Zwemer, Director, Federation of American Societies for Experimental Biology, Translation Project

Colonel William McIntosh, National Aeronautics and Space Administration

Captain John DeCoursy, Military Entomology Information Service, Department of the Army

Dr. Quentin Hartwig, Office of Technology Utilization, National Aeronautics and Space Administration

CONTACTS AND EXPERTS IN BIOMEDICAL COMMUNICATIONS

Dr. Errett C. Albritton, National Institutes of Health

Miss Winifred Sewell, National Library of Medicine

Dr. William S. Barker, Head, Studies & Support Section, Office of Science Information Service, National Science Foundation

Dr. I. H. Sher, Institute for Scientific Information

Mr. Melvin Day, Scientific and Technical Information Division, National Aeronautics and Space Administration

Dr. Monroe Freeman, Director, Science Information Exchange

Mr. John Sherrod, Chief, Information Services and Systems Branch, Atomic Energy Commission

Dr. Jack Stearns, National Referral Center

Mr. Gregory Abdian, Defense Documentation Center

Dr. Frank Fremont-Smith, New York Academy of Sciences

Dr. M. M. Kessler, Associate Director of Libraries, Massachusetts Institute of Technology

Dr. Orr Reynolds, Director, Bio-Science Programs, National Aeronautics and Space Administration

Dr. Walter Claus, Division of Biology and Medicine, Atomic Energy Commission

Captain John C. Busby, SC, United States Navy

Mr. Scott Adams, Deputy Director, Medical Literature Analysis and Retrieval System, National Library of Medicine

3.3(h)(2)

6.2(d)

14 February 1964

MEMORANDUM FOR: Chief, Life Science Division, Office of Research and Development

SUBJECT : Dolphins

1. In reference to your memorandum dated 4 February 1964, the [redacted] proposals have been reviewed, and the following comments are to be noted:

a. Phase I-B, paragraph 4, Harbor Location from Boat. The Maritime Branch is primarily interested in the "unmanned" mode as opposed to the "manned" mode of harbor penetration and therefore would like to know [redacted] [redacted] ideas as to how this "unmanned" mode is to be accomplished.

b. Phase I-B, paragraph 5, Post-Mission Rendezvous with Boat. It is assumed that the basic sonar beacon rendezvous training will be accomplished in the compound prior to open water trials.

c. Phase I-C, paragraph 2,3. The transfer of dolphin control from trainer to field agent does present a definite problem. Could this problem be overcome by using several different trainers during the basic phases and at the same time develop the dolphin loyalty not to be dependent on "who gives the signals and rewards" but rather on what the "proper and accustomed signals and rewards" are to be. Thus the "signals and rewards" are always known to the dolphins and become the predominant, as opposed to the "trainer", factor in the training, in the hope that the transfer from trainer to field agent would then become easier.

SECRET

GROUP 1
Excluded from automatic downgrading and declassification

2. The Maritime Branch definitely plans to monitor the entire program from concept to finish, however, existing and future maritime operational commitments may limit participation during specific periods.

3. Maritime Branch appreciates and welcomes ONR support in this program, and would like Dr. Galler's office to periodically review the progress reports. However, it is desired that knowledge of specific operational applications be limited to CIA personnel only.

[redacted]
Chief, Maritime Branch
Special Operations Division

~~SECRET~~

3.3(h)(2)

6.2(d)

7 February 1964

MEMORANDUM FOR: Chief, Life Science Division, Office of Research and Development

SUBJECT : Dolphins

1. The Maritime Branch of SOD is extremely interested in the proposed work to be done by [redacted] in connection with the training of Dolphins.

2. When work under the contract with [redacted] has progressed to the point where simulated operational requirements might be introduced into the program, we would be delighted to assist in this phase of the work.

3. We appreciate Dr. Aldrich's suggestion that the Maritime Branch of SOD monitor this program from time to time. The Maritime Branch will avail itself of this privilege.

[redacted]

Chief, Maritime Branch/
Special Operations Division

 6.2(d)

3.3(h)(2)

ORD 2690-64
3 December 1964

MEMORANDUM FOR: Chief/Maritime Branch/SOD

SUBJECT: Extension of Project OXYGAS

1. Attached are two copies of a proposed follow-on for Project OXYGAS which reflects the views of individuals in ORD and [redacted] from your Office. This proposal, if supported, will begin in January and will continue for six months. Both the tasks and the cost estimate are subject to negotiation which, for budgetary reasons, will have to be completed by the end of December. Before holding further discussions with the contractor, I would like to receive your endorsement and comments on the following.

a. Assuming that the contractor successfully completes the current technical feasibility study, will Maritime Branch/SOD still be interested in the program? Will Maritime Branch/SOD undertake operational feasibility, assuming successful completion of this second phase?

b. We would like to have you submit tasks of more direct operational interest to Maritime Branch/SOD which might be added to or substituted for those listed in the attached proposal. You will note that the system design study is incorporated in this proposal. I believe you were interested in sea launch and recovery and air transportation of the animals. In the light of our earlier discussions, I will be happy to add these tasks if Maritime Branch/SOD will provide the necessary support to carry them out. Specifically, this may include air transportation, a chase boat as listed in cost estimate item 3.1, and the use of a larger vessel similar to one which might be used in a future operational situation. Our Office is reluctant to purchase this equipment as we would have no further use for it in the foreseeable future.

c. As in the past, we request active participation by Maritime Branch/SOD in the monitoring of this study and would like to have an appropriate member of your staff survey [redacted] as a potential operational testing site.

d. Certain types of special equipment (u/w telephones, homing devices, etc.) designed primarily for your operations may be required during the course of this study which would require additional funds. This may amount to perhaps 10-12 K during the six-month period. Your financial support would be appreciated if funds are available to you, assuming we mutually agree that these equipments are essential to the study.

2. I would like to reinforce my comment during our previous meeting with respect to our intentions in this project. We will continue to support the research and technical aspects with manpower and funds through FY'65. If this project proves to be promising, the program will become increasingly operational. We should then expect to phase out our support except in technical areas. I cannot foresee exactly where the cutoff point will be but feel we can work this out on a mutually satisfactory basis as the program developes.

[redacted]

STEPHEN L. ALDRICH, M. D.
Deputy Assistant Director
Office of Research and Development

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Feasibility Research on a System to Provide High Resolution Photography Over Denied Areas

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April 1978
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Feasibility Research on a System to Provide High Resolution Photography Over Denied Areas

A Research Study

By

Charles N. Adkins

Operations Technology Division

Office of Research and Development

APPROVED:

Chief, Operations Technology Division, ORD

April 1978

Date

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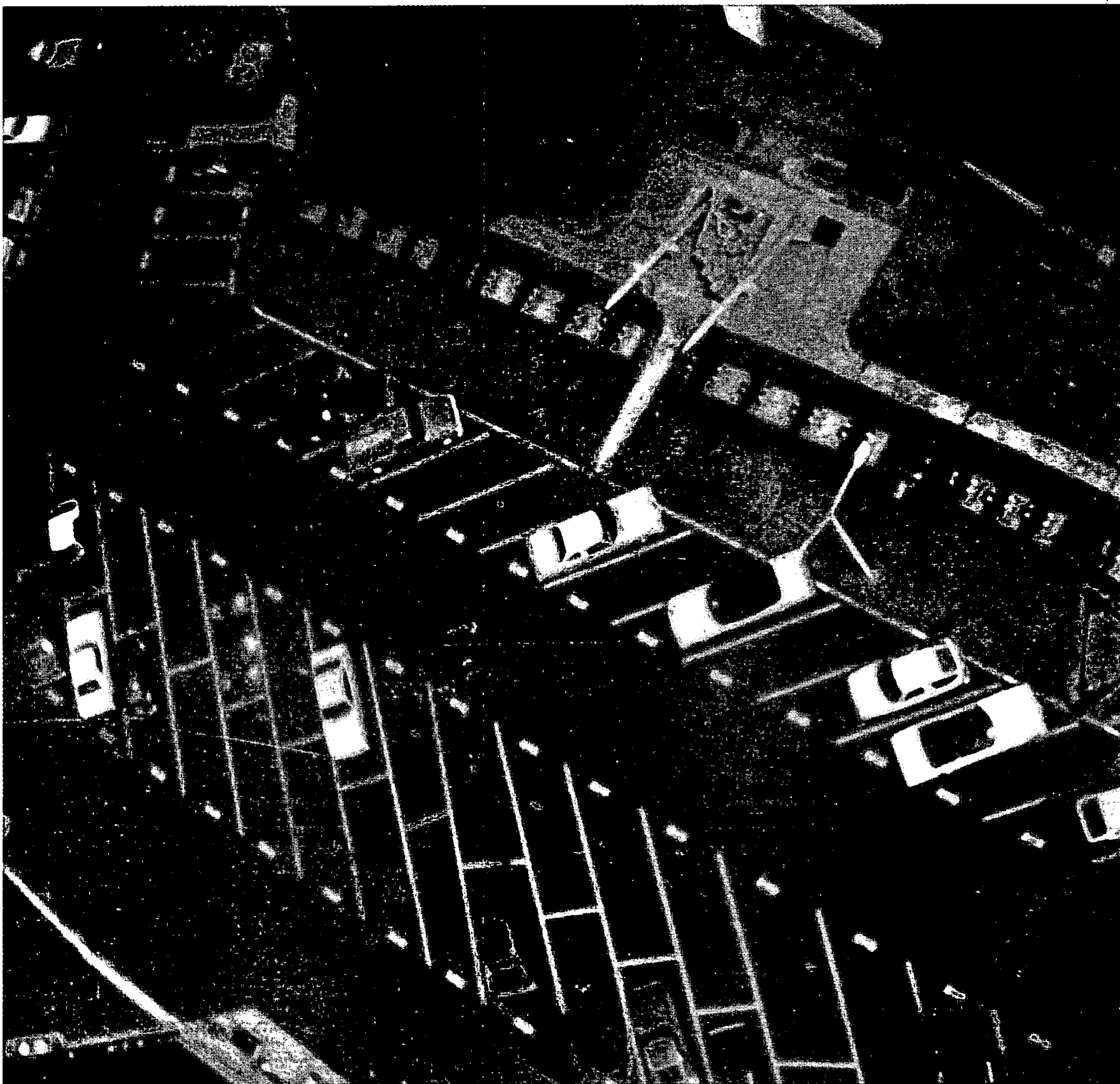

2445 Color of Museum Park

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FEASIBILITY RESEARCH ON A SYSTEM TO PROVIDE HIGH RESOLUTION PHOTOGRAPHY OVER DENIED AREAS

ABSTRACT

~~(TS)~~ Research was conducted on a system (Tacana) which may provide high-resolution photography over denied areas by the use of homing pigeons. The pigeons receive no specialized training; they fly from the release point across the target to the home loft (e.g., [redacted] etc.). An adjustable timer in the camera starts the photographic coverage over the target and lasts for about four minutes (150-220 pictures). Each picture covers an area on the ground about 90 feet square. The research was directed toward photographic coverage of denied areas where direct overflight is possible. Coverage of the Soviet Nuclear A-class submarine work at the shipyards in Leningrad was considered as an example high-priority target. Two simulated targets (Andrews AFB and the Washington Navy Yard) were chosen to provide data on system performance, including in-flight photography. The photographic analysis was performed by NPIC and compared with overhead satellite photography and the specific intelligence requirement in the Leningrad area. It is concluded that there is a good probability that homing pigeons can be used to satisfy the high-resolution photographic requirement in the Leningrad area. A 16mm silent film is available showing various aspects of this program. High resolution prints of the Avian Photography are available under separate cover as a supplement to this report.

ACKNOWLEDGMENTS

~~(C)~~ The National Photographic Interpretation Center (NPIC) provided all photographic development and analysis. This was coordinated through [redacted] (ISB/ APSD/TSG) who also directed the photographic experiments and recommended the type film and film development best suited for this particular system.

~~(TS)~~ Acknowledgment is also extended to the Deputy Director for Intelligence (DDI), whose offices (OIA and OWI) provided data associated with the Agency's high-resolution photographic require-

ment in the Leningrad area. The DDI was also instrumental in arranging the temporary reassignment of [redacted] (an avid homing pigeon enthusiast) from the Office of Strategic Research to the Office of Research and Development. [redacted] was responsible for the selection of loft keepers in Oregon, Alaska, and Virginia and directed the relocation experiments. He was also responsible for collecting the photographic data over the two simulated targets (Andrews AFB and the Washington Navy Yard) which included all aspects of operation, maintenance, and field repair of the avian cameras.

PART 1
INTRODUCTION

~~(TS)~~ The idea of using birds for emplacement and photographic coverage has been explored by the Agency for several years. These studies invariably required some form of specialized training which required the birds to respond in a desired, predictable way to a specific recognized object. The purpose of this research is to investigate the collection of high-resolution photography by the use of homing pigeons which receive no special training other than learning to carry a small avian camera. The pigeons fly from the release point across the target to the home loft [redacted] An adjustable timer in the camera starts the photographic coverage over the target and lasts for about four minutes (150-220 pictures). Each picture covers an area of about 90 feet square from an altitude of 100 feet and has a resolution on the order of one inch (see Appendix A: Evaluation of Photographic Coverage).

~~(TS)~~ Though this research applies to any target where direct overflight is possible, photographic coverage of the Soviet Nuclear A-class submarine work at the shipyards in Leningrad is considered as an illustrative example. Part 2 of this report discusses the high-resolution photographic requirement in the Leningrad area and shows the possible launch points, target sites, and loft locations [redacted]

~~(S)~~ With the exception of the camera development, this research was conducted in the time frame between September 1976 and July 1977. The program was designed to answer critical questions associated with the relocation of homing pigeons, their ability to collect photography over example targets, and the behavior and statistics of their performance. Part 3 discusses the camera development, and Part 4 describes two example targets in the Washington, D.C. area (Andrews AFB and the Washington Navy Yard) used to provide statistical data and in-flight photography. Part 5 addresses bird behavior and statistics for the relocation and example target phases of the program. An example Scenario and Mission associated problems are discussed in Part 6. Part 7 presents the Summary and Conclusions and discusses certain areas in which further research may be needed.

~~(TS)~~ The analysis of the photography collected over the example targets was performed by NPIC and compared with overhead satellite photography and the specific intelligence requirement in the Leningrad area. This analysis is presented in Appendix A. It is felt that the overall results to date firmly establish the feasibility of using homing pigeons to collect the desired high-resolution photography in the Leningrad area. The total contractual cost for this research was $78,000.

PART 2

TARGET DESCRIPTION

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PART 3
CAMERA DEVELOPMENT

Background

~~(S)~~ Significant camera development started subsequent to the [redacted] tests conducted in the fall of 1975. During these tests, pigeons flew with an MCW-22 camera which used 9mm film, a Minox "Bull's Eye" lense, and weighed about 55 grams. The shutter speed at this time was 1/200 to 1/400 of a second, and a very high percentage of the pictures were excessively blurred. It was determined that the blurring was due to angular rates produced by the six hertz flapping frequency of the bird. Calculations conducted in late 1975 predicted a required shutter speed of 1/1200 to 1/2500 of a second in order to obtain resolutions on the order of one inch per 100 feet of altitude. However, with the f/3.5 Minox lense, exposure constraints precluded rates faster than 1/1400 of a second. Therefore, two approaches were taken: first, research was initiated on a [redacted] f/2.7 lens to permit subsequent design of a very high speed camera; and, second, a 1/1400-second system was designed and constructed using the existing Minox lense and a 16mm film format. This camera, called the MCW-24, weighed only 35 grams and was first test flown in January 1976. Furthermore, this camera contained two timing circuits (the MCW-22 used only one) which not only turned the camera on at the predicted time-over-target, but also turned the camera off at the end of the roll. This second timer prevented excessive camera wear and increased the system reliability to a great extent. The design of this camera also included a linear motion compensation feature; the film velocity during the taking of pictures exactly compensates for a forward ground velocity of about 36 mph at 100 feet altitude. This feature was verified by photographing bar charts fixed to the side of an automobile driven at various speeds.

~~(S)~~ The MCW-24 was test-flown through the spring and summer of 1976 for a total of about 30 flights. About 20 to 30 percent of the pictures taken during these tests showed a resolution of one inch (or better) per hundred feet of altitude (100 feet is a typical altitude), whereas about 30 percent also showed resolutions of 1½ to 2 inches, and about 40 to 50 percent were excessively blurred due to flapping and high roll rates of the bird in turns. This was close to the expected result and verified the prediction that the high-speed [redacted] camera would be required to obtain high resolution a large percentage of the time. Table 4 lists some data for the MCW-24 camera. Here, resolution is defined by the measurements from "bar charts" which were photographed from the birds during in-flight experiments. Figure 9 shows the MCW-24 camera with harness.

Current Effort

~~(S)~~ The current effort was begun in early October of 1976. The [redacted] six-element lens system (f/2.7) had been assembled and tested, and work was initiated to develop a complete [redacted] Camera" with a shutter speed of about 1/2400 of a second. At this time tests were initiated, using the MCW-24 Camera to investigate a variety of film types and several film processing techniques under a variety of sun angle/lighting conditions. These tests, directed by NPIC, were conducted by use of a helium-filled balloon which hoisted the camera aloft to take pictures of bar-chart and miscellaneous targets. Figure 10 is a print using 3400 film processed in D-76 for five minutes. The sun angle is 68 degrees and the ground resolved distance (GRD) is 0.56 inches at 50 feet. Tests were also made with color using Aero Color negative 2445 and MS Ectachrome positive. Special AHU film and a high-resolution 3414 film were tested, as well as equivalent types with ultra thin base. The 3400 (or 3410) is essentially a "pan X" film and was selected over the higher resolution films because of its greater speed and the fact that GRD, or blurring, was due more to the avian platform motion than the "graininess" of the film. The MCW-24 camera was test flown on birds a total of 49 times, which includes 12 flights over Andrews Air Force Base and seven flights over the Washington Navy Yard. There were a total of three MCW-24 camera failures, one due to film jamming and two due to damaged E-cells in the

TABLE 4

MCW-24 Characteristics

Camera Plus Film		28.0 grams
Timer and Batteries		7.0 grams
Harness		4.5 grams
TOTAL		39.5 grams
Lense:	f/3.5, 15 mm focal length	
Film:	16 mm format 90′ wide by 45′ in track at 100′	
	140 to 200 pictures per roll	
	14 acres area coverage per roll	
	1.5- to 2-inch resolution at 100′	
Dimensions:	0.8 x 0.8 x 1.8 inches	

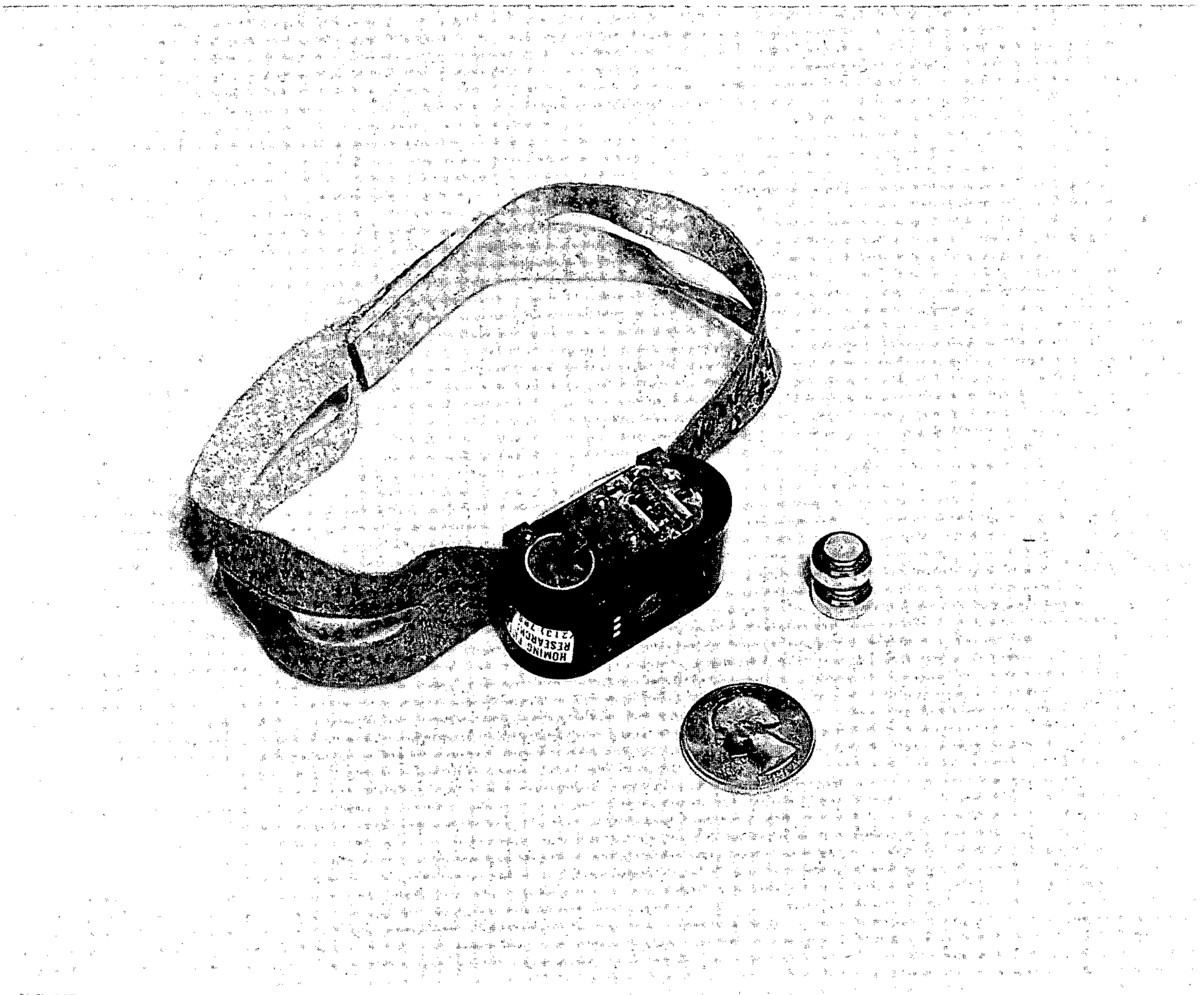

FIGURE 9. MCW-24 Camera

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timer circuit. The faulty E-cells were traced to an improper timing procedure which allowed transient current spikes to damage the E-cells. Also, analysis of the flight films over Andrews Air Force Base showed that the pictures taken with the MCW-24 camera had considerably more blurring than those taken during the spring and summer of 1976. This was traced to a fatiguing of the shutter spring which caused a reduction in shutter speed from 1/1400 of a second to 1/1000 of a second. Since delivery of the new [redacted] camera was imminent at the time this problem was diagnosed, no attempt was made to redesign the MCW-24 shutter spring. Other detailed data on temperature tests, current drain, and battery performance are contained in Appendix B.

~~(S)~~ The [redacted] camera with f/2.7 lens was first test flown on 21 January 1977. This system provides a square format on 16mm film which covers an area of 90 feet by 90 feet on the ground from

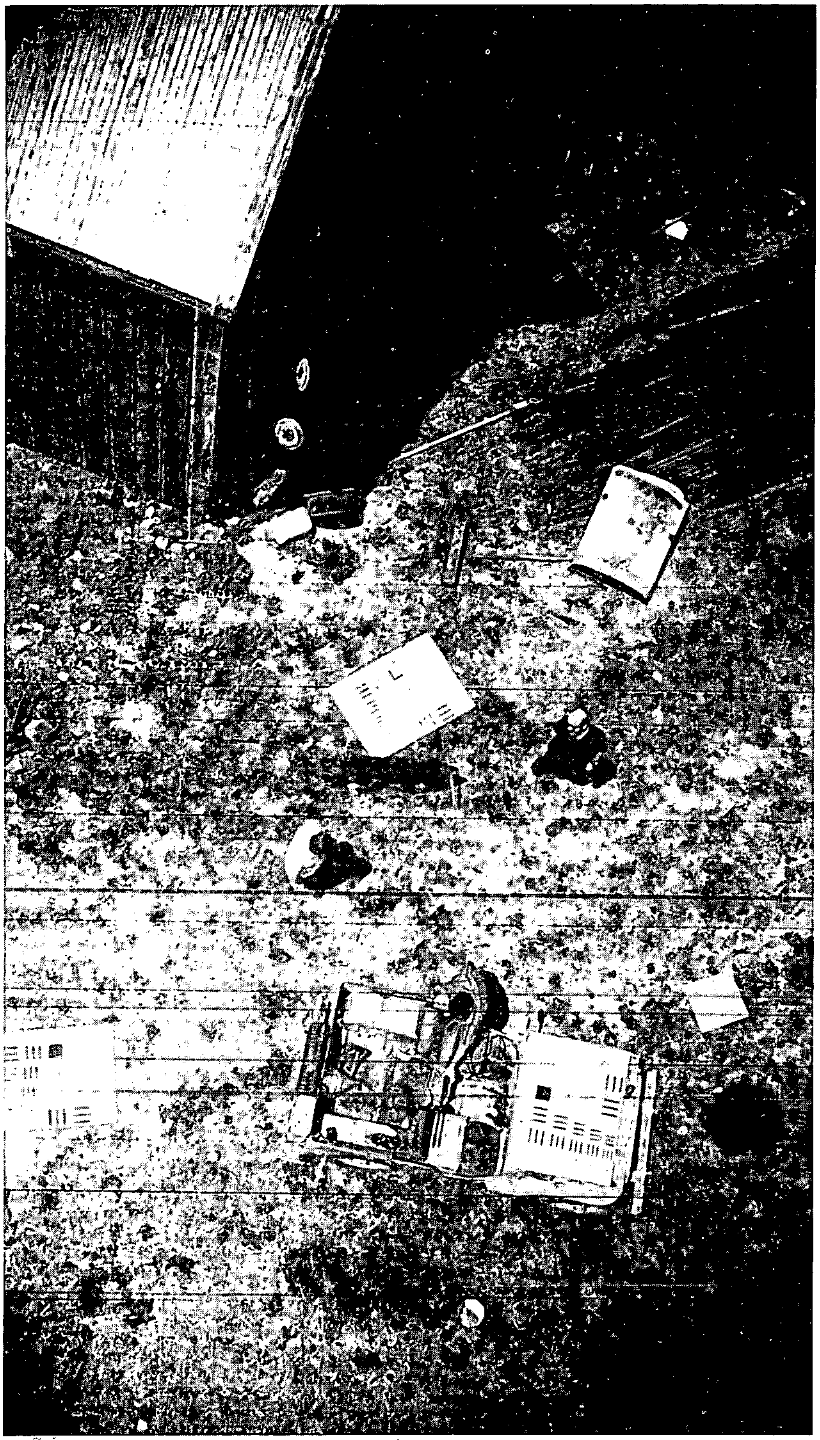

FIGURE 10. Balloon Picture Using 3400 Film SECRET

an altitude of 100 feet. The film capacity is 220 frames (using UTB film) which corresponds to about 41 acres of area coverage per roll from 100 feet altitude. The first [redacted] camera, labeled C-10, had a shutter speed measured at 1/2200 to 1/2400 of a second. On the second flight over the Washington Navy Yard, this camera and bird were lost; the bird returned two weeks later without the camera. However, almost all pictures from the first flight over the Yard were extremely sharp and showed little blurring due to platform motion.

(~~S~~) [redacted] cameras C-11 and C-12 were received from the contractor and test flown through early July of 1977. However, these cameras experienced several shutter failures which were eventually traced to too deep an anodizing process which was structurally weakening the shutter material. This problem was corrected and the cameras were also modified so that new shutter assemblies could be installed in the field should failures continue to occur. No further camera failures occurred, but it was noticed that the pictures from C-11 and C-12 were not as consistently sharp as those from the one roll of C-10. The problem was finally traced to a malfunction in the timing equipment used to measure the shutter speeds of C-11 and C-12. The result was that all pictures taken by C-11 and C-12 prior to July 1977 were made with shutter speeds of only 1/1600 of a second instead of the desired 1/2400 of a second. This problem was corrected and four additional flights were made with camera C-11 and six with C-12. Table 5 gives some general data for the [redacted] camera, and Figure 11 shows the [redacted] camera with harness and avian transmitter. Figure 12 shows the bird

TABLE 5

[redacted] CAMERA DATA

LENS
- Wide angle 48.5° Circular Field (90 ft. at 100 ft.)
- Less than one inch resolution at 100 ft.
- f/2.7 with 15mm focal length

FILM
- 16mm format with 220 frames/roll
- Motor driven continuous 1.2 sec/frame
- 3 or 4 rolls per set of batteries
- 41 acres area coverage/roll at 100 ft.

WEIGHT

Camera, film, batteries, fasteners	43 g.
Harness	4.5 g.
TOTAL	47.5 g.

Dimensions—7/8 x 1 x 2.2 inches
Shutter speed—1/2200 to 1/2400 of a second.

with camera and harness. Other detail data are contained in Appendix B.

~~(S)~~ At this time it is felt that the [redacted] camera contains all the features required to obtain the desired high-resolution photography from a bird platform, and that sufficient research has been conducted to adequately demonstrate feasibility.

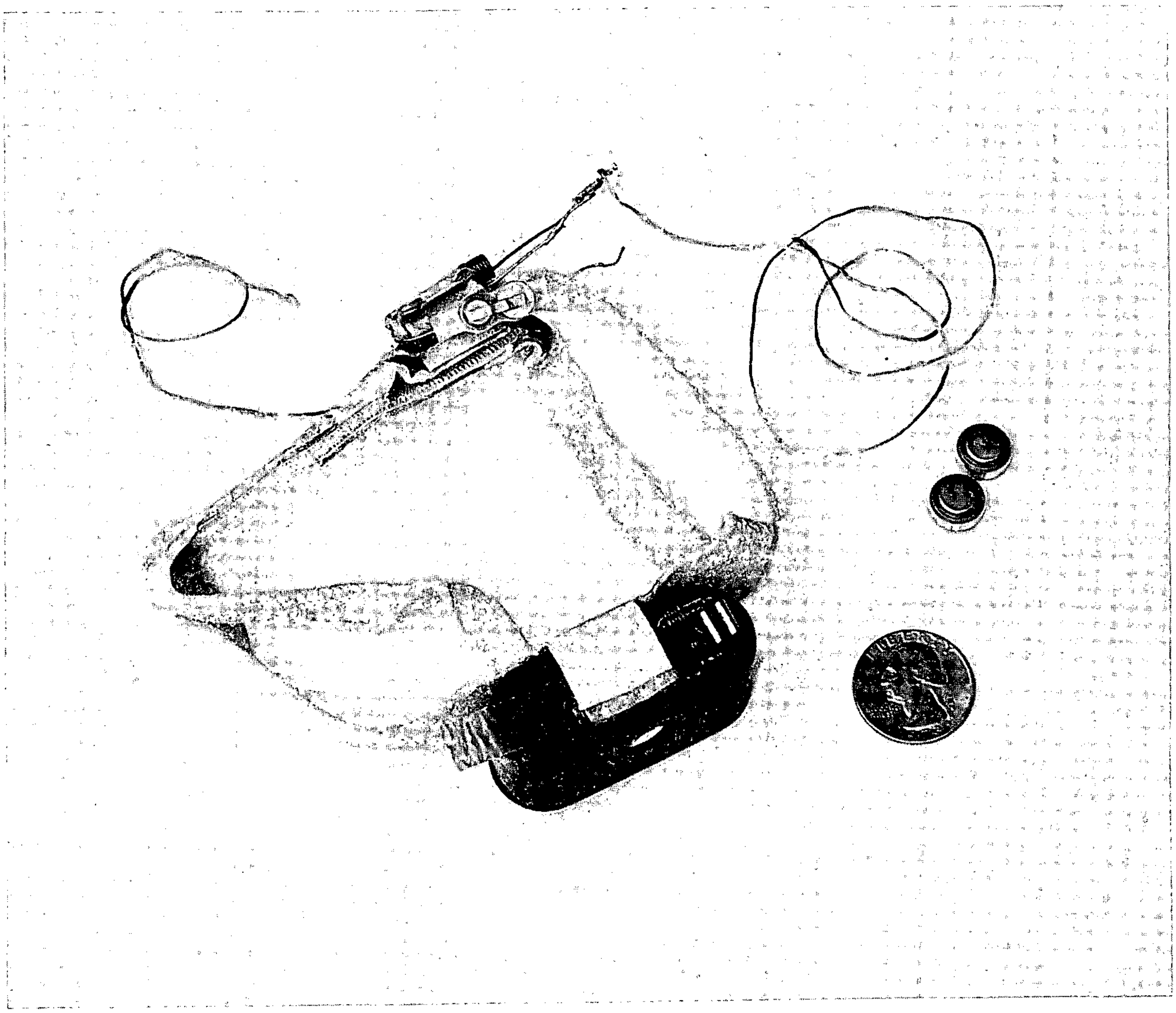

FIGURE 11. [redacted] Camera

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FIGURE 12. Bird With Camera

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PART 4

TWO EXAMPLE TARGETS IN THE WASHINGTON, D.C. AREA

Andrews Air Force Base

~~(S)~~ One of the first actions in the program was to obtain a group (kit) of birds which could be used to collect data against local targets. Such a group, called kit 1F, was purchased [redacted] located at [redacted], Virginia. These birds (nine in all) had previously been trained only to the west (75 miles) of [redacted] The first training flight on this program was conducted on 4 October 1976, one mile to the southeast, toward Andrews Air Force Base. There were two training flights at three miles and one each at six and 12 miles. The sixth flight, on 15 October, was from Andrews Air Force Base, 18 miles from the home loft at [redacted] On the next day, four birds were selected to carry harnesses and weights the 18 miles home. The birds were then given one day rest and, on 18 October, bird number 1F4 carried camera number C-7 over Andrews Air Force Base; camera numbers C-9 and less are MCW-24 models described in the previous section.

~~(S)~~ It had been very difficult to determine vanishing bearings (final directions of departure) from the launch site due to the high density of trees to the east of the Base. The film from camera C-7 was compared against satellite photos to determine the bird's trajectory during the several minutes of photography. Figure 13 shows this first trajectory (labeled no. 1) was to the north of the direct line home. Figure 14 is an example of the photography (about 140 pictures) taken on this flight. For the next flight, the launch point (no. 2 in Figure 13) was moved to the southwest and the trajectory, though still north of the line home, was closer to the runway and hangers. Figure 15 shows several military trucks parked on the base. For the third trajectory, the launch point was moved still further to the southwest, and the bird flew right up to the runway before turning north. Figure 16 shows an incinerator plant located in the southeast portion of the base.

~~(S)~~ At this point it was suspected that the birds might be avoiding the runway because of the noise and aircraft traffic. One particular bird, number 1F2, had been flying the 18 miles in about 33 minutes with a dummy weight and a 12 mph headwind. On 27

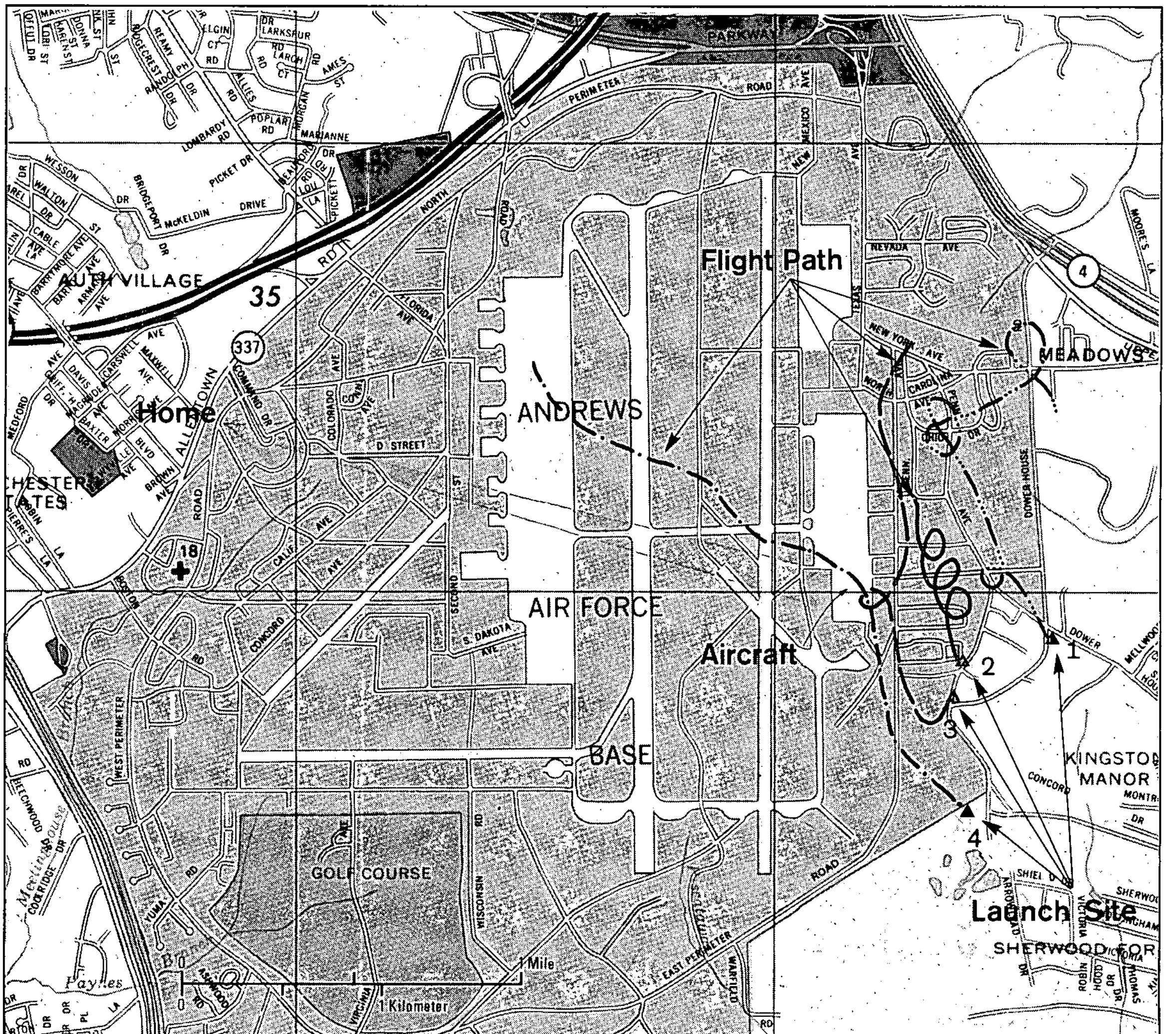

FIGURE 13. Four Flight Paths over Andrews Air Force Base

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November, this bird carried camera C-5, returning home in 34 minutes. The flight path is shown as trajectory no. 4 in Figure 13. This flight was directly across both runways, resulting in the photo of the aircraft shown in Figure 17.

~~(S)~~ By the end of October, three of the birds were lost (one returned three weeks later) and eight more birds were added to kit 1F. Flights continued through December with a total of 11 camera flights and 19 flights with dummy weights. As mentioned in the previous section, analysis of the film showed that there was a higher percentage of blurred photos (see Figure 17) than during the previous summer tests due to a decrease in shutter speed from 1/1400 to 1/1000 of a second. Since the [redacted] camera was to be delivered shortly, these MCW-24 cameras were not modified. While waiting for delivery of the [redacted] camera, the birds were worked to the east of [redacted] toward the Washington Navy Yard.

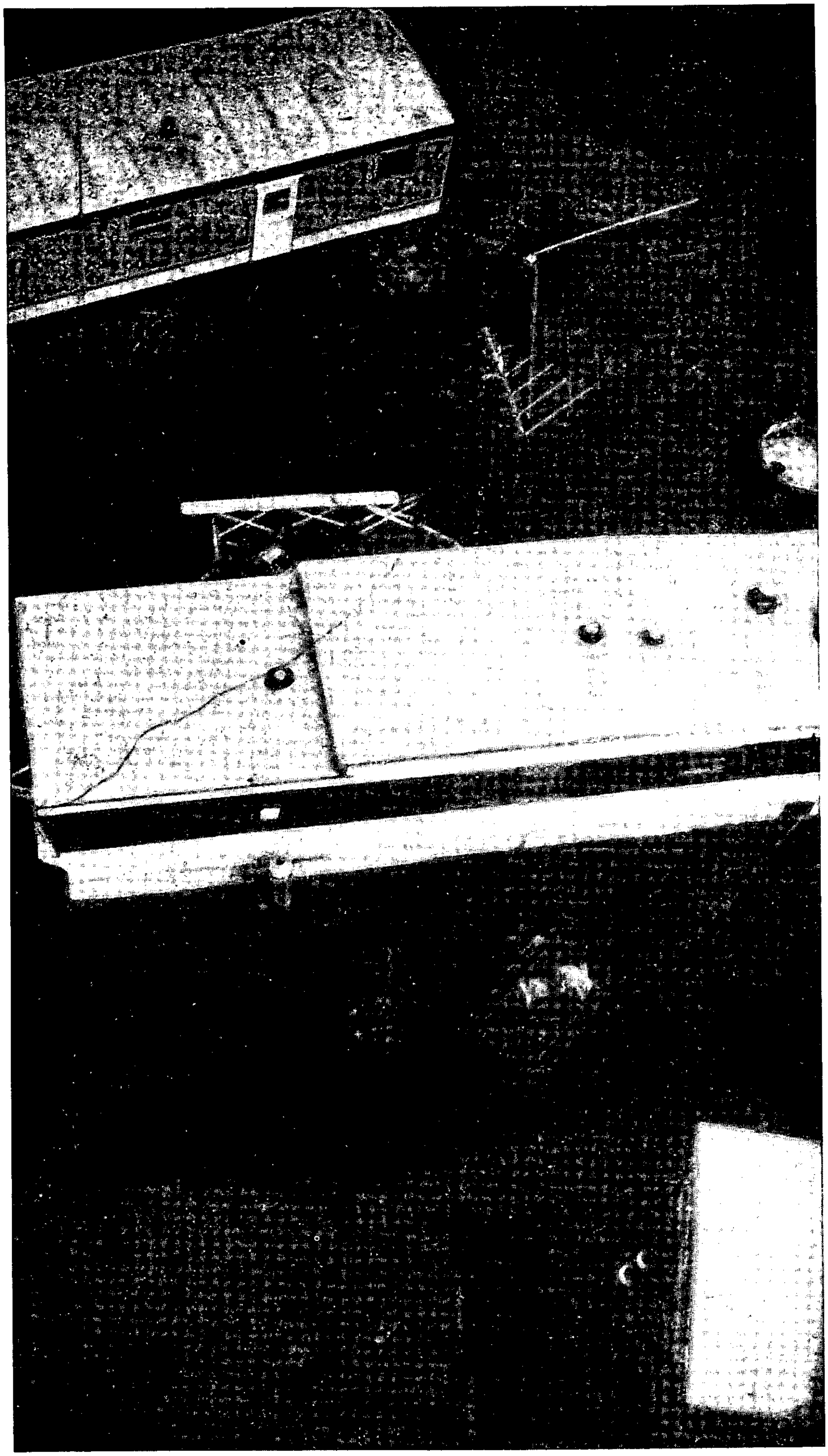

FIGURE 14. Mobile Home Complex on Andrews Air Force Base

FIGURE 16. Incinerator Plant on Andrews Air Force Base

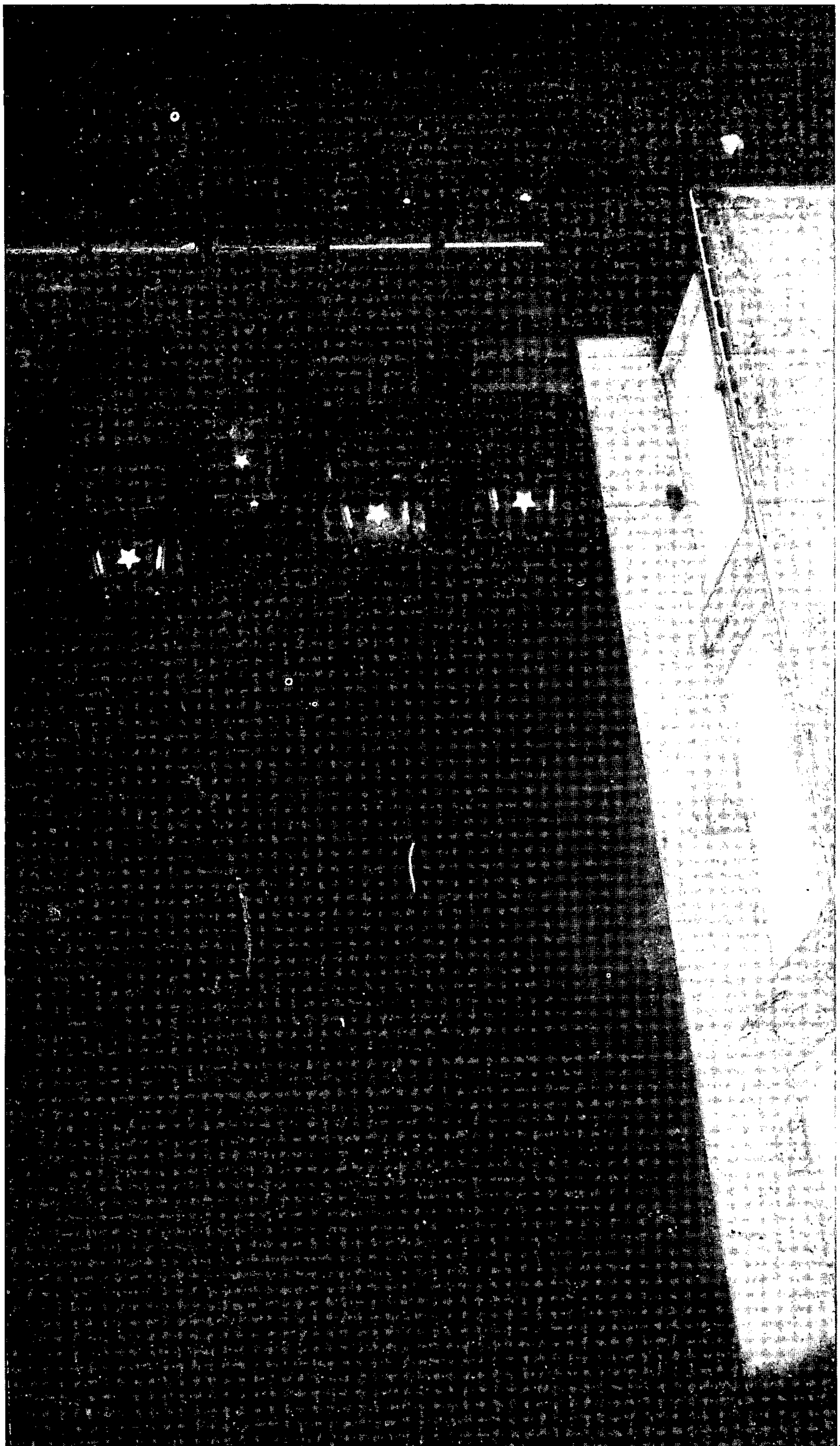

FIGURE 15. Military Trucks on Andrews Air Force Base ~~SECRET~~

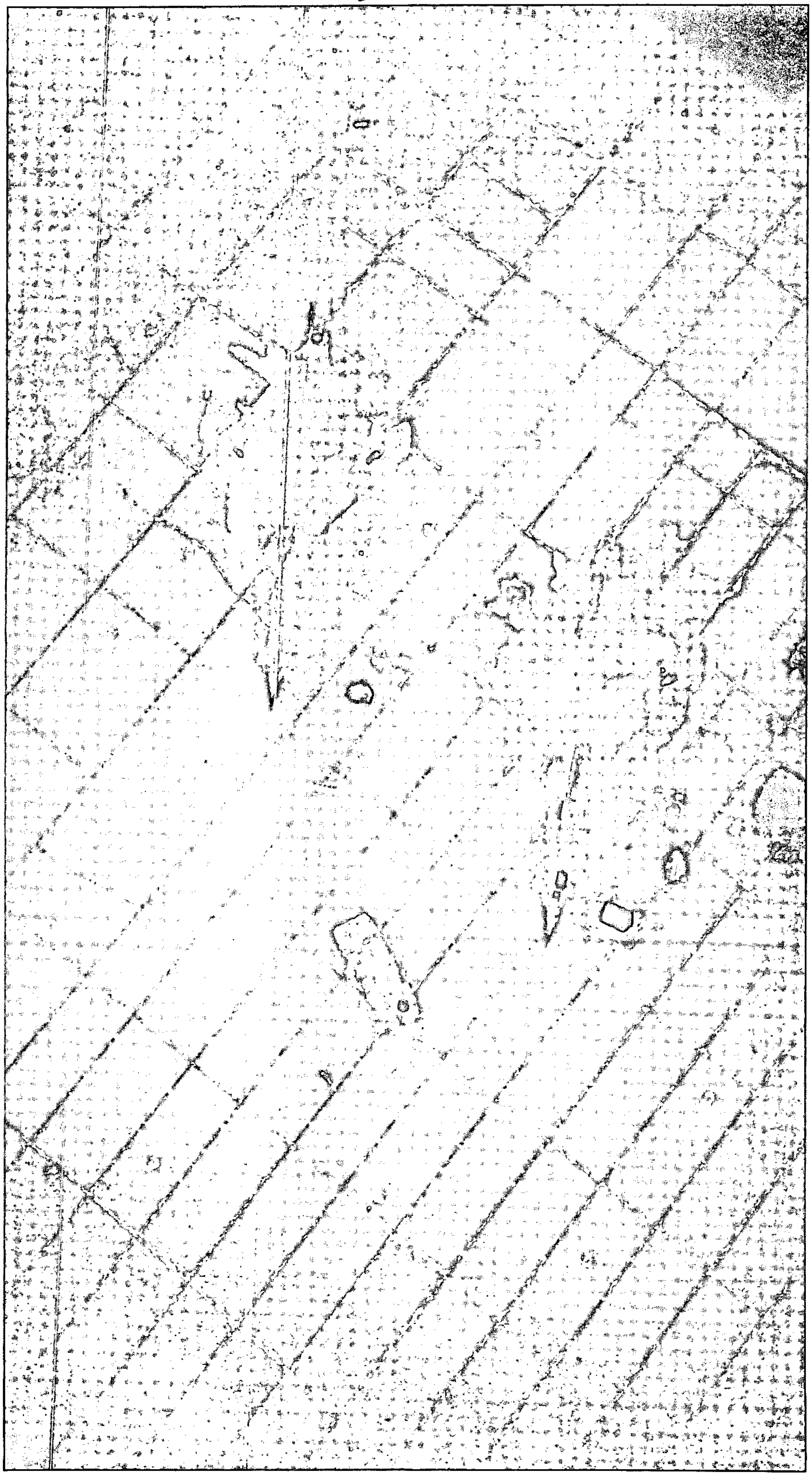

FIGURE 17. Military Aircraft on Andrews Air Force Base

~~(S)~~ On 21 January, bird 1F2 was released at Andrews with a [redacted] camera and a small avian DF transmitter (see Appendix B) which totaled about 50 grams in weight. Just after release, the bird was attacked by a hawk and managed to escape to the east. By use of the DF equipment, the bird was located one mile distant on top of a church, apparently unharmed. On the following morning, the bird had not returned. With the temperature in the low teens, the bird and camera were found in a packing crate behind a shopping center some three miles northeast of the church. Though this bird continued to fly well, it would never again perform properly with either camera or weight.

~~(S)~~ Over Andrews Air Force Base, there were a total of 12 flights with the MCW-24 camera, 19 flights with dummy weights and one attempted flight with [redacted] camera number C-10. Many of these flights were conducted during one of the coldest winters on record in this area. There were no camera failures due to low temperature. It is important to note that the body temperature of a pigeon is 107°F. Generally, pigeons perform well in cold weather and poor in extremely hot weather.

~~(S)~~ The 12 camera flights recorded most of the Andrews complex with exception of the active runways. It is felt that the birds avoided these because of the noise and aircraft traffic. The primary difficulty in launch site selection was the inability to observe the vanishing bearing among the numerous tall trees. This required tedious work and time consuming delays in comparing the flight film with satellite photos in order to determine how best to adjust the launch point. Figure 18 is a satellite photo of Andrews showing the surrounding terrain.

The Washington Navy Yard

~~(S)~~ A group of young birds (Kit 2F) was purchased in late December and trained to home during January 1977. By 17 February, these birds and Kit 1F were flying with weights from the Washington Navy Yard to [redacted] directly west of the Yard. At this time, four relocated birds were also flying the [redacted] with weights. During the remainder of February and early March, these birds were "single-tossed" (launched one at a time) to collect data on individual performance. The goal was to overfly the small museum park located between the Navy Yard museum and the river. The park and four of the trial launch sites are shown in Figure 19. The single-toss experiments did not work well. Almost every bird circled for three to five minutes waiting for other birds with which they could fly home. On 9 March, double-toss (launched in pairs) experiments began with immediate improvement in results.

In pairs, the birds immediately took up a heading in the direction of home. The "Homing of Single Pigeons" is discussed in Reference 3, and their performance does improve with training. However, this increases the training manhours by an order of magnitude. On 7 March, flights began with the [redacted] camera C-10, resulting in excellent pictures over the Navy Yard. The trajectory is shown in Figure 19. Figures 20 through 23 show the quality of pictures obtained on this flight; about 80 percent of the pictures were of this quality. On 8 April, camera C-10 was damaged and sent back for repair. Launch experiments continued from the 11th Street Bridge site, and on 21 April, camera C-10 was flown again and lost. A DF transmitter was carried with the camera, but no signal could be found during an extensive search. The bird returned three weeks later without the harness or camera.

(S) [redacted] camera C-11 was received and flown on 29 April, and camera C-12 was first flown on 6 May. By mid-May several shutter failures had occurred which were eventually traced to too deep an anodizing process which caused a structural weakening of the shutter material. This problem was corrected and the cameras were also modified so that new shutter assemblies could be installed in the field should failures continue to occur. No further camera failures occurred and tests continued through 22 June. Example photography is shown in Figure 24 (an oblique of the museum park), Figure 25 (the main gate), and Figure 26 (the old Naval Gun Factory building). Analysis of this photography showed that a higher percentage of the pictures (i.e., Figures 24 and 25) were blurred from C-11 and C-12 than from C-10. At first it was thought that the increased percentage of blurring was due to the high winds or nervous birds. However, it was finally determined that the equipment used to measure the shutter speed had malfunctioned, resulting in an actual shutter speed of only 1/1600 of a second instead of the expected 1/2400 of a second. This problem was corrected, and between 6 and 15 July, four additonal flights were made with camera C-11 and six with camera C-12. These tests focused on testing several "special films" supplied by NPIC. These were:

1. Aero color negative 2445
2. FE 6526, a high-speed fine grain film
3. 1414, a high-resolution UTB film
4. SO-131, an infrared film
5. H&W Type 77 panchromatic

Figure 27 shows a color shot of one corner of the museum park. A detailed analysis and evaluation of film and photography is contained in Appendix A.

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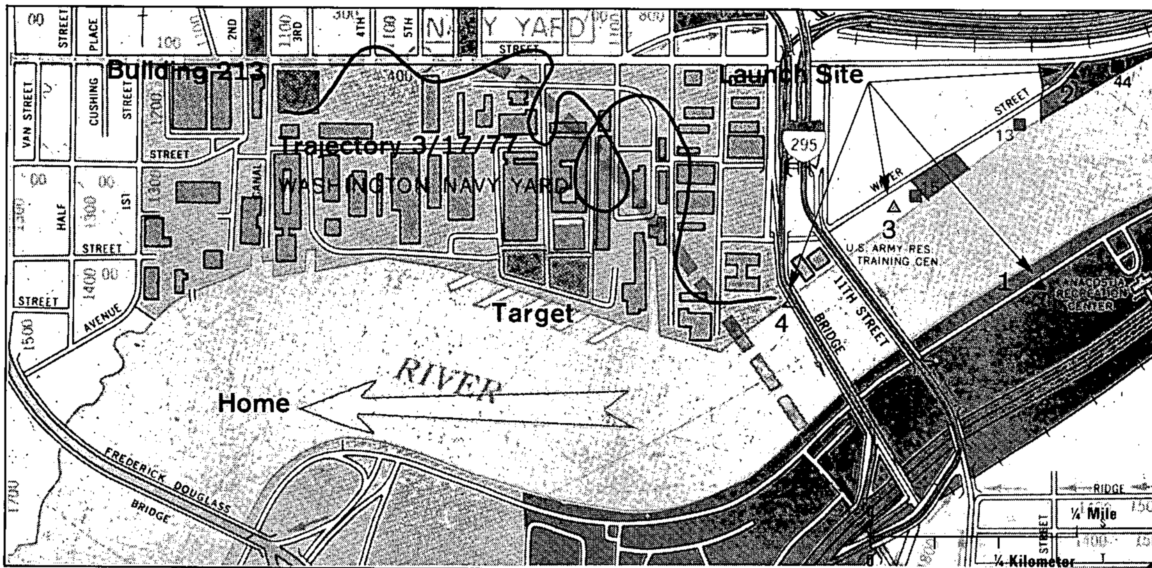

FIGURE 19. Map of the Washington Navy Yard

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~~(TS)~~ Of these last ten flights, four were recorded as "hitting the target." It should be pointed out that the included angle of the museum park, measured from the 11th Street Bridge launch site, is 10 degrees in azimuth. In Figure 4 the included angle of the Sudomekh Yard, as measured from the release point near the [redacted] is about 80 degrees in azimuth. An acceptance angle of 80 degrees is equivalent to trying to hit any part of the Washington Navy Yard from a release site on the 11th Street Bridge. Of 84 paired flights from the 11th Street Bridge, fewer than six missed the Navy Yard completely. However, this was after the behavior of the birds was established and the release site adjusted for maximum probability.

~~(S)~~ On one flight, the camera was tilted to the side to obtain a high percentage of oblique shots. If a pair of birds were flown with cameras titled to the right and left, a large area to either side of the flight path would be recorded. Figure 28 is an example of this kind of oblique photography.

~~(S)~~ There were a total of 219 flights over the Navy Yard with either cameras or weights. Seven flights were with the MCW-24 camera and 31 were with the new [redacted] Camera. The remaining 181 flights were with weights; 64 were with relocated birds. During a series of 84 paired flights from the 11th Street Bridge, 25 percent were visually recorded as hitting the target (the museum park), and 54 percent missed the target by less than 75 yards. These statistics are discussed in more detail in the next section. Figure 29 shows a satellite photo of the Navy Yard and surrounding area.

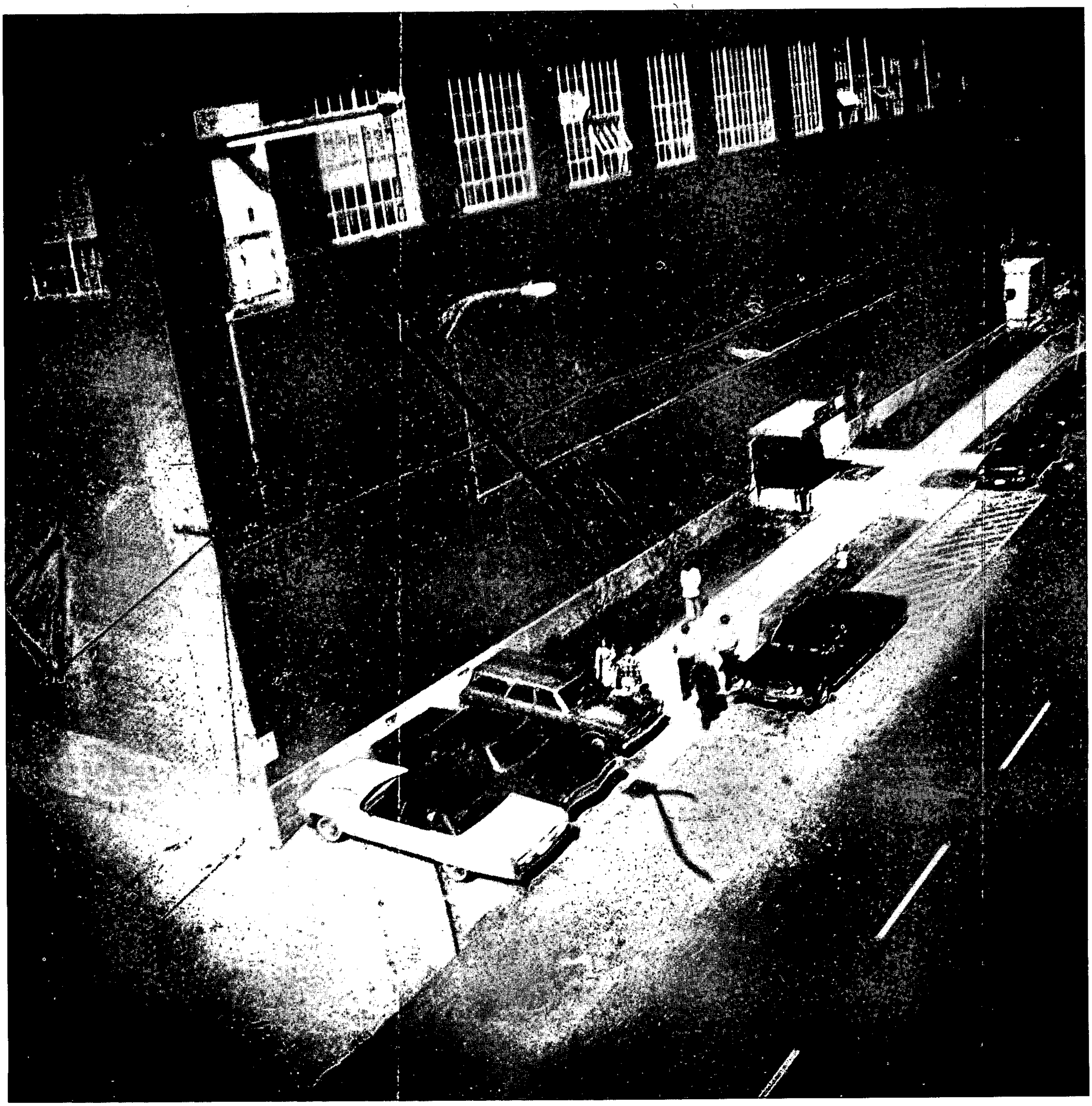

FIGURE 20. Corner with People Walking to Work

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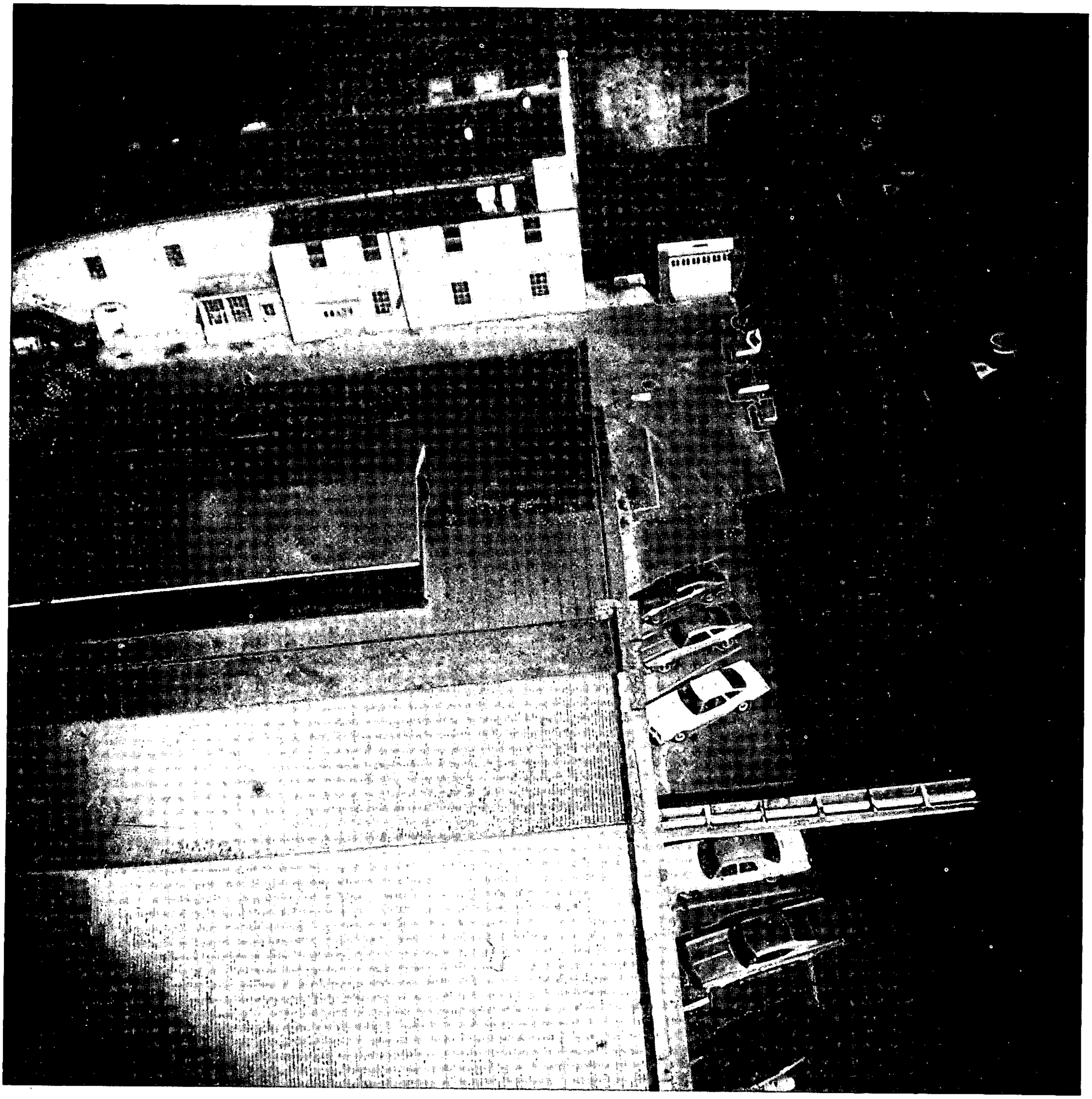

FIGURE 21. Alley Way

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FIGURE 22. Roof Top with Air-Conditioner

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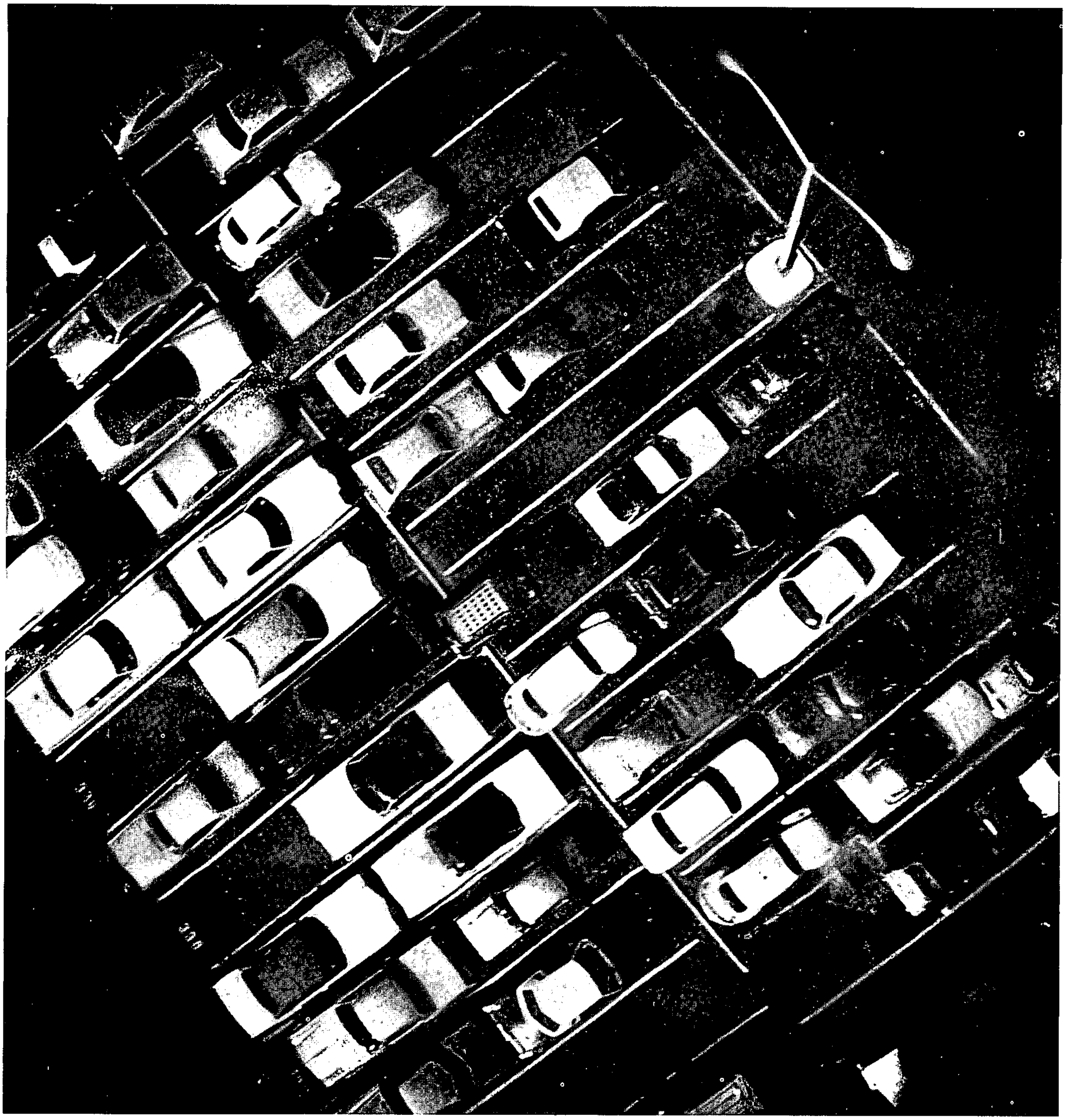

FIGURE 23. Parking Lot

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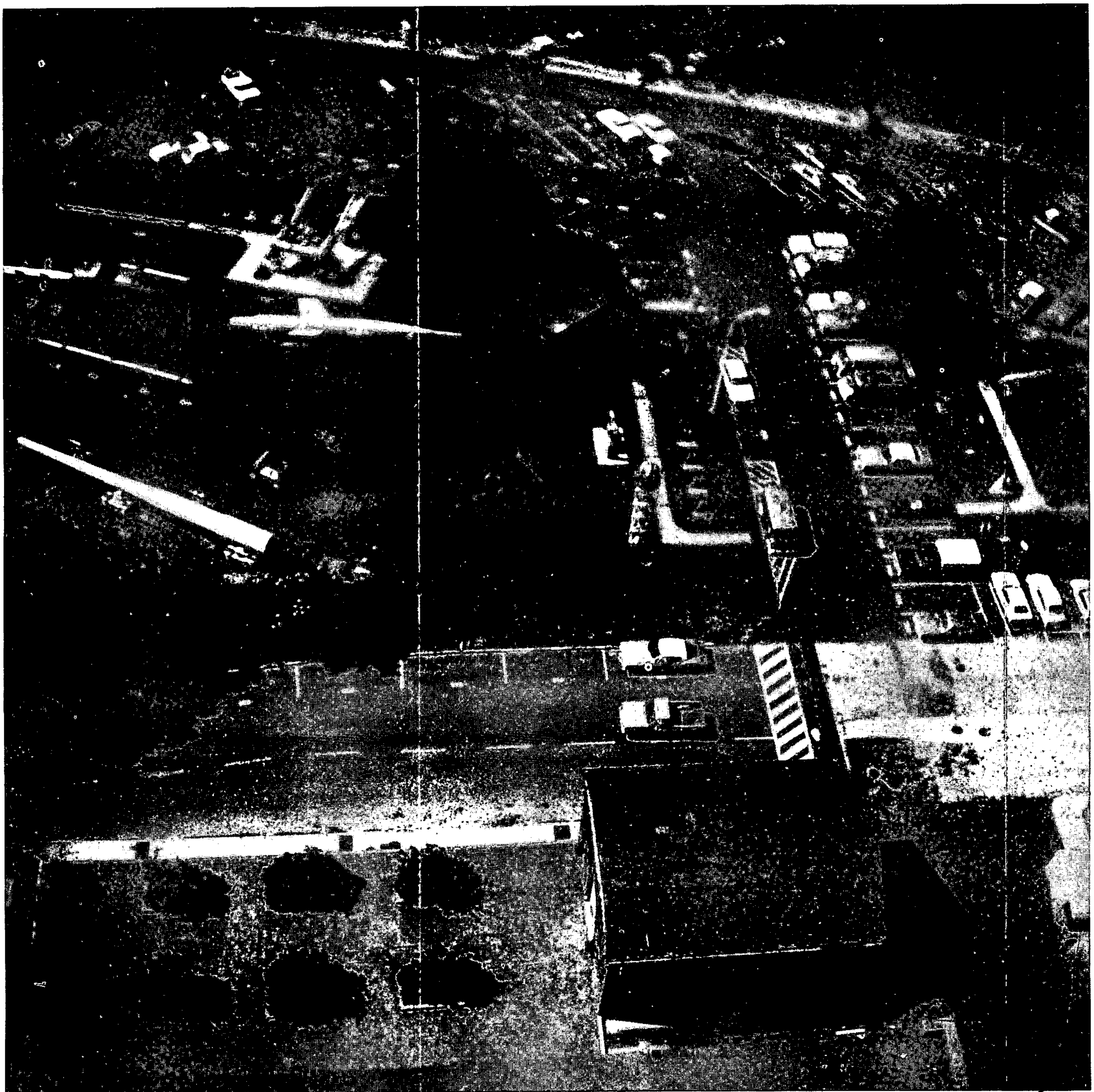

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FIGURE 24. Oblique Shot of Museum Park

FIGURE 25. Navy Yard Main Gate

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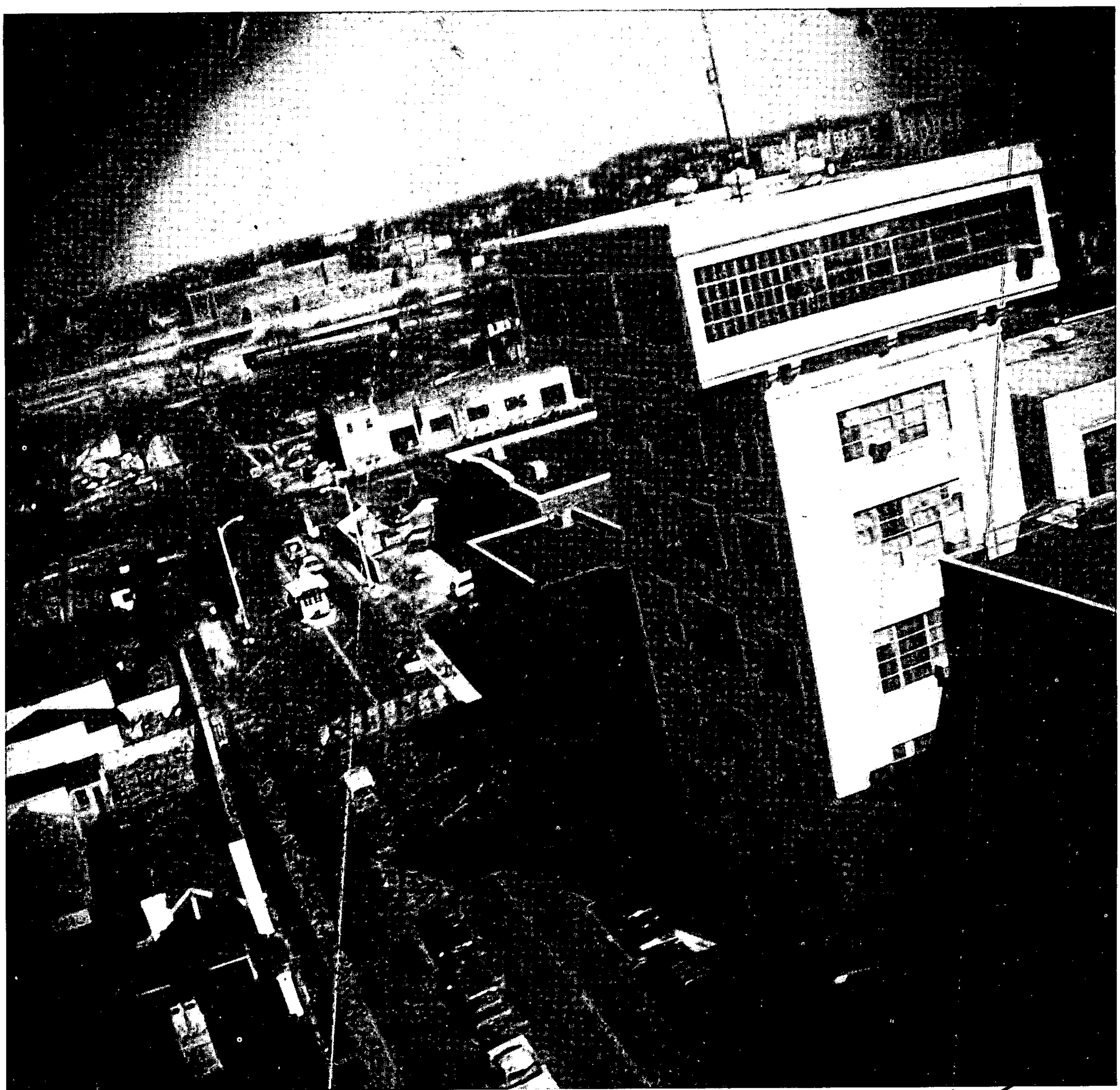

FIGURE 26. Old Naval Gun Factory

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FIGURE 27. 2445 Color of Museum Park

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FIGURE 28. Oblique Photograph Over the Navy Yard

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PART 5

BIRD BEHAVIOR AND STATISTICS

~~(S)~~ It is not enough to show that the camera can take acceptable pictures over the target. Certainly of equal importance is the capability of the bird to fly over the target and the frequency, or expectation, of its performance. Data on performance were collected almost entirely from local birds which were flown over two example targets in the Washington, D.C. area.

~~(S)~~ Another very important problem is that of providing birds of proven performance in the target area. This might be done in several ways. One way is to test birds locally over example targets and select those of good performance for relocation to the target area. A second possibility is to take young birds to the target area so that this is their primary home. These birds could then be relocated in the Washington area and tested over example targets. Those of acceptable performance could then be taken back to the target area with a high degree of confidence that they would perform well at their primary home. In either case, the issue of relocating birds from their primary home to a distant secondary home is of great importance. During this research, experiments were conducted with 132 homing pigeons which were relocated to lofts in Oregon, Alaska, Missouri, and Virginia.

Performance Over Example Targets

~~(S)~~ In early October 1976, the first group (Kit) of nine birds was obtained [redacted] located at [redacted] Virginia. This Kit, called 1F, was increased to 17 in number by the end of October. These were all veteran flyers; three had won diplomas in 300-mile races, and the rest had been trained to at least 75 miles to the west of [redacted] The first training flight was conducted on 4 October 1976; and the sixth flight, on 15 October, was from the far side of Andrews AFB, 18 miles to the southeast of [redacted] On the next day, four of the nine birds were selected to carry weights (the same shape and weight as the camera) the 18 miles home. It was found very difficult for observers to obtain vanishing bearings from the launch site due to the high density of tall trees to the southeast of the base. On 18 October bird number 1F4 was launched with a camera, resulting in trajectory number one shown in Figures 13 and 18 by a comparison of avian and satellite photography. It is apparent that this trajectory is considerably north of the direct line home to [redacted] It is speculated, as discussed in Reference 3, that this behavior might be due to the effects of the previous training direction, which required the birds to fly east, instead of northwest, to get home. In order to compensate for this factor, the launch point was moved several times to the southwest, finally resulting in trajectory number four which crossed both active runways and photographed the military aircraft shown in Figure 17. It is also speculated that the birds may have avoided the runways due to the noise and aircraft traffic. For this reason, and the difficulty in observing vanishing bearings, attention was turned toward the Washington Navy Yard as a second example target.

(S) In late December 1973, a group of young birds (Kit 2F), 14 in all, was obtained and trained to fly during January 1977. Unlike Kit 1F, these birds had never flown before. By 17 February both kits were flying with weights from the Washington Navy Yard, located [redacted] directly east of [redacted] Virginia. These tests continued through mid-July 1977.

(S) Of the 17 birds in Kit 1F, seven survived through July 1977, two were lost at the loft for unknown reasons, and eight were lost in flight training. These eight were lost before the end of November 1976. This implies that about half of the old birds could not adapt to the regimen of being trained to carry weights and "dropped out" early in the program. Table 6 shows the "Loss" data for Kit 1F. Of the seven surviving birds, four showed exceptional performance, and three were marginal. Table 7 shows the flight performance of Kit 1F in terms of the number of times a weight or camera was carried by each bird. These data include flights with weights at short training distances which provided a gradual buildup in carrying ability.

TABLE 6

LOSS DATA FOR KIT 1F

BIRD NO.	DATE LOST	DISTANCE MILES	NUMBER FLIGHTS
3	1/19/77	0	*
7	10/05/76	3	2
9	10/29/76	18	9†
10	11/27/76	18	13
11	11/06/76	3	1
12	11/16/76	3	1
13	4/07/77	0	*
15	11/27/76	18	13
16	11/27/76	18	13
17	11/17/76	1	2

*Lost at loft, reason unknown.

†Four times to 18 miles, two with weights.

TABLE 7

FLIGHT PERFORMANCE FOR KIT 1F

BIRD NO.	TOTAL FLIGHTS WEIGHTS	ANDREWS AFB		NAVY YARD	
		WEIGHTS	CAMERAS	WEIGHTS	CAMERAS
1	10	1	0	2	0
2	22	3	5	9	1
3†	10	2	3	0	0
4	29	2	4	13	3
5*	21	4	1	4	0
6	25	2	0	12	3
8	30	2	0	20	15
9**	2	2	0	0	0
13†	20	1	0	9	0
14*	8	0	0	3	0

*Placed on widowhood 3/3/77.
†Lost at loft, reason unknown.
**Lost fourth time from Andrews.

TABLE 8

FLIGHT PERFORMANCE FOR KIT 2F

BIRD NO.	TOTAL FLIGHTS WEIGHTS	NAVY YARD	
		WEIGHTS	CAMERAS
2	15	11	0
10*	21	15	0
12	17	13	9
13	26	29	6
14	14	10	0

*Placed on Widowhood 3/3/77.

(S) Of the 14 young birds in Kit 2F, four were selected for experiments associated with relocation; of the ten remaining, five were lost on the very first release at the home loft. This is an unusually high rate of loss and is most probably due to the late start in their training. These birds were about 60- to 80-days old at the time of their first release; typically, young birds are first released at about 30 to 40 days of age, before they become too "wing strong" and while they are less likely to fly off before learning where home is. Normally, only a 10- to 20-percent loss is expected. Of these five remaining birds, all survived. Table 8 shows the flight performance of Kit 2F in terms of number of times a weight or camera was carried, including several short training flights. As seen in the Table, two of these five young birds performed exceptionally well and carried a camera many times over the Navy Yard. Bird 2F10 was placed on "Widowhood," which is explained later.

(S) The experiments at the Navy Yard were directed toward finding a launch site from which the birds would fly over, or as close as possible to, the small museum park located between the Navy Museum building and the river. This park contains many naval artifacts, such as missiles, torpedos, small submarines, etc. Ground truth data was measured on several of these items for use in evaluating the avian photography. This park runs for about 250 yards west along the river and is about 70 yards wide. As mentioned above, all birds were flying from the Yard with weights by 17 February 1977. The first experiments were from across the river in Anacostia Park (launch site one in Figure 19). At this site the birds were "single-tossed" (launched one at a time) in an attempt to collect individual data on vanishing bearings. However, with few exceptions, the birds circled in the area for two to five minutes and departed in various directions. The launch site was moved across the river (launch site two in Figure 19) and then to just east of the 11th Street Bridge (launch site three in Figure 19) with only slight improvement in results. At this time it was decided that the reason the birds were circling for several minutes was because they were waiting for other birds with which they could fly home. Therefore, on 9 March double-toss experiments (launched in pairs) began at launch site three with a significant improvement in results. Most pairs of birds took up an immediate heading in the direction of home. This experiment was repeated on 10, 11, and 15 March with comparable results. Figure 30 shows a single-toss experiment from launch site two.

FIGURE 30. Single-Toss Experiment

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(~~S~~) On 17 March, a detailed series of experiments began from the 11th Street Bridge (launch site four) during which 84 paired flights were launched. Visual landmarks were located with respect to the museum park so that miss distance data could be recorded for each pair of birds. The actual launch site was adjusted along the bridge in order to maximize the likelihood of overflying the park. Of the 84 flights from this site, 21 were recorded as hits (a miss of less than 35 yards from the center of the park). Figure 31 is a histogram of this data in terms of miss distance from the center of the park. Since the bridge site is about 400 yards from the park, the angular miss can be determined as the arc tangent of the miss distance divided by 400. Twice the angular miss (measured from the target center) can be considered as the total subtended angle of a hypothetical target. In this way one can sum the data in Figure 32 to compute the cumulative distribution as a function of the subtended angle of a particular target as measured from a chosen launch site. Figure 32 shows the chance of overflight by one pair of birds as a function of the subtended angle of the target. For example, if the target in question subtends an angle of 25 degrees, there is about a 50-percent chance of overflight. However, this applies only when the launch site has been adjusted to locate the most probable direction home through the center of the target.

(~~TS~~) For most of the launch sites in Figure 4, the Sudomekh Yard subtends an angle of 10 to 70 degrees. This would indicate a

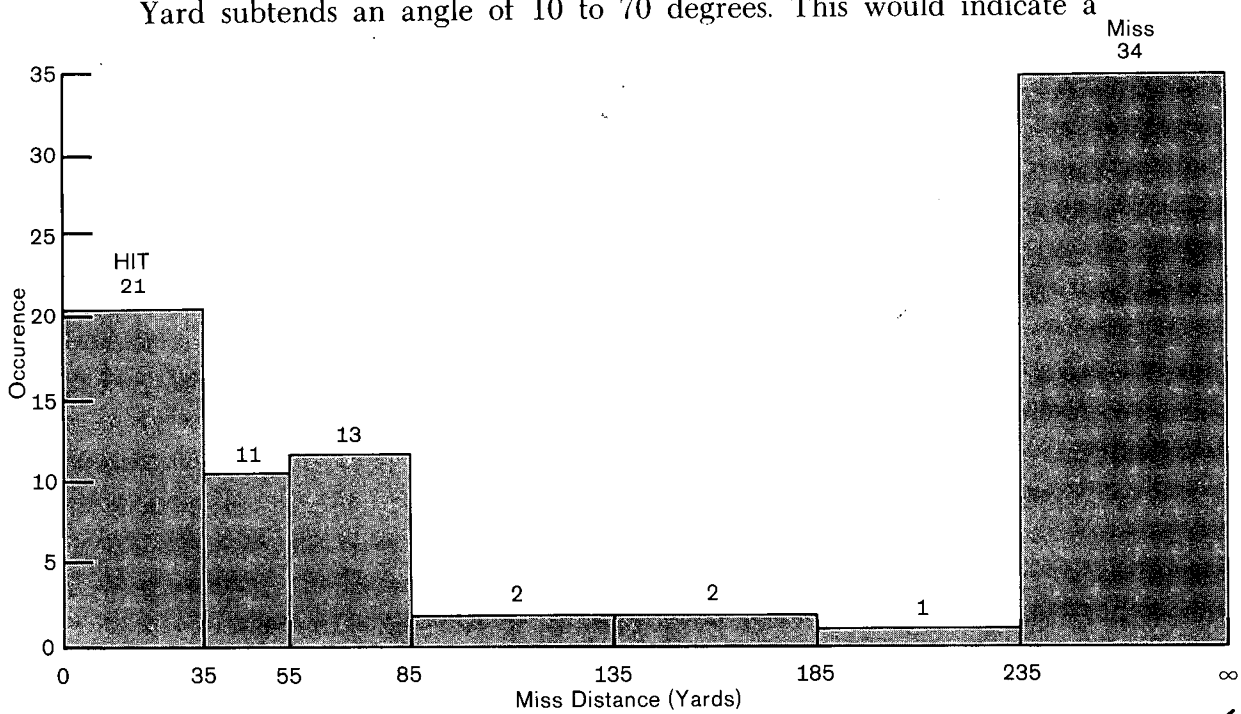

FIGURE 31. Histogram of 84 Paired Flights

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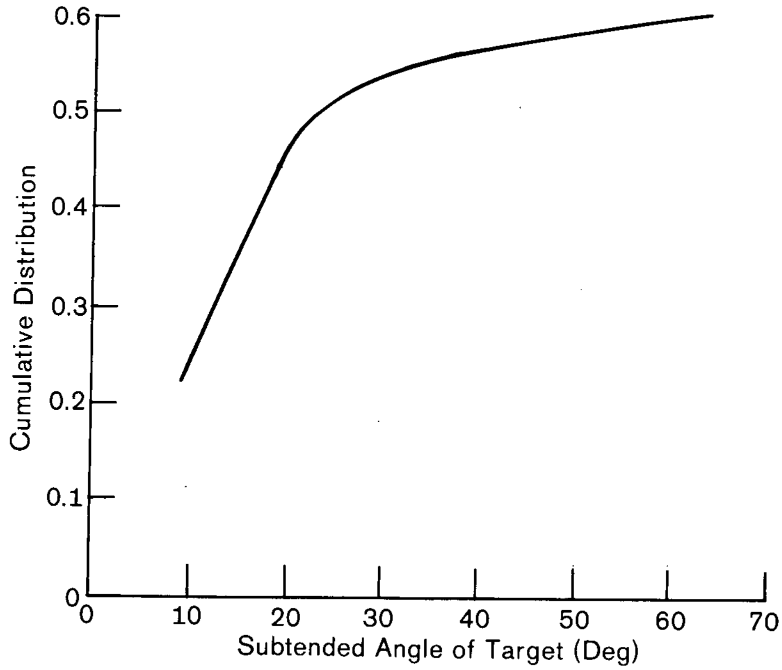

FIGURE 32. Chance of Overflight vs. Subtended Target Angle

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25- to 60-percent chance of overflight once a preferred site (or flight line) has been determined. If there is good visibility, the direction of the preferred flight line can be established without risk of flying the avian camera. Otherwise, as was the case with Andrews AFB, the avian and satellite photography must be compared to determine the new trial launch site.

~~(S)~~ The 84 paired flights were conducted with eight birds, four from Kit 1F and four from Kit 2F (the young birds). During the last ten flights, four pairs were recorded as hitting the target. Figure 33 shows a bird with camera returning from a flight over the Navy Yard.

~~(S)~~ NPIC analyzed 36 rolls of avian film. Of these, six rolls contained 23 frames of the museum park.

Relocation Experiments

~~(TS)~~ One of the first problems on this project was to find competent loft managers who could provide and receive birds for relocation experiments. It was felt important that these lofts should be as widely separated as possible and that one should be in Alaska which has the same latitude and magnetic dip angle as Leningrad. Three highly competent people were found in [redacted] Oregon; Anchorage, Alaska; and [redacted] Virginia. A fourth loft was constructed in [redacted] Missouri, on the farm of [redacted]

FIGURE 33. Bird With Camera Returning From the Navy Yard

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[redacted] This fourth loft provided relocation data by an "informed novice" as well as a ready supply of birds for flight testing the avian camera prior to shipment.

~~(S)~~ Three kits of birds (1L, 2L, 1W) were obtained from the [redacted] area. One of these kits, 1W, had been relocated several times before on the previous project. A fourth kit, 1D, was obtained from [redacted] as young birds which had never flown. All other birds were obtained from Oregon, Alaska, and Missouri, and distributed to the four selected lofts. Table 9 shows the disposition of the 118 birds used in this experiment, including the date each kit was received and the date of the first release at the new home loft. Table 10 shows the results for each of the 118 birds, including the number of days each bird was held captive before the first release. As expected, the birds which had never flown before, kit 1D, had the highest percentage of survival (55%). This, however, is low for young birds and most probably due to the fact that they were too old and "wing strong" causing them to fly off before learning the surrounding area. This is essentially the same percentage, and probable cause, described previously for kit 2F. In Table 10, loss data is shown by number of release at the loft (1R, 2R, etc.) and also with respect to the number of training flights from a remote launch site (1F, 2F, etc.). All birds that survived were trained from sites at least five miles from the loft.

TABLE 9

DISPOSITION OF 118 BIRDS

KIT	NUMBER BIRDS	ORIGIN	DESTINATION	DATES RECEIVED	DATES RELEASED	NUMBER DAYS CAPTIVE
1W*	6	California	Oregon	10/25/76	12/26/76	62
1L	13	California	Oregon	10/25/76	12/02/76	38
2L	12	California	Oregon	10/25/76	12/05/76	40
1D**	11	California	Oregon	11/30/76	12/26/76	26
1B	12	Oregon	Missouri	11/05/76	11/27/76	22
2B	12	Oregon	Alaska	11/06/76	12/08/76	32
3B	6	Oregon	Virginia	11/05/76	12/23/76	48
1S	12	Alaska	Oregon	11/09/76	12/26/76	47
2S	12	Alaska	Missouri	11/09/76	11/28/76	17
1H	12	Missouri	Alaska	10/30/76	12/07/76	37
2H	10	Missouri	Virginia	10/29/76	12/17/76	48

*Had been relocated several times previously.
**Young birds which had never flown.

TABLE 10

RELOCATION EXPERIMENTS WITH 118 BIRDS

KIT	BIRD NUMBERS 1	2	3	4	5	6	7	8	9	10	11	12	13
1W	1R	1R	*	1R	*	*							
1L	D	1R	*	1F	D	1F	1F	3R	*	1R	1F	1R	1R
2L	1R	1R	H	*	*	D	1R	1R	*	*	*	*	
1D	1R	1R	*	*	*	*	*	1F	1R	*	D		
1B	3F	1R	2R	*	2R	2R	1R	2F	2R	*	*	*	
2B	4R	4R	*	4R	*	4R	4R	4R	4R	4F	D	4R	
3B	1R	17F	2R	1R	1F	*							
1S	1R	I	H	S	*	2R	*	I	*	*	*	2R	
2S	2R	*	*	2F	3R	3R	2R	*	3R	3R	3R	2R	
1H	4F	*	4F	4F	5R	*	5R	5R	9R	5R	5R	4F	
2H	1R	*	D	*	E	I	D	*	D	15F			

D=died, I=injured, S=sick, H=hawk, E=escaped.
1R, 2R, etc.=lost on 1st, 2nd, etc., release at loft.
1F, 2F, etc.=lost on 1st, 2nd, etc., flight from remote site.
*=survived and homed in (31% of 118 birds).
NOTE: Kits 1W and 1D were not 1st relocation birds.

~~(S)~~ Of the 101 birds (discounting kits 1W and 1D) being relocated for the first time, Table 11 shows survival statistics relating to the origin of kits, and Table 12 shows statistics relating to their destination or new home loft. The low origin statistics for Missouri and Oregon (23%) are primarily due to the low destination statistics for Alaska (only 17%). In order to investigate this anomaly, which could impact severely on the proposed Leningrad targets, an additional kit (3B) of 25 birds was obtained from Oregon and sent to Anchorage on 1 January 1977. One of these birds died. Of the remaining 24 birds, 12 were flown many times from 30 miles, and

TABLE 11

ORIGIN STATISTICS ON 101 BIRDS

ORIGIN	KIT	FRACTION	ORIGIN FRACTION	ORIGIN % SURVIVAL
California	1L	2/12	8/25	32
	2L	6/12		
Oregon	1B	4/12	7/30	23
	2B	2/12		
	3B	1/6		
Missouri	1H	2/12	5/22	23
	2H	3/10		
Alaska	1S	5/12	8/24	33
	2S	3/12		

TABLE 12

DESTINATION STATISTICS ON 101 BIRDS

DESTINATION	KIT	FRACTION	DESTINATION FRACTION	DESTINATION % SURVIVAL
Alaska	2B	2/12	4/24	17
	1H	2/12		
Oregon	1L	2/13	13/37	35
	2L	6/12		
	1S	5/12		
Missouri	2S	3/12	7/24	29
	1B	4/12		
Virginia	2H	3/10	4/16	25
	3B	1/6		

two of these have been to 120 miles. These 12 surviving birds have been worked steadily (at least once a week) from 30 miles since their release in February. At this writing, all 12 are still flying at the Anchorage loft and have been worked harder than any other kit.

~~(S)~~ Table 13 shows overall relocation statistics for the 101 birds with a 28-percent survival from losses of all kinds. Note there were not always losses on the very first release. However, of the 44 birds lost during release at the loft, 31 were lost the first time losses occurred, and the remaining 13 were lost the second time that losses occurred for each kit. This implies that losses do not always occur at the first opportunity, but they do appear to occur in large groups. It was noticed that the "first loss" occurrence did tend to happen on bright sunny days with low wind and few clouds. The same statements can be made with regard to the 15 losses during flight training from remote launch sites; 13 birds left the first time losses occurred, and the remaining two left the second time losses occurred. It is interesting to note that of the 59 birds lost during release and flight training, only 25 percent were lost in flight training whereas over half of the losses happened the first time losses occurred.

~~(S)~~ A small project loft (see Figure 34) was constructed adjacent to the [redacted] loft at [redacted] Virginia, which was used to train kit 2F to fly, and also for the relocation of kits 2H and 3B. Table 12 shows that four of the 16 birds survived relocation. However, Table 10 shows that two of these birds (2H10 and 3B2) had made 15 to 17 flights (4 or 5 with weights) before they were lost. Table 14 shows the flight performance for these two relocated kits in terms of the number of times they carried weights of the same shape and weight as the avian camera. Bird 2H8 was eventually lost in April 1977, after numerous flights from the Navy Yard, and was not counted as a relocation loss. Two of these birds were moved to the widowhood experiment to be discussed later.

Additional Relocation Experiments

~~(S)~~ Including kits 1W and 1D, there were 33 birds surviving the relocation experiments in Oregon, Alaska, and Missouri. Most

FIGURE 13

FIRST RELOCATION STATISTICS

	NUMBBR OF BIRDS			LOST IN RELEASE AT LOFT						LOST IN FLIGHT TRAINING					
KIT	Start	Finish	Died, etc.	1R	2R	3R	4R	5R	>5R	1F	2F	3F	4F	5F	>5F
1L	13	2	2	4	0	1				4					
2L	12	6	2	4											
1B	12	4		2	4					0	1	1			
2B	12	2	1	0	0	0	8			0	0	0	1		
3B	6	1		2	1					1	0	0	0	0	1
1S	12	5	4	1	2										
2S	12	3		0	4	4				0	1				
1H	12	2		0	0	0	0	5	1	0	0	0	4		
2H	10	3	5	1						0	0	0	0	0	1
Subtotal				14	11	5	8	5	1	5	2	1	5	0	2
Total	101	28	14				44						15		

TABLE 14

FLIGHT PERFORMANCE FOR RELOCATION KITS 2H AND 3B

BIRD NUMBER	TOTAL FLIGHTS WEIGHTS	NAVY YARD WEIGHTS
2H2**	7	3
2H4	21	15
2H8	19	13
2H10	3	0
3B2*	4	0
3B6**	7	4

*Lost after 15 to 17 flights.

**Moved to widowhood experiment 3/3/77. 2H8 was eventually lost 4/11/77.

FIGURE 34. Exterior View of the Attic Loft

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loft managers typically train their birds to come into the loft quickly in response to audio cues, such as whistles, rattling feed cans, or door chimes. During these experiments, each loft manager was provided a magnetic tape cassette with a particular music selection that would not normally be associated with an audio cue. All birds learned quickly to respond to the musical cue. In addition, all birds learned to enter the loft through an air-conditioning shell which had a 4½-inch hole in its top face. Exit from the loft, for exercise, was provided by emplacement of a ramp leading up to the drop hole.

~~(S)~~ The surviving 33 birds were shipped to Virginia by air freight. Four were used in the widowhood experiment (to be explained later) and 29 were placed in an attic loft. Figure 34 is an exterior view of the attic loft. The top most air-conditioning unit is a shell complete with drop hole and entrance way from the attic as shown in Figure 35. In Figure 34, the view is blocked to the south and west by the apex of the roof. To the north and east the view is also blocked by tall trees. The birds were held captive about 40 days during which time a round of youngsters were raised. Also, reinforcement to the music and drop hole was provided by using a simulated air-conditioning shell located on the loft floor; this training is shown in Figure 36. The 29 birds were organized into two groups. For the first release, the first group of 12 birds was

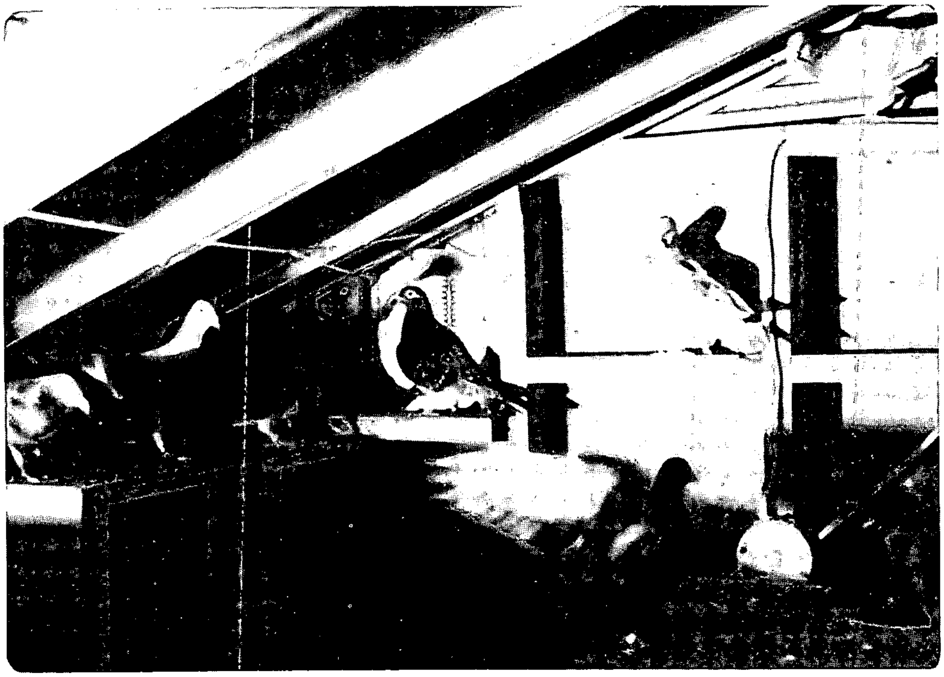

FIGURE 35. Interior View of the Attic Loft

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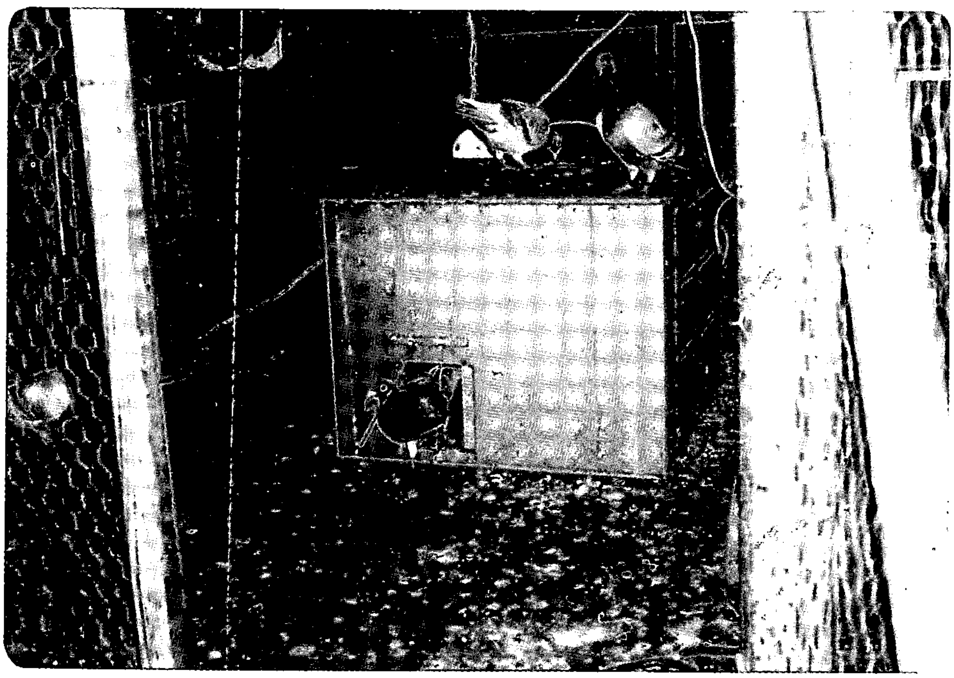

FIGURE 36. Reinforcement Training to Drop Hole

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allowed to leave the air-conditioner shell by use of a ramp similar to that shown in Figure 37. All 12 birds were lost on the first release. It was speculated that the birds could not see enough of the surrounding area through the louvers in the air-conditioning unit to prevent being lost. Therefore, the second group of 17 birds were hobbled by placing rubber bands around the last four or five primary flight feathers. This causes a gross aerodynamic imbalance and greatly suppresses the ability and desire to fly. On the first day of release, 10 of the 17 hobbled birds walked out onto the roof and spent the day. Six of these birds did not reenter the loft that evening, but all were in by the next day. After four days, all 17 birds had spent between two to four days on the roof and the wing hobbles were removed. On the first release without hobbles, 9 of the 17 birds were lost. The tenth was lost on the third release, and the eleventh was lost on the fifth release. On the seventh release, a cat was observed on the roof chasing the remaining six birds and all spent the night away from the loft; one of these did not return. By the end of the eighth release, there were five birds left, and flight training from remote sites began. By the end of the eighth flight, on 14 May 1976, all five birds were flying several miles back to the loft. A survival rate of five in 17 (29%) is typical of the previous experiments. At this time, however, unseasonally hot weather moved into the Washington area with temperatures in the mid-90's. The temperature inside the loft climbed to well over 100 degrees despite the use of overhead insulation and the installation of an attic fan in

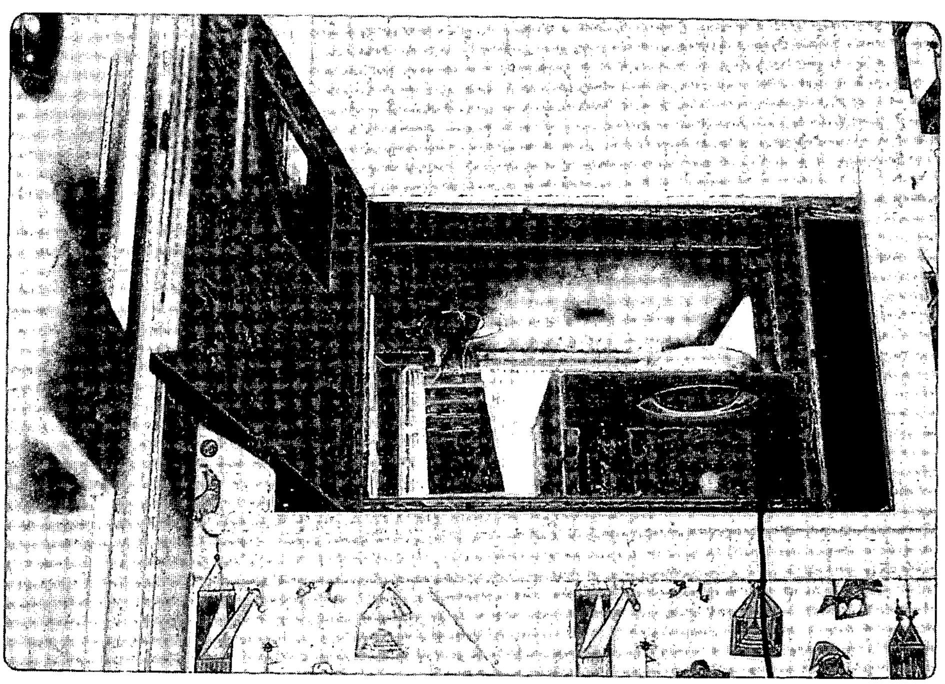

FIGURE 37. Bird Leaving Air-Conditioning Shell

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the loft area. On the ninth flight, three of the five birds did not return. The two that did were both hens that were sitting on eggs. At this point, the experiment was terminated because of the excessive temperature in the loft. It is apparent that there are a multiplicity of factors affecting relocation. Some of these are discussed in more detail in Appendix C.

Widowhood Experiments

~~(S)~~ The widowhood system is a complicated technique used by the more experienced pigeon handlers for the purpose of highly motivating cocks to return to the loft quickly and, thereby, win pigeon races. Some of the particulars are described in Reference 4 and in Appendix C. Briefly, cocks are taught that they may be with their hens only when they are taken to a remote site and released to come home. When a cock is working well on this system, he comes straight home and immediately enters the loft to be with his hen. Of the 33 birds transported to the Washington, D.C. area for additional experiments, four were placed on widowhood to study the effects on relocation. These birds were 2L5, 2L11, 1B11, and 1S11. Bird 2L5 was lost at the loft for unknown reasons. Bird 2L11 was relocated successfully and flown three times with weights, the last time from the Washington Navy Yard. Bird 1B11 was lost during a severe thunderstorm, and bird 1S11 was relocated but finally lost with a weight while flying back from the Navy Yard. Two of the old birds, 1F5 and 1F14, were placed on this system and did carry weights from the Navy Yard. The last, a young bird (2F10), also carried weights from the Navy Yard. Figure 38 shows the widowhood loft with air-conditioner shell for the entrance of the four relocated birds. Two birds, 2H2 and 3B6, which had survived the first relocation experiments, were tried on this system but failed to perform properly. The general consensus at this time is that the widowhood system is too complicated to be used in the field. At some future time it might be reconsidered as an advanced technique to be used by highly trained loft managers.

Remarks on Behavior

~~(TS)~~ It is apparent that the birds are capable of getting the camera over targets such as Andrews AFB and the small museum park in the Washington Navy Yard. By applying the results of Figure 33 to the problem of Sudomekh in Figure 4, it would appear that there is a 25 to 50 percent chance of overflight once a "preferred flight line" has been established. The fact that homing pigeons do not always have a vanishing bearing precisely in the direction of home is referred to as "launch site bias" and is

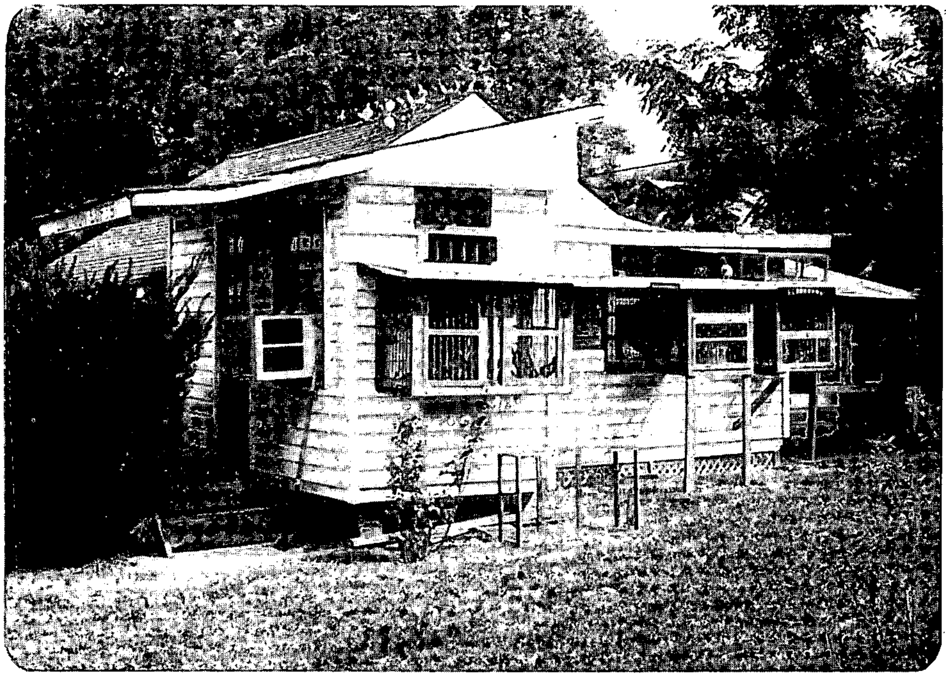

FIGURE 38. Widowhood Loft With Air-Conditioning Shell

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discussed in Reference 5. The reason for this bias is not clearly understood and must be measured for each general locality. Reference 3 also discusses visual cues wherein homing pigeons will use tall objects near their home loft to which they will visually home as a "terminal guidance" object.

(S) The relocation of homing pigeons has been a subject of study for some time. An excellent book (Reference 6) by Dr. W. E. Barker lists several essential points which are discussed in Appendix C. One of his points states that if relocated birds are placed under stress, they may well decide to leave. Certainly, this tendency was experienced ~~on~~ this program. On the other hand, the U.S. Army relocated many pigeons during World War II. The exploits of several decorated pigeons are described in the first chapter of Reference 7. Here, pigeons carried messages through storms and enemy gun fire, many returning with severe wounds. Certainly, these could be considered as conditions of severe stress. However, the precise techniques and methods used for relocation, and the survival statistics, have not been thoroughly researched and definitely should be, if further work is to be done on this project.

(S) Relocation experiments were conducted on a previous project during the spring and summer of 1976. Here, the entire pigeon loft (a packing crate) was transported to the new location site. In this way, the birds already knew what the outside of their new home looked like (a primary point in Barker's book). During the "attic loft" experiment, the second group of birds learned the view from outside the loft by the use of "wing hobbles," which appeared to work well. A still better way, if operationally feasible, was used by a loft manager in Japan, wherein he placed his imported birds in a small cage on the back of his Honda and drove them around the neighborhood.

~~(S)~~ In conclusion, the reliability of relocated birds is still a serious question, regardless of the method used for resettling. Without further research on reliability, it is recommended that young birds be taken to the target loft so that this will become their primary home. They can then be relocated to the Washington area for training and selection. Those of acceptable performance can then be returned to the target loft with a high degree of confidence that they will perform with essentially the same statistics as that described in Figures 31 and 32. During the experiments conducted in the Washington, D.C. area, there were 51 flights with cameras and 341 with simulated weights, or 392 flights with cameras or weights. These data indicate that there is about one chance in 30 of losing a camera on each flight. However, in about half of these losses, the bird and harness returned to the loft. A better method of camera attachment would reduce losses to about one in 60.

PART 6
AN EXAMPLE MISSION SCENARIO

(~~TS~~) Several assumptions are necessary. For example, assume we wish to complete a mission in the Leningrad area before the end of the 1978 calendar year. Figures 39 and 40 show that only from the

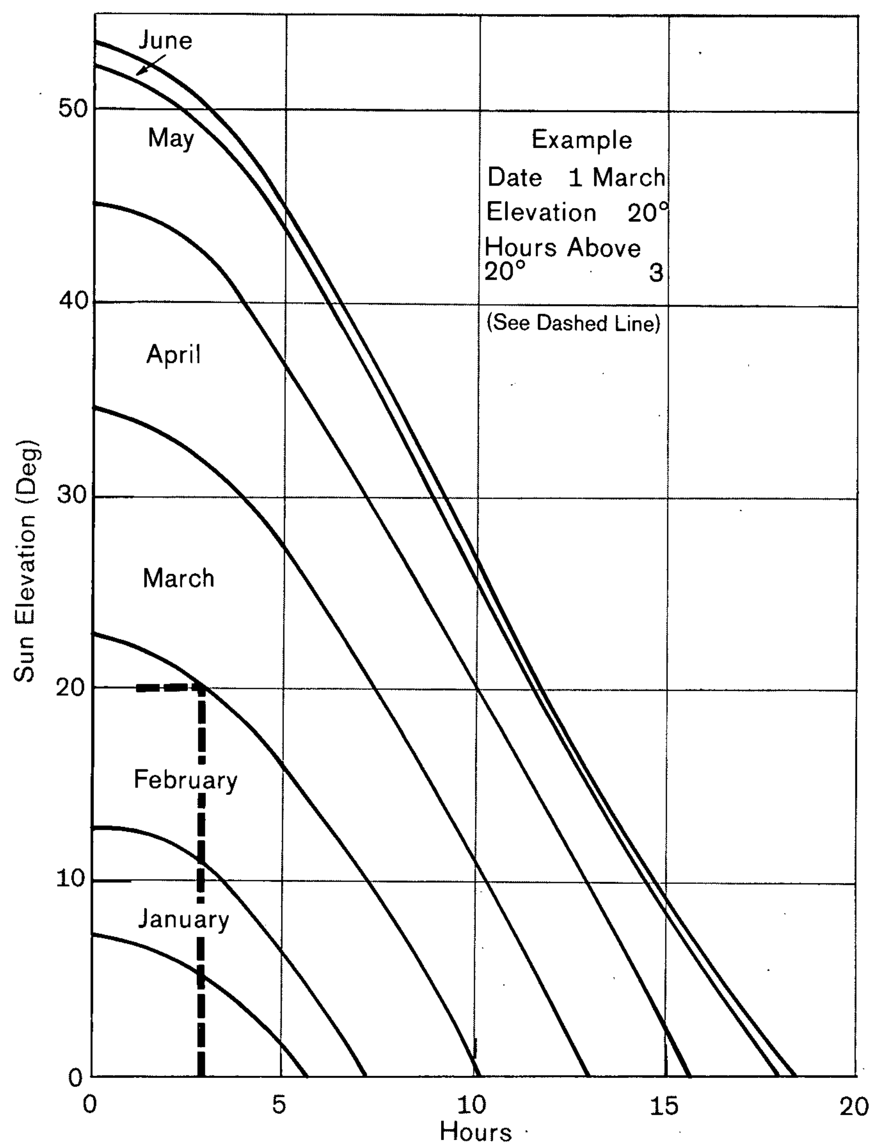

FIGURE 39. Hours the Sun is Above a Given Elevation for January - June in Leningrad

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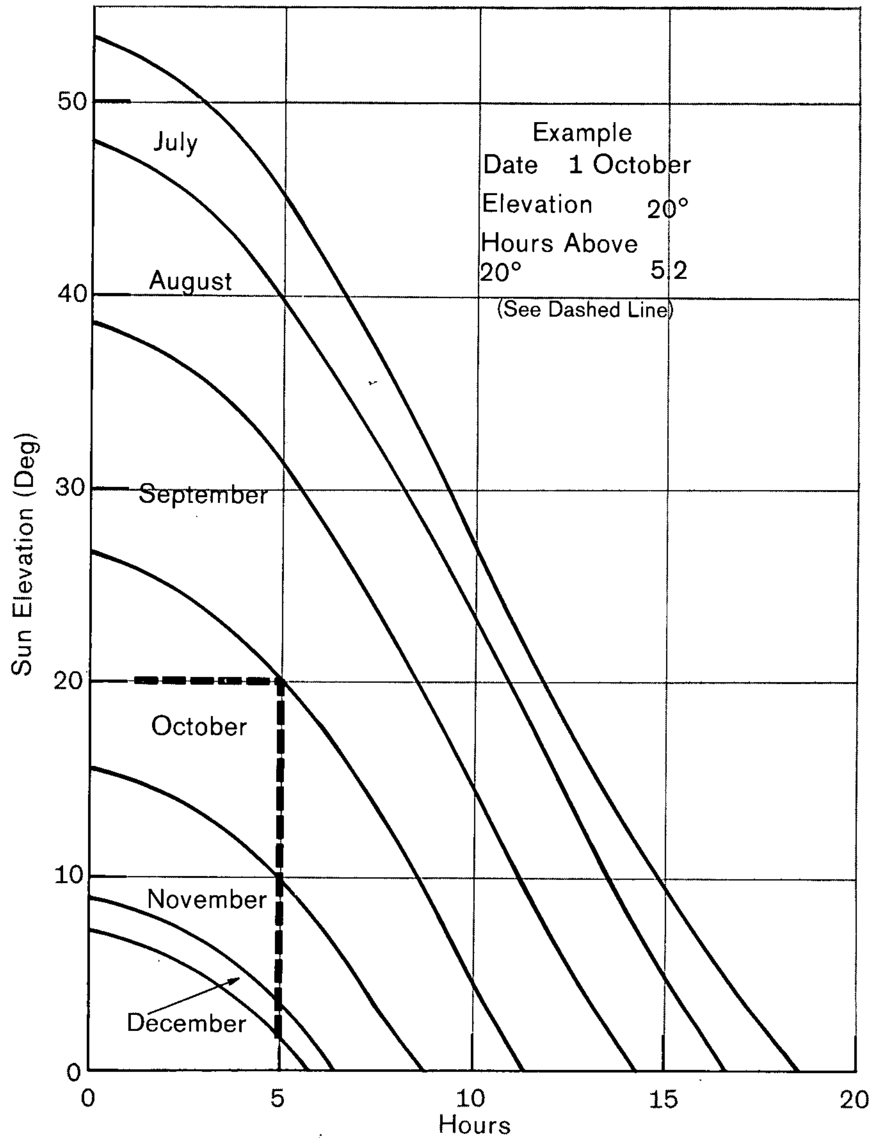

FIGURE 40. Hours the Sun is Above a Given Elevation for July - December in Leningrad

UNCLASSIFIED

latter part of February to the early part of October does the sun rise above 20 degrees in elevation for any appreciable period of time during the day. Results from the balloon tests in Part 3 indicate a sun elevation of at least 20 degrees is necessary for adequate contrast and exposure. It is felt that operational flights against the targets in Leningrad should begin no later than early August 1978 so that adequate coverage can be obtained by early October. Several plans are possible which trade risk against operational complexity. Two plans are discussed below which assume a start date of 1 October 1977.

Plan 1 (preferred)

(~~TS~~) A local loft must be purchased or constructed by mid-October 1977. During this time, 100 pairs of exceptional breeders will be purchased at an average cost of $150 a pair. These will be placed in the local breeding loft by the third week in October so that all will be on eggs by the end of the first week in November. These eggs (about 150 to 170) will hatch by the end of November. By the end of December, about 30 days of age, all young will be out of the nest eating and drinking on their own. During these three months, a loft manager must be trained in the care, handling and flight training of young birds, and a loft must be constructed in the [redacted] About half of the young birds (70) will be handpicked for transport to [redacted] the first week in January 1978; the subject of transport will be discussed later. During January these birds will be trained into the [redacted] as their primary home. If possible, the birds should be placed just outside the roof access window, shown in Figure 6, in a wire basket for several hours a day just before their first release (about one week after arrival). Certainly, the basket should not be placed where it can be seen by any possible observation post. If the basket cannot be placed on the roof, the birds should be allowed to look out as many windows and dormers as possible prior to their first release. The birds can be released in small groups which are kept hungry so that they will come in quickly when the dinner music is played. By the end of January, or the first week in February, all birds should be flying from the loft and ranging a mile or so during exercise flights. There will probably be about 60 birds left at this time. During the remainder of February, the birds should be taken out in small groups and released in parks or wooden areas (more will be said later on clandestine release techniques) but this is not mandatory. By the end of February, about 50 young birds will consider [redacted] as their primary home.

(~~TS~~) There is certainly a temptation to select some of these 50 birds for the purpose of testing their performance with weights in the Leningrad area during the month of March and trying for a mission in April or May. However, this may involve undue risk and would require sending a new loft manager to the field who had been trained in mission-oriented techiques. A safer approach would be to bring the 50 birds back to a loft in the Washington, D.C. area

[redacted]

(~~TS~~) By mid-April, these 50 birds will be ready for their first release from the local loft. Relocation techniques not available in the field can be used to increase the relocation rate of survival. It is estimated that about 20 to 25 birds will survive this relocation. By the first of May, flight training to harness and weights can begin, and the birds can be moved out toward local example targets (e.g., the Washington Navy Yard). Through the end of June, field personnel will be trained in all aspects of clandestine release, camera maintenance and repair, and techniques for determining the "preferred flight line." By the end of June 1978, 10-15 birds will be selected for transport back to the Leningrad loft.

~~(TS)~~ During July, these 10-15 birds, which consider Leningrad their primary home, can be used to determine the preferred flight line and to select suitable launch points for overflight of the selected targets. By the first of August 1978, mission operations can begin with some confidence that the probabilities of overflight are essentially those of Figure 32. The disadvantages of this plan are:

1. There are only about two months before operations must be terminated due to low sun elevation.
2. The birds must be transported three times.
3. There is a great deal of "activity" in the field [redacted]
4. The time schedule is very tight with some risk of being late.

Plan 2

~~(TS)~~ During the first half of October an operational type loft is constructed in the Washington, D.C. area capable of housing 200 pigeons. These birds will be two to three years old and all should be of proven worth from their racing records. The cost will be in the neighborhood of $100 each. These birds will be relocated to the local loft for a first release by the early part of December 1977. Again, techniques not suitable in the field can be used to increase survival. All birds should be on eggs by the first release, and wing hobbles should be used for one week after the first release. It is estimated that there will be 70 to 100 surviving to the end of December. Starting in January 1978, these birds will be trained to harness and weights and worked out to example targets. By the end of February, loft managers will be fully trained in all aspects of the mission, and the final selection of 35 to 50 birds will be made. These birds will be shipped to Leningrad in early March and the first release, with wing hobbles, will occur during the end of April. Again, all birds should be on eggs at the time of release. At least 10 to 15 birds should survive to the end of May. The performance and, hopefully, the reliability of these birds have already been established over local example targets. By early to mid-June, launch sites should be selected and mission operations can begin. The advantages of this plan are:

1. Operations start in mid-June giving about four months to collect photographic coverage.
2. Only 35 to 50 birds are taken to the field once, and all these birds have been tested over local targets.
3. There is no need to rush into the field, as with plan 1, until all personnel (and birds) are fully trained.

The disadvantages of this plan are:

1. The care and handling of 200 pigeons through the first relocation is no easy task, not to mention the harness and weight training of 70 to 100 birds.
2. The estimate of 35 to 50 birds of acceptable performance for shipment to Leningrad is speculation. There is insufficient data from this research for a reliable prediction.
3. Assuming there are a sufficient number of birds which perform well over local targets, the probability of their holding up under additional stress at the operational target is a matter of conjecture at this time. Without further research, it must be assumed that the risk of loosing camera and bird is higher with this plan than with plan 1.

~~(S)~~ Plan 1 is more complex but involves less risk in predicting performance. With additional research on the performance of birds at a secondary home, plan 2 may well be preferred; it should certainly be the goal of further research.

Transportation

~~(S)~~ During this project birds were shipped by airfreight from Anchorage, Alaska, to Dulles Airport on several occasions. During one shipment from Oregon, birds were lost for three or four days, finally arriving in fair condition; the primary danger is thirst and heat, not hunger. It is not uncommon for local loft keepers to ship birds to Japan or receive them from France and Belgium.

~~(S)~~ The issue here is that of clandestine transport. Some research has been done in this area (Reference 8) but with species other than pigeons. However, it is felt that a pigeon in good condition is among the hardiest of bird species and should survive transport as well as any. In Reference 8, birds were transported in "hole luggage" and "carry-on luggage" for periods up to 72 hours. Some holes and air passages (quarter-inch holes in the bottom) were provided for ventilation. The birds were wrapped in cloth, or panty hose, to restrict movement, and eye coverings were used which greatly inhibited auditory noise and caused a "catatonic" like state of inactivity. A layer of San-O-Sil (trademark) impregnated with water-soluable neomiocin was placed in the bottom of the luggage in order to prevent a toxic contamination of the air by ammonia in the birds excrement.

Clandestine Release

~~(S)~~ Most are familiar with the magic tricks that seem to produce large numbers of birds from nowhere. In fact, birds transport well in the outside or inside pockets of large overcoats. Consider a large inside pocket near the bottom of an overcoat. If one were kneeling, say to feed the park pigeons, it would be a simple matter to release several birds from underneath the coat.

~~(S)~~ One particular method was studied which would be convenient for the release of a number of birds over a short period of time. An access hole was provided in the floor of an automobile through which one or two pigeons could be placed onto the road or parking lot. The pigeons walked from underneath the car and immediately took flight upon reaching daylight. Figure 41 shows a pigeon with harness and weight that has just taken flight after being released by this technique. If the automobile were in a parallel parking area with adjacent parked cars, it is conceivable that several birds could be released by this method, even under close surveil-

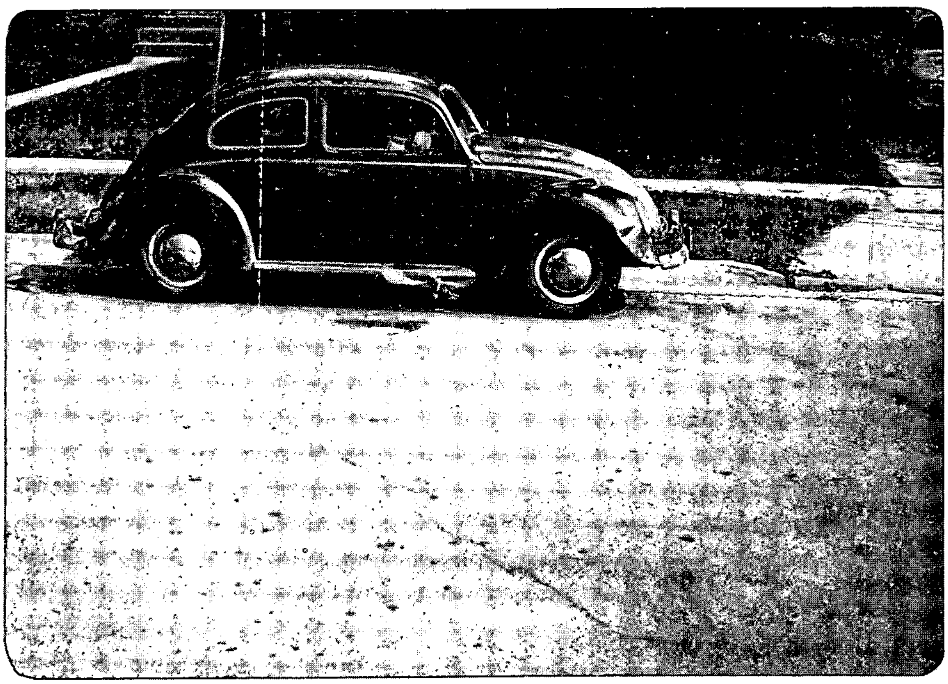

FIGURE 41. Pigeon In Flight After Clandestine Release

~~SECRET~~

lance. Various methods ranging from shopping bags to briefcases with "trick bottoms" could be tried in the local area during training exercises.

The [redacted] *Loft*

~~(S)~~ The loft in the target area must be completed prior to arrival of the first birds. This includes perches (a collapsible egg crate frame of ¼ in. plywood), nest boxes (if they are old birds), and an adequate supply of feed and medicine (see appendix C for the prevention and cure of disease). A grown pigeon will eat about an ounce of feed per day, and a few pounds of grit will last a month for 50 birds. The loft must be well ventilated without noticeable drafts. The colder the temperature, the better the birds thrive (the Alaskan loft has experienced temperatures of 40 degrees below zero). However, high temperatures (above 90 degrees) will precipitate disease and severely degrade performance. If loft temperatures above 90 degrees are to be expected (at the target area or locally), some combination of insulation and air-conditioning must be provided without the birds being in a direct draft. This issue cannot be taken lightly, particularly with young birds.

PART 7

SUMMARY AND CONCLUSIONS

~~(S)~~ It is felt that the quality of photographs collected over the Washington Navy Yard is adequate for satisfying a high-resolution requirement. Furthermore, the chance of overflight, shown in Figure 33, certainly demonstrates the feasibility of getting the camera over the target. An unexpected result of this ten-month effort was a lack of data sufficient to predict the performance of relocated birds. This is due primarily to the initial allocation of priorities dictated by the constraints of manpower and funds.

Photographic Quality

(S/TK) Of 36 camera flights over the Navy Yard, six collected 23 images of some portion of the target. Mensuration on 53 samples varying from 3 inches to 37.5 feet showed an average error of less than 1.6 inches. Perhaps of greater interest is the mensuration of 22 small objects (less than 2 feet) which showed an average error of about ¾ of an inch with 90 percent of all errors less than 1.8 inches. In comparison with KH-8 photography of the same target, the avian system was rated as having a higher image interpretability as well as the ability to see smaller objects. The National Imagery Interpretability Rating Scale (NIIRS) ratings were 7.8 for the avian system and [redacted] Furthermore, it is believed that the avian system, due to its extremly low altitude, has a high potential for using color photography (SCAT) for materials identification (see Table A4 in Appendix A).

Camera Research

~~(S)~~ It is felt that the [redacted] camera can be brought from research to operational status within the time frame of either plan discussed in Part 6. However, it is suggested that the following be considered carefully:

1. The field replaceable shutter assembly has greatly contributed to system reliability. However, a method for measuring shutter speed in the field should be developed as a check on system performance. Low shutter speeds were the primary cause of image blurring on this project.

2. A method should be developed for identifying the type, location, and degree of light leaks prior to each mission. This

problem is not difficult to solve and would provide a most important check on system performance.

3. An effort should be made to reduce the weight of the [redacted] system, particularly the method of harness attachment which is subject to periodic failure. Research in this area would improve bird performance.

4. Some barrel distortions in the [redacted] lens were observed at the edge of the field of view. Mensuration accuracy could be improved if the lens were calibrated or redesigned.

5. Appendix B contains low temperature data and suggestions for providing a low temperature system.

~~(S)~~ Some preliminary research was conducted to increase the lateral coverage by use of a miniature panoramic camera which has the same weight as the current [redacted] system. The lateral coverage is adjustable and would increase the oblique photography to the right and left of the flight path. Figure 42 is a picture of this

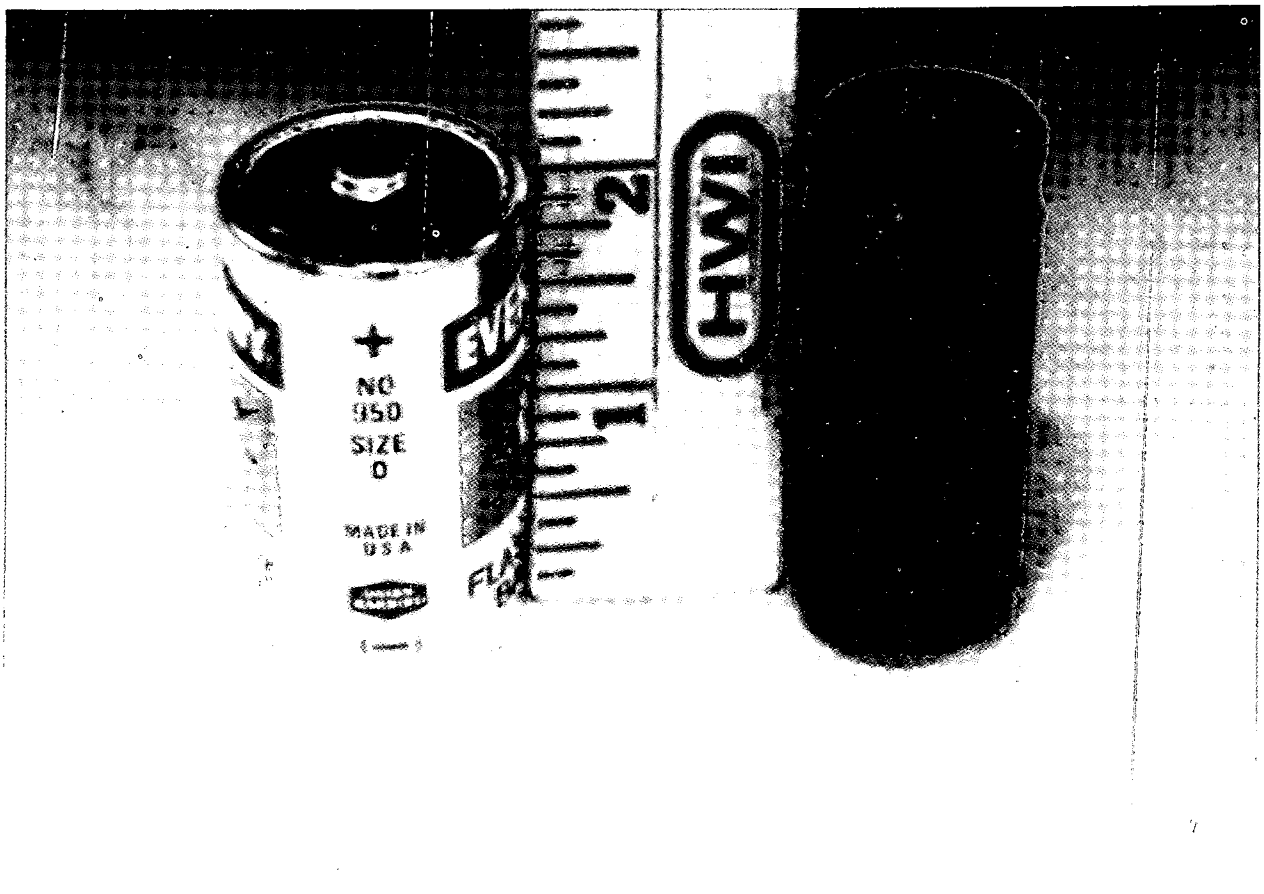

FIGURE 42. Miniature Pan Camera

~~SECRET~~

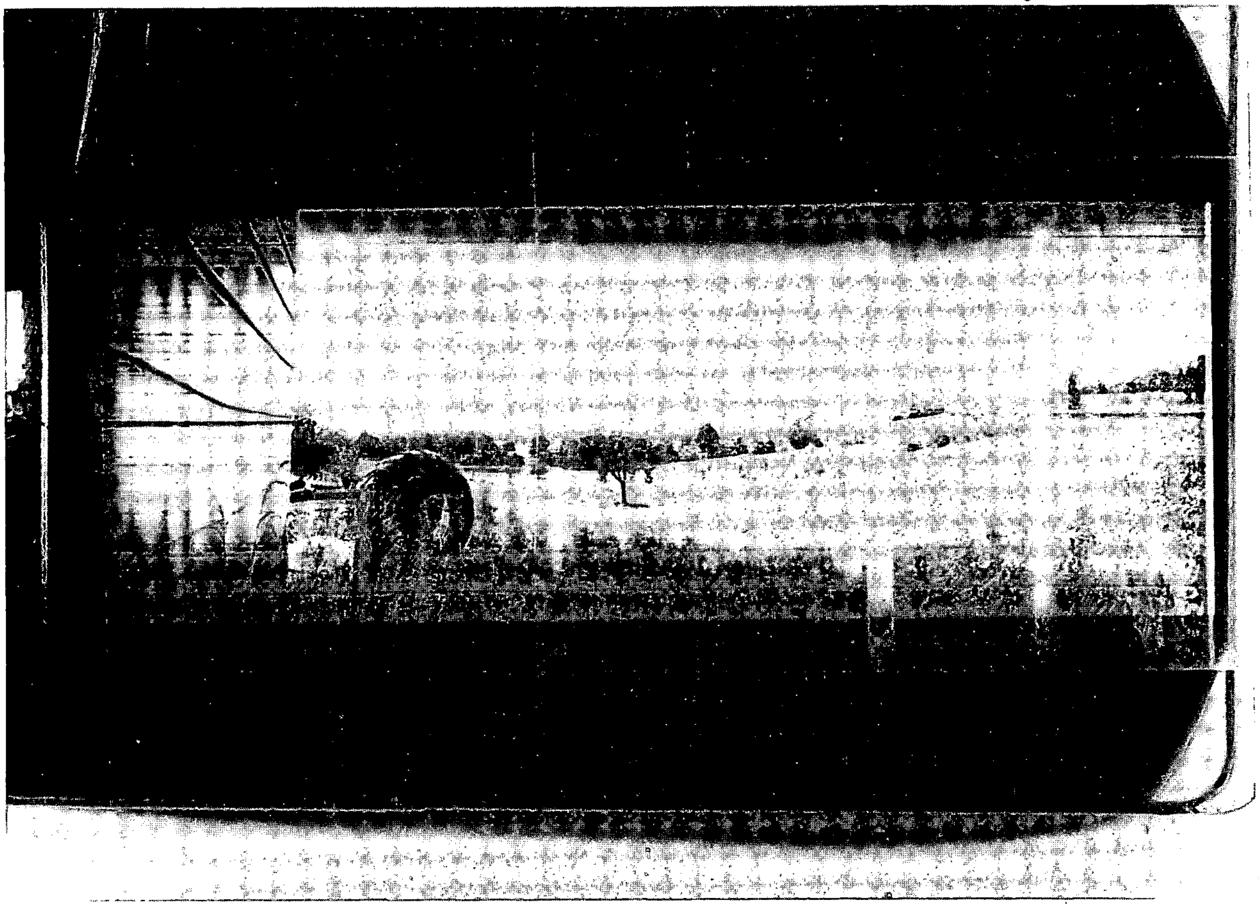

FIGURE 43. Pan Picture With 180° Field of View

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miniature pan camera. Figure 43 is a picture taken by this first research unit with a 180 degree field of view. The goal would be to achieve the same photographic quality as the current avian system. However, no further research is planned at the present time. The point here is that increased coverage would provide increased intelligence and, therefore, fewer flights and less risk.

Bird Performance

~~(S)~~ The ultimate goal should be to provide a hard core operational kit of birds which have been trained over local targets and selected for proven performance. These birds would be held at a local operations-type loft for rapid deployment to any target area with confidence in the expected performance and reliability. It is felt that the key ingredient in achieving this goal is the local loft and the dual involvement of research and operational field personnel. Aside from providing a training ground for personnel and a proving ground for new ideas, such a loft might act as a vehicle for fusing together the practical problems in the field with the science of research.

Concluding Remarks

~~(S)~~ Whether or not sufficient data has been presented to warrant the initiation of an operational plan is dependent on the importance of the intelligence need in relation to the risk and logistic complexity in the field. It is hoped that this report contains sufficient data and candor to allow those concerned with the intelligence requirement and field operations to form a proper judgment. It is suggested that an active interchange between research and the concerned parties may provide a plan with acceptable risk and logistic complexity, and clearly identify the type and degree of research required for adequate support.

APPENDIX A
EVALUATION OF PHOTOGRAPHIC COVERAGE
(Prepared by NPIC)

Section 1 Summary

1.1 *Introduction*

~~(S)~~ During the past year (6/76-7/77) the National Photographic Interpretation Center has provided analytical and production support for a research study (Tacana) being carried on by the Office of Research and Development/Operations Technology Division to determine the feasibility of using an avian (pigeon) platform for purposes of collecting overhead reconnaissance photography. This support has included:

— The evaluation of the system imagery for exploitation purposes by the Imagery Exploitation Group (IEG) and the Technical Services Group (TSG).

— Assistance in the camera modification development, film selection, and system quality evaluation by the Technical Services Group.

— Imagery production and film processing by the Production Services Group (PSG).

(U) Following is a summary of the results of the various studies and observations which will aid in describing the quality of the exploitation product from this system.

1.2 *Interpretability*

(S/TK) ***The Tacana system has the capability to acquire imagery of an exploitation quality equal to, or better than existing systems, including the KH-8.***

1.3 *Mensuration*

~~(S/TK)~~ ***The Tacana system can image measurable objects of small dimensions.*** Twenty-two measurements made of object dimensions of 3 inches to 2 feet indicate that 90% of the errors (from ground truth) are less than or equal to 0.15 feet (4.5cm). Fifty percent of the errors are less than or equal to 0.06 feet (1.82cm).

1.4 *Digital Image Manipulation*

~~(S)~~ ***Interactive Digital Image Manipulation techniques clearly reduce the imaging effect of directional smear sometimes produced by the Tacana system.*** The beneficial effects of other IDIMS techniques (to enhance the detail of shadows and highlights, reduce grain noise and clarify fine detail) were less obvious. These techniques will usually benefit any general film imaging system (including Tacana) that has acquired threshold level detail imagery (where density and resolution information is almost present).

1.5 *Image Quality Analysis*

~~(S)~~ ***The Tacana system has the potential to acquire imagery of less than 1 inch (2.54cm) GRD*** under optimized conditions of lighting, platform stability, camera reliability, and flying height. Most of the time the system will perform at a lower quality level due to the unpredictable nature of the platform and variable flying heights. A camera shutter speed of at least 1/2000 second is required to produce a reasonable percentage of sharp (non-smeared) images from a given flight.

1.6 *Film Selection*

~~(S)~~ ***The Tacana is a fair weather (with sun) system and is adaptable to both black-and-white and color films*** (EK 3410, FE 6526 and Aero Color Negative 2445). Because the camera is a fixed exposure unit, clear sun (no clouds or heavy haze) acquisitions of less than 20 degrees solar elevation will require a faster film with a resultant loss in overall image quality.

1.7 *Other Summary Comments*

1.7.1 ~~(S)~~ ***An avian (pigeon) platform can be used to acquire imagery of a specified target area.*** Of 36 test flights evaluated over the Washington Navy Yard of a designated target (Willard Park, the Navy Museum display area of about 64,000 square feet), 6 flights acquired 23 images of some portion of the park.

1.7.2 (U) ***Throughout this study, image quality was compromised due to poor camera reliability*** (i.e., power failures, shutter breakdowns, light leaks producing fogged film, optical system misalignments and/or internal flare). While these "kinds" of malfunctions and effects are typical of problems associated with research and prototype fabrication, a clearer view of system performance could be obtained if they were corrected in future development efforts.

1.7.3 (U) ***The present*** [redacted] ***lens produces imagery containing a high degree of barrel distortion.*** The mensuration accuracy could probably be improved if each camera was calibrated and future lens systems (i.e., design) had reduced distortion effects.

1.7.4 ~~(S)~~ ***Greatest detail imagery will be obtained with this system on black-and-white film.***

1.7.5 ~~(S)~~ ***Using color films this system has a high potential for materials identification (using SCAT) and certain camouflage, concealment and detection applications.*** Further research should be done to determine the effectiveness of this system in these areas. The Tacana's large scale imagery and its relative freedom from high altitude atmospheric effects during acquisition are beneficial for this type of analytical analysis.

Section 2 Determination of Exploitation Suitability

2.1 *Introduction*

(~~S/TK~~) Because the Tacana study was a research effort, it is felt a measure of performance from a user point of view would be meaningful to aptly describe the quality of the system product. Following are NPIC evaluations that describe the exploitation (interpretation, mensuration, and image manipulation) potential of the system. The nature of this study involved parallel development of the bird, camera, targeting philosophy, and films and processes; therefore, it is impossible to predict a level of system performance to be expected operationally. However, efforts were directed towards describing the exploitation suitability of the system in terms of its potential to perform when all elements appear to be functioning at their optimum, i.e., no camera malfunctions, tired and untrained birds, or wrong film/poor process combinations. Certain KH-8 data (and photography) is included in the analysis for informational purposes. For editorial convenience, a study describing the capability of the Interactive Digital Manipulation System to improve the Tacana exploitation product is placed in this section.

2.2 *Interpretability*

2.2.1 (T~~S/T~~K) Figure A1 shows the percentage occurrence of NPIC/IEG photointerpreter NIIRS ratings* of 85 images acquired

*~~(S)~~ NIIRS (National Imagery Interpretability Rating Scale) is a uniformly understood and systematically applied judgment by photointerpreters of the interpretability of acquired imagery, regardless of collection source. It is a graduated scale divided into 10 numbered rating categories, with 0 representing unusable imagery and nine representing imagery with the best interpretability. It is enough to know here that NIIRS is an accepted Intelligence Community measure of interpretation quality and is used to aid collection and mission planners, engineers, photoscientists and other PIs. For further information see NIIRS Documentation, Vol. II, TCS-9842/74.

by the Tacana system over the Washington Navy Yard 3/17/77. This data represents an average rating by three PIs of a complete flight operation. Operational PI NIIRS data from KH-8 Mission 4348 is also shown. The Tacana flight evaluated represents the best performance of the total system (in terms of image quality) that was obtained during the test phase of this study. This is not a measure of predicted system performance but does describe the capability of the system to produce high-quality imagery when all aspects (bird, camera, weather, etc.) are performing reliably.

2.2.2 (~~S~~) Figures A10-A17 represent Tacana vertical and oblique images from the flight that were rated by the PIs. Other types of photographs typically acquired by this system are illustrated by Figures A18 thru A20 showing observed maximum flying height (about 300 feet) and Figures A21 and A22 representing adjacent frame quality differences caused by inconsistent bird motion (a common occurrence with this system). Figures A23 thru A27 show sequential (adjoining) frames from one flight covering the Navy Yard, Willard Park Display Target Area. Of interest here is to note the target mapping effect that can be accomplished with this kind of a system. It is useful to compare these pictures with the KH-8 coverage of the target area (Figure A30). Figures A23 thru A27 also exhibit certain camera anomalies that are more completely described in Section 3.2.7.

2.2.3 (U) There are no peculiar problems associated with viewing Tacana imagery. Its small format image (12.5 x 12.5mm) and large scale (nominal 2000:1) lend themselves well to producing duplicate positives, handling, and viewing with existing (low magnification) photointerpretation equipment.

2.2.4 (~~S/TK~~) Due to the small area coverage of each frame (nominal 30 x 30 meters) and the inconsistent aiming of the platform, some type of collateral coverage should be available to the interpreter for determining his Tacana coverage in the general target area. KH-8 coverage is suitable for this mapping function.

2.2.5 (U) To simplify the duplication of this type of imagery (16mm strips, nominal 3 meter lengths per 200 exposures) a three density level exposure of each image segment will satisfy most frame-to-frame density differences caused by illumination and target brightness variations. For example, one image segment of 10-15 images would be duplicated three times (once each at three different density levels) side by side on a 20.3 x 25.4cm (8 x 10 inch) chip of duplication film. This technique allows the PI to easily select the best frame for interpretation as well as giving him the opportunity to exploit two different brightness areas (shadow and highlight) of a given scene.

2.3 *Mensuration Suitability*

2.3.1 *Introduction*

(S/TK) An exercise was performed to provide a view of the mensuration of imagery produced by the Tacana system. Supportive data and accuracy standards were provided from the KH-8 and ground truth information.

2.3.2 *Exercise Procedures*

(S) A target test area similar to an operational area was selected at the Washington, D.C. Navy Yard museum (Willard Park, Figure A30). Within this test area, a TALOS missile was singled out as being representative of the type of target appropriate for study (Figure A29). This missile has an assortment of different shapes and dimensions that would be both quantitatively and qualitatively important in an intelligence sense.

(U) The procedures for this exercise were to first acquire distances from the target site for use in scaling. These distances ranged from 15 to 40 feet (5 to 12 meters).

(U) Two system photographs were used for this study (Figures A25 and A28). Other coverages of the target area were not included because of severe blurring due to platform motion, lens distortion effects and/or extreme obliquity.

a. *Scale Determination*

(S/TK) Good satellite coverage of the Washington, D.C. Navy Yard is minimal. Two KH-8 frames were found that could be used for determining a working scale. Monoscopic measurements were made and compared with ground truth dimensions. From these values, one or more were chosen as a scale reference in deriving dimensions from system imagery. The scale dimension used had to be as close as possible to the target, generally parallel to the target and nearly in the same object plane. The last requirement could not always be done, especially in trying to get a variety of dimensions from the TALOS missile which not only rests upon a raised base, but also has a nose-up attitude. Because of this target problem, additional targets in the vicinity of the TALOS were chosen in order to demonstrate the capability of the system to "see" small dimensions.

b. *Focal Length and Format Edges*

(S) Although the cameras have unique design features for their size and function (moving film and an image motion compensator), the imagery can be analyzed as frame photography since the photograph is exposed simultaneously over the entire format. With that in mind, the frame format edges and focal length were looked at to find out if the imagery lended itself to analysis by either graphical or analytical means.

2.3.3 *Results*

(~~S~~) Preliminary results* showed that small dimensions could be measured. This exercise was to test the Tacana system for mensuration feasibility on "operational" imagery which included long dimensions (2-38 feet) and small dimensions (0.2-2.0 feet). The results also compare the image formats of the two types of cameras and their respective focal lengths. This additional information is important for future exploitation of operational imagery.

a. *Format Edges*

(~~S~~) The format edges are important in that they are used to aid in computing the focal length. There are two types of cameras: one with a rectangular format measuring 12.5mm by 7.5mm, and the other with a square format 12.5mm by 12.5mm. The rectangular imagery acquired with the Model I (MCW-24) had fuzzy format edges when viewed on a monoscopic comparator at 5X magnification. However, the square format imagery (Model II [redacted] camera) had sharp, well-defined edges when viewed on the comparator.

b. *Focal Length*

(~~S~~) The nominal focal length of the Tacana camera is reported as 15mm. A test was done to check this value for the rectangular format camera. Two focal lengths were computed: 14.05mm and 14.19mm.

c. *Target Data*

(~~TS/~~TK) Mensuration data was gathered from two photographs (Figures A25 and A28). The data points were measured on the 829 Mann Comparator. There was a total of 53 dimensions measured ranging from [redacted] The scale was determined from KH-8 measurements and the scaled distances compared with ground truth. The errors, or differences from ground truth, ranged from [redacted] This data is listed in Table A1. Histograms were

*The preliminary tests were done using imagery taken from a fixed or static camera platform, i.e., a balloon. No written report was required; however, results can be reviewed.

TABLE A1

MENSURATION DATA FROM NAVY YARD IMAGERY*

GROUND TRUTH	MEASURED DISTANCE	ERROR	GROUND TRUTH	MEASURED DISTANCE	ERROR
[redacted]					

* All dimensions given in feet

constructed for three separate data sets: overall dimensions, dimensions less than or equal to two feet, and dimensions less than or equal to one foot. See Figures A2, A4 and A6, respectively. Corresponding graphs showing cumulative percentages of errors were constructed in order to better interpret the results. See Figures A3, A5 and A7.

2.3.4 *Conclusion*

~~(S)~~ This section will attempt to draw together those points of the study which need to be emphasized. Reviewing Figure A3 for overall dimensions [redacted] it shows (as the dotted lines indicate) cumulative percentage values of errors at both the 90 and the 50 percentile marks. Following the dotted lines over to the curve and down, it is seen that 90% of the errors are less than or equal to [redacted] and 50% of the errors are less than or equal to [redacted] ft.

~~(S)~~ Since the most interest is in small dimensions (2.0 ft. or less), Figure A5 was constructed showing the errors of those dimensions ranging from [redacted] to 2.00 ft. On this graph, 90% of the errors are less than or equal to [redacted] and 50% of the errors are less than or equal to [redacted]

~~(S)~~ If only the dimensions less than or equal to one foot are graphed, the data sample becomes so small that it is difficult to make an analysis. Figure A7 of the cumulative percent of errors for these short dimensions shows that 90% of the errors are less than or equal to [redacted], and 50% of the errors are less than or equal to [redacted]

~~(S)~~ In conclusion, the results show that for dimensions less than or equal to 2.00 ft., the probability of a measurement being within [redacted] of the true value is 90%, or 90 out of 100, and being within [redacted] of the true value 50%, or 50 out of 100. In a like manner, the same statement can be said for the two other data sets. It must be pointed out that the stated probabilities are applicable only for the data sample (photographs) used here.

2.3.5 *Summary*

(~~S/TK~~) Probably the most interesting and impacting quality of the Tacana system is its ability to "see" small dimensions that otherwise could not be seen on KH-8 imagery, and be able to measure these dimensions accurately. Limiting the test to just one target area reduced the data sample considerably. Limiting the study to two good photographs further reduced the data set. However, it must be emphasized that the exercise, being a feasibility study, was very practical. The results can be assumed to be indicative of those for an operation such as Tacana where image acquisition has not been optimized to its full potential.

2.4 *Interactive Digital Image Manipulation (IDIMS)*

2.4.1 *Introduction*

~~(S)~~ Test imagery acquired by Tacana over the Washington Navy Yard was manipulated on the IDIMS to illustrate the capability of the system to improve smeared imagery for exploitation. Because Tacana has no exposure control, imagery exhibiting heavy shadows was also selected for analysis.

(U/~~AIUO~~) The IDIMS is located in Room 4N 814, Building 213, and is utilized to extract additional intelligence information from problem imagery for photointerpreters and analysts. The IDIMS consists of a Hewlett-Packard 3000 CX computer with peripherals (i.e., three magnetic tape drives, one line printer, one card reader, four analyst terminals) and two COMTAL TV display monitors. A DICOMED, Inc., image recorder is capable of producing high quality hard copy results (black/white or color) on film or Polaroid paper. Approximately 200 image manipulation processing functions ranging from simple manipulation (e.g., contrast stretching) to complex manipulation (e.g., Fourier analysis and filtering) can be applied to digital imagery. The target area on a film transparency is digitized on a PDS microdensitometer and then manipulated on the IDIMS to achieve the desired results.

(U) Upon selection of the frames for analysis, an area from each was digitized on a PDS microdensitometer using an 8 micrometer sampling and step-over interval, and an 8 micrometer scanning aperture. The digital array generated on the PDS was 512 samples x 512 lines. This array covers a square area (4.096mm x 4.096mm) on the Tacana ON film. Figure A32 (a-d) illustrates the effects of IDIMS on a smeared Tacana Navy Yard acquisition.

2.4.2 *IDIMS Technique*

~~(S)~~ The 512 x 512 microdensitometer scan was reduced by a factor of two (i.e., making the image equivalent to a 16 micrometer scan) to speed up processing in the Fourier transform domain. No information was lost in the reduction process since this frame contains much less fine detail than the other three frames and is shown in Figure A32a. A Wiener filter/image motion correction routine was first applied to the Fourier transform of the image with little or no improvement.

~~(S)~~ A second Fourier transform technique, defined as "rooting" and similar to applying a high pass filter to a Fourier transform was applied to the magnitude (i.e., amplitude) of the Fourier transform. This technique raises the magnitude to a power and is an alternate means for correcting for moderate image motion and for enhancing edge detail. Figure A32b is the result of the rooting technique and Gaussian filter only. Figure A32c represents the effect of two additional edge enhancement techniques (to A32b). The exponential value of the function was then changed to 0.5 (i.e., similar to applying a very high pass flter). The resulting image was then inverse transformed and a 5 x 5 low pass convolution filter applied to reduce the noise. This result is shown in Figure A32d. Much sharper edge definition is apparent in this result than in the original degraded image.

(U) Inverse filtering, i.e., dividing the Fourier transform by the image motion equation (sin wx/wx) to remove the image motion, was not attempted. Also, the phase portion of the Fourier transform was not corrected by direct inverse filtering.

2.4.3 *DICOMED Results*

(~~U/A~~IUO) The hard copy results listed above were generated on Plus-X 120 film in the DICOMED high resolution mode. This film transparency was then processed in the Versamat at a speed of ten feet/minute. The DICOMED film copy is comparable to results viewed on the IDIMS. An infinite number of results can be displayed on the IDIMS using a trackball cursor which controls the contrast/brightness upon completion of the more sophisticated IDIMS routines.

2.4.4 *Summary*

~~(S)~~ IDIMS improved the smeared frames used in this evaluation. Some loss in "enhancement" effect is noted in the intermediate paper prints as PIs gain most benefit from the IDIMS directly from the viewing screen.

~~(S)~~ Possible future Tacana experiments, if deemed feasible, should center on restoring smeared imagery using a number of existing routines with varying parameters. The maximum a′ posteriori (MAP) method of restoring images should possibly be investigated. The MAP algorithm processes small sections of the image sequentially and pieces them together to create the restored picture. The Office of Research and Development/CIA is currently evaluating this technique [redacted]. Research and application of the MAP restoration technique to operational smeared photography in 1976 indicated some improvement in image quality. Tacana imagery not degraded by image motion or defocus can be manipulated with existing IDIMS functions.

Section 3 Image Quality Analysis and Film Selection

3.1 *Introduction*

3.1.1 ~~(S)~~ Film selection for the Tacana system was based upon an examination of quality factors desired from the product which were appropriate to the exploitation objectives of this study. The quality goals were:

a. The film should have a film speed and latitude to record a wide range of target reflectances under variable light conditions.

b. The camera/film combination should have a recording potential of 5.08cm (2 in.) Ground Resolved Distance (GRD).

c. The prime film consideration will be black-and-white. Color films will also be investigated for their applicability.

d. Other factors which affect mensuration, field handling, camera/film compatibility, interpretability, etc., will be considered and maximized.

3.1.2 (U) The specific quality factors examined were:

a. Film Speed

b. Resolution

c. Exposure Range

d. Processing Flexibility

e. Base Thickness

f. Granularity

g. Field Application

h. Availability

3.1.3 (U) Final film recommendations were based upon a weighted scoring which takes into account the relative importance of each quality factor to produce an optimum image for exploitation purposes. See Section 3.2.6 for scoring methodology. Table A6 illustrates the scoring technique and weighted quality factors used for each film that was evaluated. The preceding factors and their relative significance to this system product would not necessarily be the same for other systems.

~~(S)~~ For this study, there were two unusual constraints:

a. The camera is a fixed exposure type allowing no control for film speed or varying light conditions.

b. The pigeon platform is unpredictably variable in the directional nature of his motion, flight path, and velocity. The following sections will describe the techniques and results of the evaluation of each quality factor used in the film selection process.

3.1.4 ***System Parameters***

(U) Table A2 describes those characteristics of the camera, platform, target, and light conditions that were used for the analysis. Where no data was available, estimates (noted) were made for purposes of calculations.

3.2 *Film/Quality Factors Evaluation*

3.2.1 ***Film Speed/Latitude***

(U) Figure A8 represents the estimated exposure range we would expect to record with this system for low altitude photography. Basic assumptions for the calculations were taken from Table A2. The exposure values were calculated from:

$$E = IT$$

where E=Exposure in meter candle seconds
I=Intensity in meter candles
T=Time in seconds

Image Illumination was calculated from:

$$IF = \frac{0.64B}{N2}$$

where IF=Image illumination
B=Surface Brightness
N=f/Number
0.64=estimated lens transmission factor

(U) The film curves shown in Figure A8 represent three significantly different effective aerial film speed (EAFS) materials. They are typical for those films and do not represent an effect of unique processing or handling.

(U) An analysis of this figure also provides the basis for an estimate of the film type which would be required to obtain a proper system exposure and dynamic range. It reflects the exposure values (Log Exposure) for shadow and non-shadow areas of a target given:

a. A fixed shutter speed (1/2200 sec) and aperture (f/2.7) camera.

Table A2—System Parameters

Camera	**Mod. I (MCW24)**	**Mod. II** ([redacted]
Lens type	Minox	[redacted]
Aperture	f/3.5	f/2.7
Focal Length	15mm	15mm
Film Size	16mm unperf.	16mm unperf.
Format	12.5 x 7.5mm	12.5 x 12.5mm
Shutter Speed	.0007 sec. (1/1400)	.00045 sec. (1/2200)
Platform (avian)		
Forward Velocity	variable; 40 knots*	
Pitch and Roll Rate	variable; 40 knots*	
Propulsion (wing beat) Rate	6/Hz	
Flying Height	variable; 30.48M (100 ft)*	
Target (Nominal, Intelligence Type)		
Contrast	1.6:1	
Reflectance	12%	
Lighting *(Sunlight,50°-60° Solar Elevation)		
Direct Illumination	10 Foot-Candles	
Open Shade	10 Foot-Candles	

* Estimated for preliminary calculations.

b. A target of estimated 2% reflectance.

c. Various solar elevations.

(U) The range lines indicated by shadow and bright sun represent the scene exposure range. The ideal film (in terms of speed and latitude) would be represented by the straight line portion of its characteristic curve falling between the exposure range lines. By moving the left exposure range line to coincide with an appropriate solar elevation, the required log E can be estimated for various solar elevations for a clear (sunlighted) acquisition.

~~(S)~~ The above analysis and subsequent testing determined that 3400 series (3410) film was the best compromise of all the considered quality factors. Eastman Kodak was also requested to determine the availability of any new films which might be compatible for the system. They indicated that a candidate film was in the R&D stage and would be available in early 1977 for testing. 3410 material was then used for all system testing until arrival of the experimental material (FE 6526) in June. It was evaluated and found to be more compatible than the 3410 (see Section 3.2.6).

3.2.2 *Resolution/GRD*

~~(S)~~ A determination of the camera/film system resolution potential was made [redacted] Missouri. The resolution test consisted of suspending the camera from a balloon and photographing resolution targets of known contrast with color and black-and-white films. The materials used for baseline data were Eastman Kodak 3410 and 1414. They were selected because initial calculations indicated that the 3410 material had a film speed (EAFS) that would just satisfy the system exposure needs, and the 1414 would provide a high resolution base line to compare the impact of film resolution needs against exposure and camera performance. Figure A33 illustrates the test range. Objects in the scene were those readily available at the site. They were used for subjective impressions of image quality and initial mensuration estimates. The resolution targets were 100:1 contrast type (AF1959) graduated in 6th root of 2 increments.

(U) Figure A9 shows the resolution data obtained from this test. Each point represents the average of two to four resolution readings (based upon the individual coverage) from seven frames. The highest resolution readings were consistent with several prior ground/bench resolution tests. Although this test was done only for the Model I MCW-24 (Minox lens) camera, subsequent tests on the Model II [redacted] lens) camera indicated that it is representative of the camera/film performance. Also included in Figure A9 are the film resolution specifications as supplied by the manufacturer. The right axis indicates the calculated GRD at 100 ft. altitude when the resolution performance of the system is as noted on the left axis. The bottom axis indicates target contrast. For example, a 50 c/mm image taken at 100 ft. of a 2:1 contrast target could theoretically produce a GRD of 0.8 inches on 3410 film.

~~(S)~~ Analysis of this balloon test data indicated that the camera was the primary resolution determinate (or the 1414 resolution would have been considerably higher). Frame-to-frame variability was high. Nonetheless, because the camera was well focused and checked out prior to the test and no malfunction occurred, it is assumed that its variability is part of the system and, at worst, its potential performance at 100 ft. altitude could provide (on the average) better than 2 inches GRD (at 1.6:1 contrast) on 3410 series film.

3.2.3 *System Evaluation*

~~(TS)~~ Subsequent to the resolution and exposure evaluation of the camera and film from the balloon platform, a test of the total system (bird, camera, film) was undertaken over Andrews AF to determine the effects of the avian platform motion dynamics on the image quality. These tests were to combine a bird location and training exercise with additional image quality and camera optimization experiments. Also it would begin to give a better estimate of the problems associated with operations over large cultured areas. Prior to this, only operational flights over basically non-cultured areas had been made and these had been difficult to evaluate from an image quality point of view. Table A3 indicates the estimated performance of the system on the Andrews tests with camera Model I (MCW-24). Photoscientists evaluated 854 images from five test flights. The quality determination was based upon a subjective estimate of GRD. A three-level scale was used for the judgments:

(1) Better than 15.2cm (6″) GRD (about NIIRS 8-9)

(2) From 15.2cm (6″) to 76.2cm (30″) GRD (about NIIRS 5-7)

(3) Worse than 76.2cm (30″) GRD (about NIIRS 1-4)

~~(S)~~ Examination of the data from Table A3 indicated that the total system could perform with a potential quality (GRD) approaching study goals. This data also indicated that (1) performance

Table A3—System Performance Over Andrews AFB

GRD

Flight No.	No. of Images	Better than 6″	6″-30″	Worse than 30″
1	251	22%	37%	41%
2	235	15%	41%	44%
3	123	7%	34%	59%
4	117	5%	65%	29%
5	128	6%	43%	51%

decreased with succeeding flights, and (2) even at best (Flight #1) the probability of a system acquisition approaching the GRD goal was low (about 22%). These observations led to a camera examination which showed a shutter spring breakdown, and that a faster shutter speed was needed to increase the number of high GRD pictures. At that time the camera contractor was developing a Model II [redacted] camera unit utilizing a special design f/2.7 lens (to replace the f/3.5 Minox lens) and a larger image format. The larger lens aperture was initially proposed to allow a slower, higher resolution film to be used with the system. Based upon the preceding GRD/film performance test data and the Andrews GRD evaluations, it was felt that the unpredictable motion characteristics (altitude and velocity) of the avian platform was the greatest single contributor to degraded imagery. Therefore, the decision was made to increase the shutter speed to produce a higher percentage of sharp (non-motion degraded) images. The following formula, using known and estimated platform dynamics of roll, maximum velocity, etc., determined that in excess of 1/2000 sec. was necessary to assure more consistent, non-smeared imagery. The first Model II prototype flight incorporating the improved shutter indicated this to be so. This complete flight (85 images) was NIIRS rated by NPIC/IEG PIs for confirmation and the data is shown in Section 2.1.

$$\text{Required Shutter Speed} = \frac{\text{Platform Flying Height}}{(1000)\ (\text{Required Resolution})\ (\text{Lens Focal Length})\ (\text{Platform Velocity})}$$

3.2.4 ***Processing and Other Film Characteristics***

3.2.4.1 (U) Numerous combinations of films and developers were tested to determine if some specialized process might optimize some specific quality factor of a film to make it more effective for this system. Developers used included: PUSH-POTA (NPIC formulation), H and W, Kodak D-76, Kodak D-19, Rodinal, and Kodak HC110. The primary process factors evaluated included film speed manipulation, contrast control, and field (operational) utilization. All films were not evaluated with all developers, but an effort was made to determine if certain high resolution films could be made of an appropriate speed and dynamic range without compromising other factors of handling and image quality. Sensitometric data was collected where possible (1414, 3410, FE6526) for evaluation.

(U) Following is a brief summary of the film/developer examinations:

a. ***PUSH-POTA (NPIC formulation)***

(U/~~AIUO~~) Effectively increased the EAFS of all films that were processed (1414, 3410, 5069) about 2 times. But 1414 (at an

EAFS of 15) was still too slow, 3410 did not need such a magnitude of speed increase, and 5069 gave almost an equivalent speed as 3410 but did not have an appropriate latitude.

Additionally, PUSH-POTA produced dichroic (chemical) fog on the 1414 and had an extremely high fog density with the 3410. Field use is possible but a 95°F processing temperature requirement and questionable storage life makes its handling difficult.

b. ***Kodak D-76***

(U) Worked well with 3410 and FE6526 films. Clean working, stable, and readily available. It produced about a 50% speed increase with a moderate loss of dynamic range.

c. ***Kodak D-19***

(U) Worked well with 1414 but produced a very limited exposure range product for this system. It is designed to add (with 1414) contrast to high altitude aerial acquisitions that are typically of low overall scene contrast (haze effects, etc.). It did not increase the 1414 EAFS enough to make it usable. Produced a high contrast image with the 3400 with some speed benefit in the highlights.

d. ***RODINAL***

(U) Produced acceptable imagery with 3410 and 410. Has potential for further evaluation, but it is difficult to handle in the field requiring very precise (syringe) application.

e. ***Kodak HC110***

(U) Good results with FE6526 film. Readily available and clean working. With a matrix of tested dilution rates and processing times, it has the capability to alter film speed and contrast relative to the camera exposure/target (scene) brightness ratio. This was used for the 6526 film the last few weeks of the study and the results obtained were sensitometrically and subjectively acceptable.

3.2.4.2 ***Base Thickness and Granularity***

(U) For this system a 2.5 mil. base thickness film is most appropriate in terms of film load (more exposures/flight) and handling. Granularity of a film has an effect on mensuration and PI exploitation. It is difficult to measure the total benefits of a finer grained material with this system's resolution capability, but it is enough to know that a lower granularity usually provides better exploitation performance.

3.2.5 *Color Films and Analytical Application*

3.2.5.1 ~~(S)~~ The system restrictions of the fixed exposure camera, variable lighting conditions, limited process manipulations available (speed pushing, etc.) and inherent lower resolution capabilities of color materials made selection limited. The films evaluated were SO-255, 2445, 2448, Vericolor II, SO-397 and SO-131 (false color infrared). All were positive types except 2445 and Vericolor II. The final selection (EK 2445, Figure A31) was made based upon its speed, resolution characteristics and wide (relatively) exposure latitude. It is well suited for duplicate positive reproduction, paper print enlargements, process manipulation and color correction.

~~(U/AIOU)~~ NPIC is presently contracted with Calspan Corporation to implement SCAT onto the Interactive Digital Image Manipulation System (IDIMS). The technique is probably applicable to the Tacana system but, as yet, has not been tested against negative color materials.

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*Smith, Turinetti, *RADC's Research in Color Image Interpretation,* Journal of Applied Photographic Engineering Volume 3, Number 2, 1977.

Table A4—SCAT Materials Discrimination

3.2.6 *Film Selection*

3.2.6.1(U) Table A5 summarizes the basic characteristics of the films that were considered for this system.

(U) The films selected and illustrated in this report represent materials that performed best overall as indicated by the weighted quality/performance scoring criteria (Table A6).

(U) The performance value (1 to 10) indicates how well each film performed in satisfying a given quality factor. The sum of all quality factor scores (WF X PV) was added to provide a final total value for each film. (See Table A7.)

Table A5—Film Characteristics

BLACK-and-WHITE

Film Type	Speed (EAFS)	Resolution 1000:1	(c/mm) 1.6:1	Granu-larity	Thickness (MILS)	
3414/1414 (EK)	9-15	630	250	9	3.2	High Definition Aerial
FE6526 (EK)	80-100	350	150	10	2.9	Experimental, Potential to Replace 3400 Series
3410 (EK)	80-100	240	90	20	2.9	PAN-X Aerial
3401 (EK)	200	95	35	32	3.1	Plus-X Aerial
5069 (EK)	80-180	250	100	—	4.5	High Contrast Copy
SO-410 (EK)	100-200	250	100	6	4.5	Photo Microphotochrome
VTE "80" (H&W)	80-100	160	70	—	4.5	Panchromatic
COLOR						
SO-242/255	6-8	200	100	11	3.7/2.7	High Definition Aerial (positive)
2448	32	80	40	12	4.8	Ektachrome MS (positive)
2445	100	80	40	13	4.9	Aero Color (negative)
Vericolor II	100	70	30	—	5	Commercial (negative)
SO-397	64	80	40	13	4.9	Ektachrome EF (positive)
SO-131	40	63	32	17	4.8	Aerochrome Infrared (2443 type)

Table A6—Film Scoring Factors

Film Quality Factor	Weighting Factor (WF)	Performance Value (PV)	Score (WF) X (PV)
Film Speed	5.5	(1-10)	
Resolution	5		
Exposure Range (Latitude)	4		
Processing Flexibility	3		
Base Thickness	3		
Granularity	2.5		
Field Application	2.5		
Availability	1		

Table A7—Film Scores

Black-and-White		Color	
Film	Score	Film	Score
*FE6526	204	2445	163
3410	194.5	SO-397	159.5
		SO-242/255	148.5
5069	188	2448	141.5
3411	182	VERICOLOR II	138
1414	179.5	SO-131	100
VTE "80"	177.5		

* This film is presently experimental. Eastman Kodak indicates that it will replace 3400 series Aerial Reconnaissance Films in the near future.

3.2.6.2 *Recommended Films and Processes*

Black-and-White: Film—FE6526 (Eastman Kodak)
Developer—HC110, Dilution D
Six minutes 21°C (70°F)
Constant Agitation

Film—3410 (Eastman Kodak)
Developer—D-76, 6 1/2 minutes 21°C (70°F)
Constant Agitation

Color: Film 2445—Eastman Kodak Aerocolor Negative
Standard Color Process as recommended by the manufacturer.

3.2.7 *General Camera Anomalies*

(U/~~AIUO~~) The photographs in this report are used to describe The exploitation quality of the system, as such they are so referenced in preceding sections. They also show the effect of various camera problems associated with its development. Directing attention to these anomalies is only intended to indicate factual difficulties encountered in assembling system performance data and indicates the need for further reliability production efforts. It should be pointed out that the camera is a commendably engineered unit and these effects are common and expected in this type of research effort and could be corrected in the routine modification and upgrading of the camera units for field use.

Demonstrate the effect of non-uniform sharpness due to probable misalignment of the film plane with the optical axis. Decentration of an element in the optical system or an imperfect and/or improperly positioned field corrector would produce a similar effect (noted in the lower central portion of these photographs).

The off-center light area in these photographs represent an effect of internal lens flare (stray light reflected to the film by improperly baffled optical components). This fogging of the film has the effect of producing a lower contrast and resolution image. It was present in most cameras in varying degrees.

Represents the "barrel" lens distortion effect present in the [redacted] (Model II camera) lens (curved portion of waterline edge at bottom of frame). This type of distortion reduces towards the center of the image format.

~~TOP SECRET~~
Handle via
TALENT-KEYHOLE
Channels

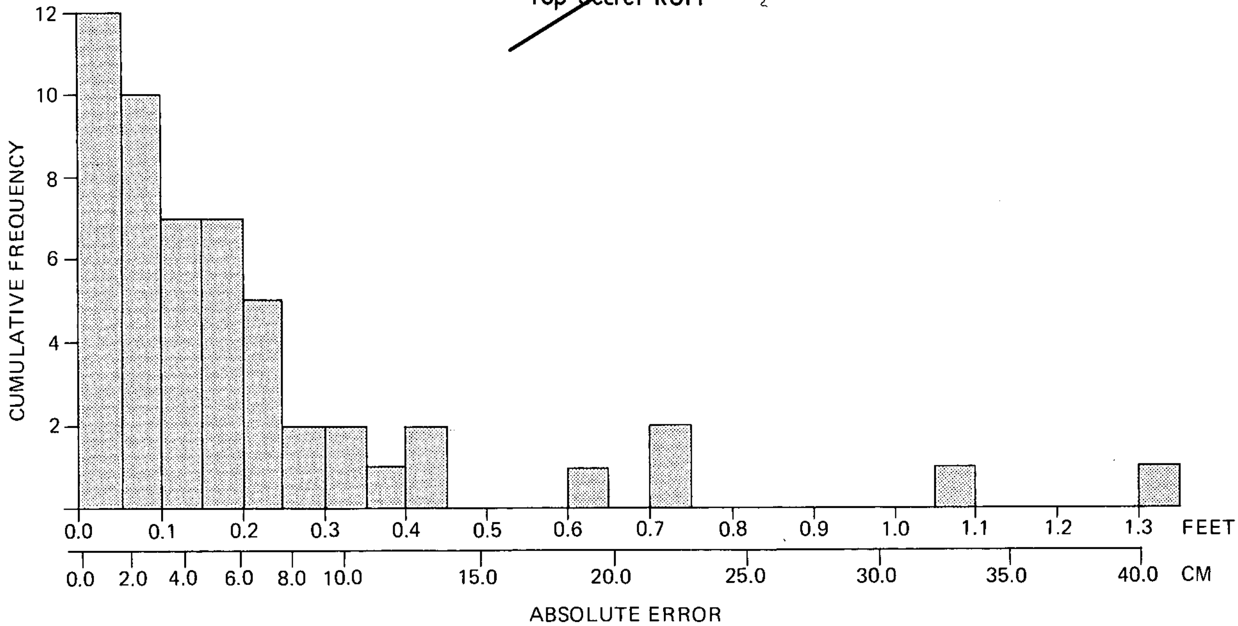

FIGURE A2. Histogram of Cumulative Frequency of Error in Measurements of 53 Dimensions (.25 Feet - 37.5 Feet)

UNCLASSIFIED

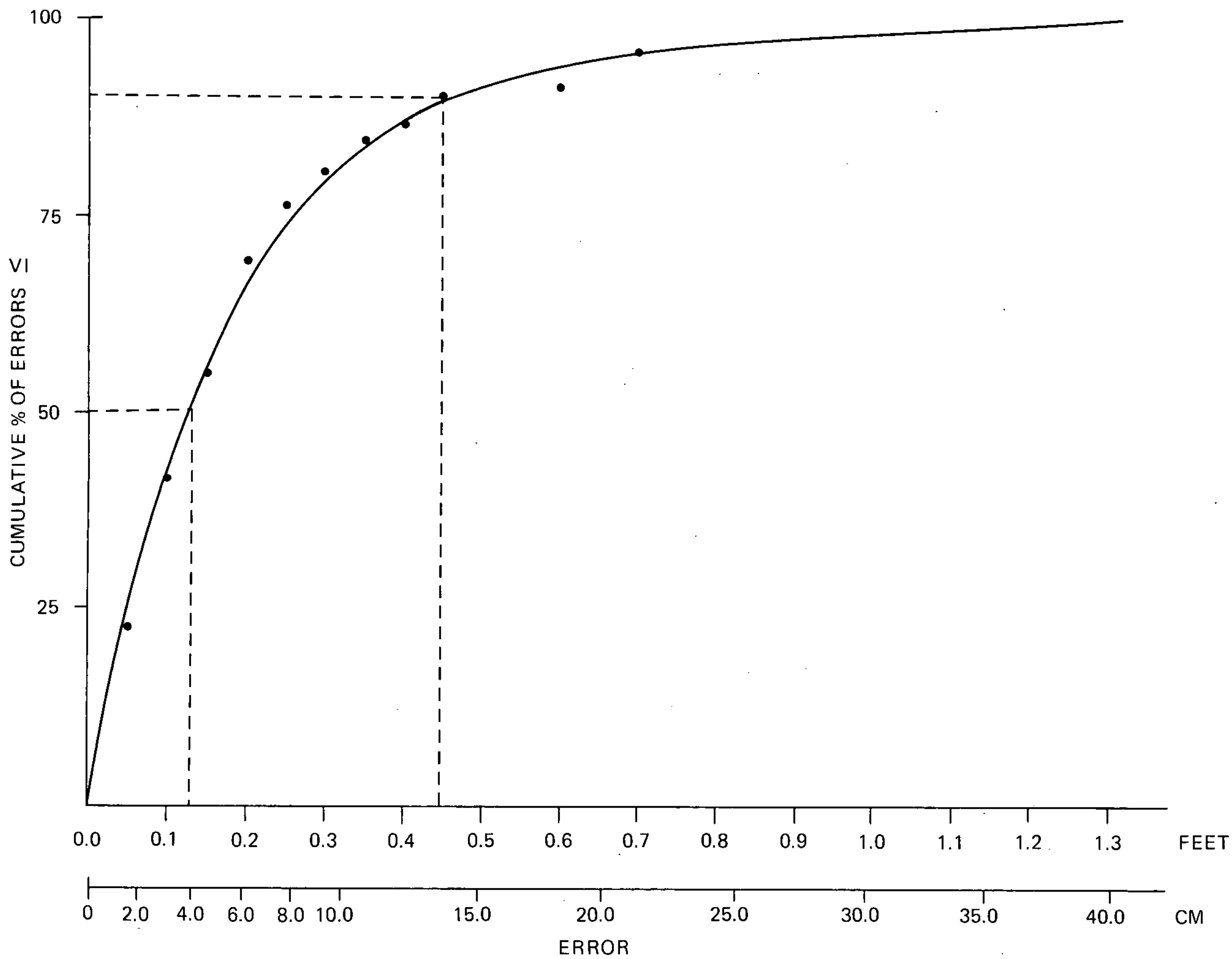

FIGURE A3. Graph of Cumulative Percentage Error for Measurements of 53 Dimensions

UNCLASSIFIED

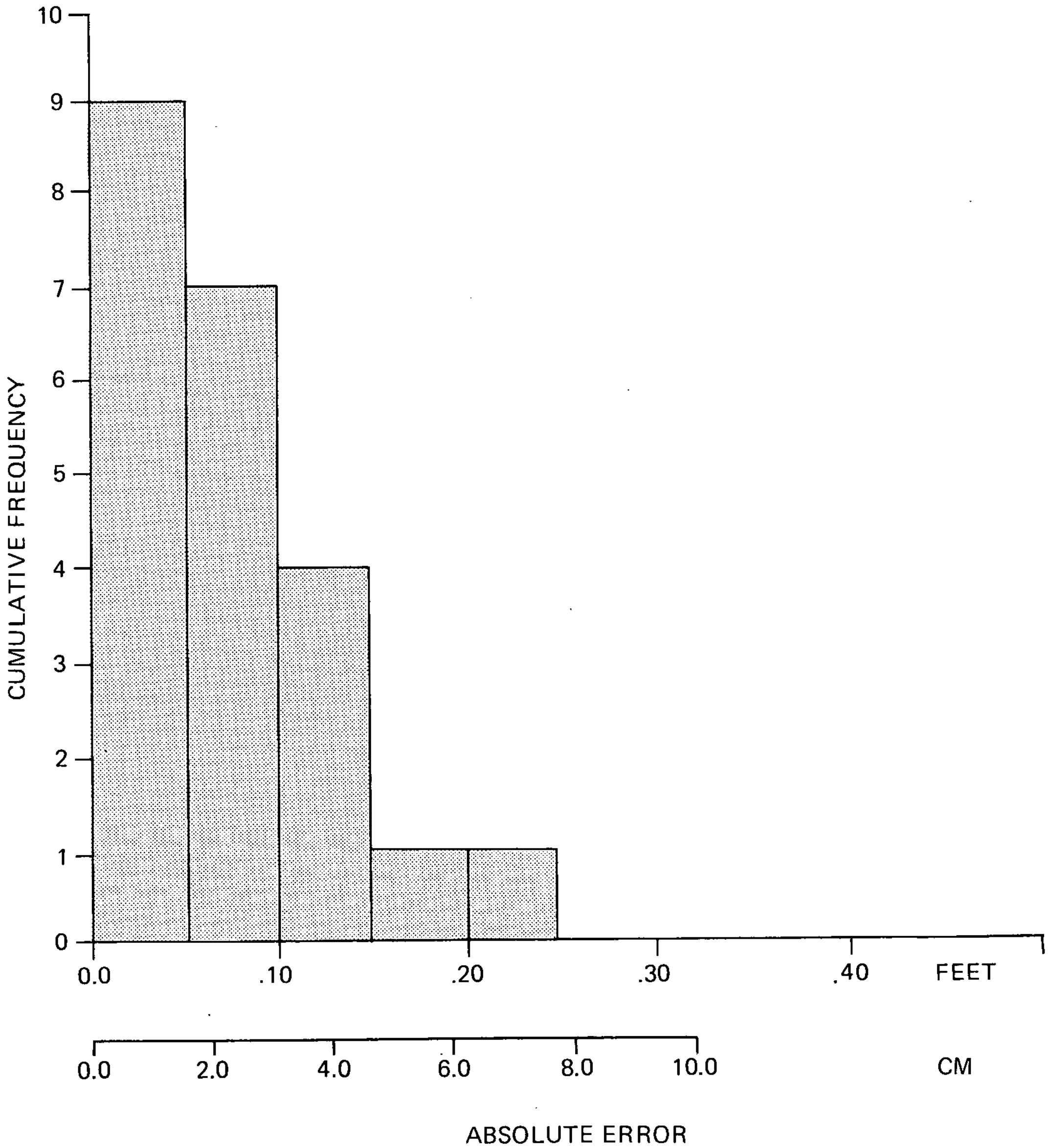

FIGURE A4. Histogram of Cumulative Frequency of Error for 22 Dimensions of 2 Feet or Less

UNCLASSIFIED

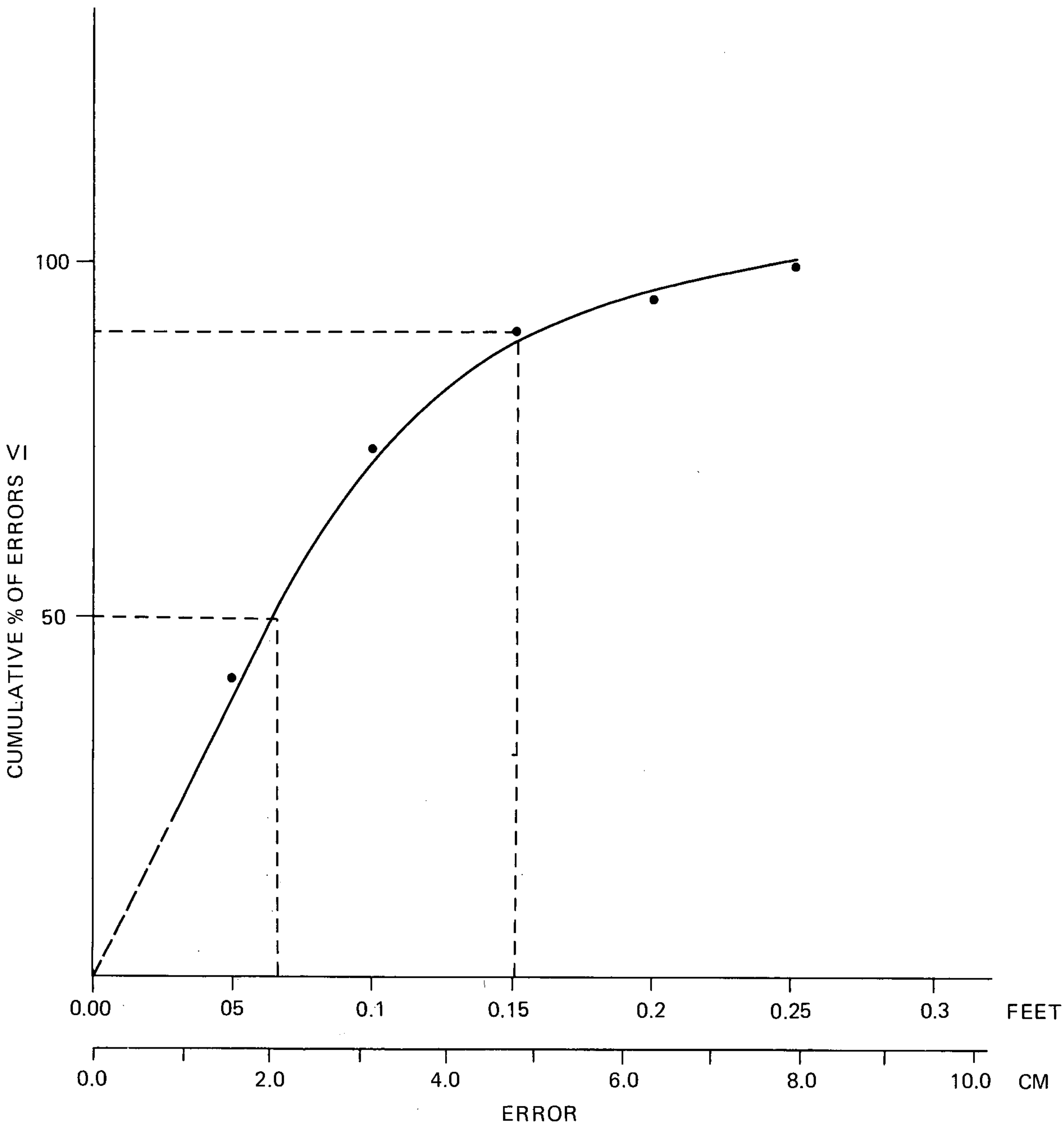

FIGURE A5. Graph of Cumulative Percentage Error for Measurements of 2 Feet or Less

UNCLASSIFIED

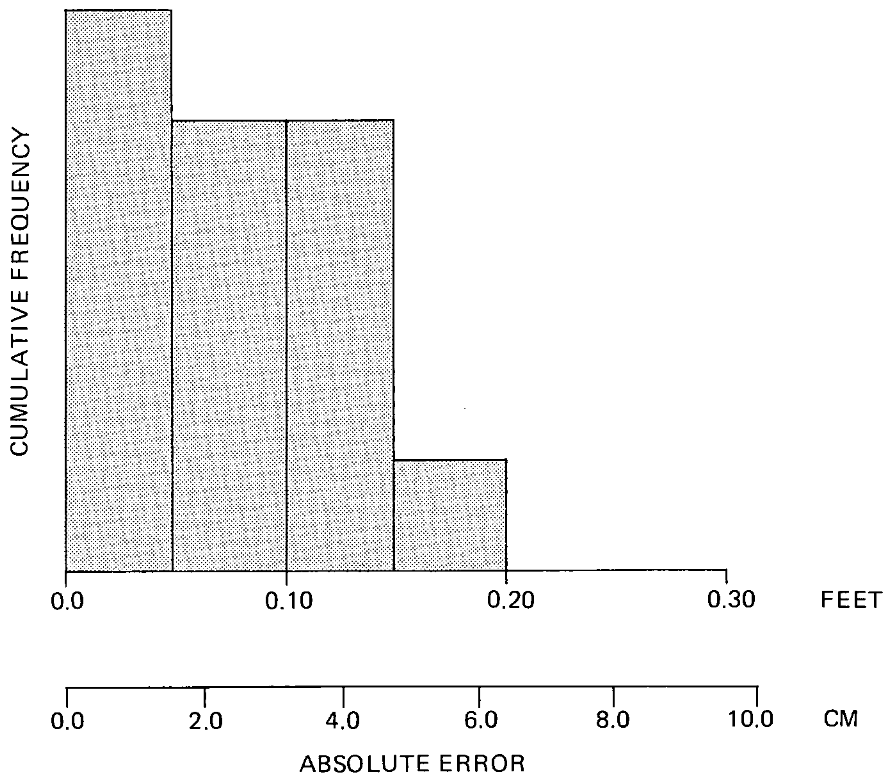

FIGURE A6. Histogram of Cumulative Frequency of Error for 14 Dimensions of 1 Foot or Less

UNCLASSIFIED

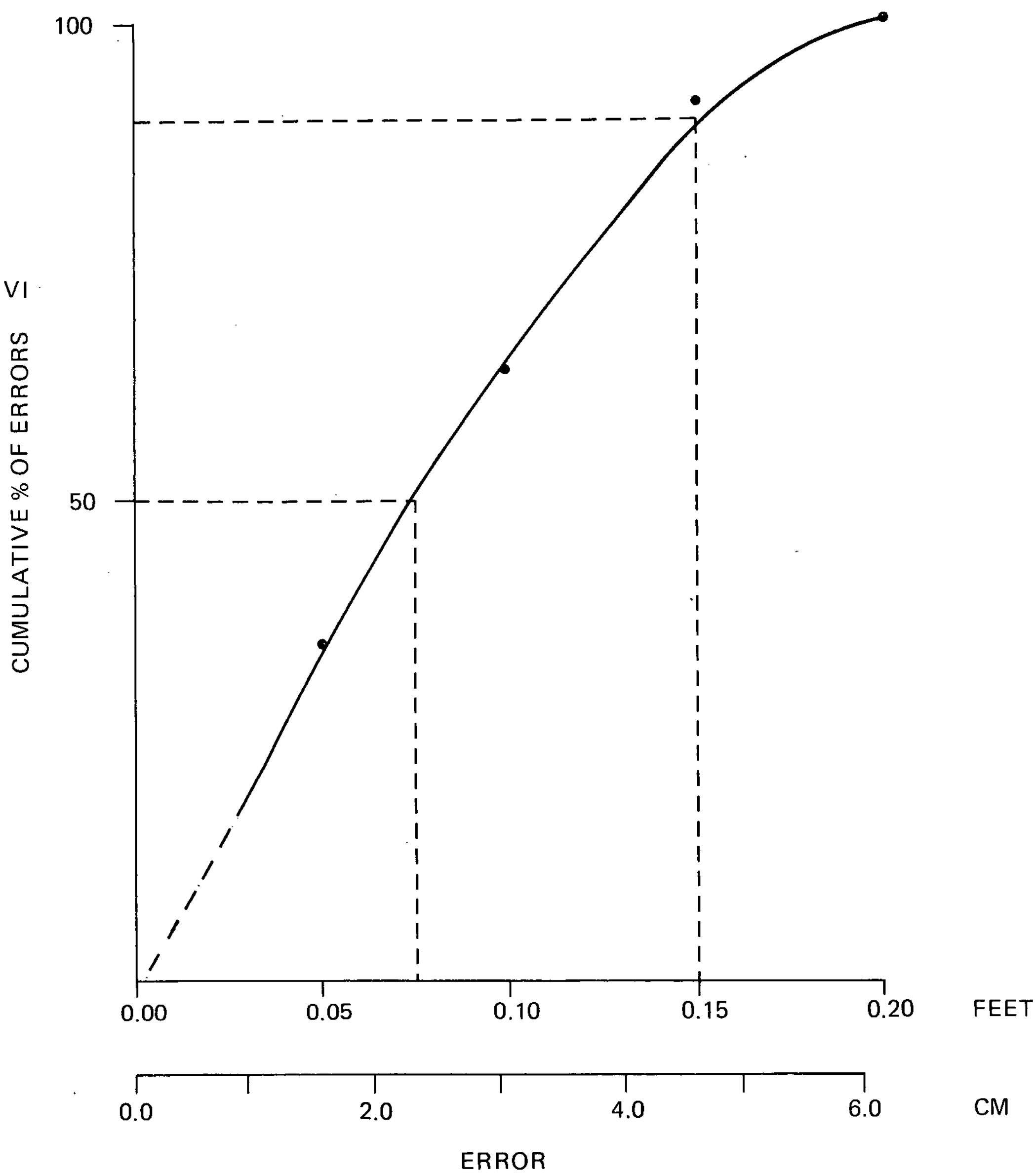

FIGURE A7. Graph of Cumulative Percentage Error for Measurements of 1 Foot or Less

UNCLASSIFIED

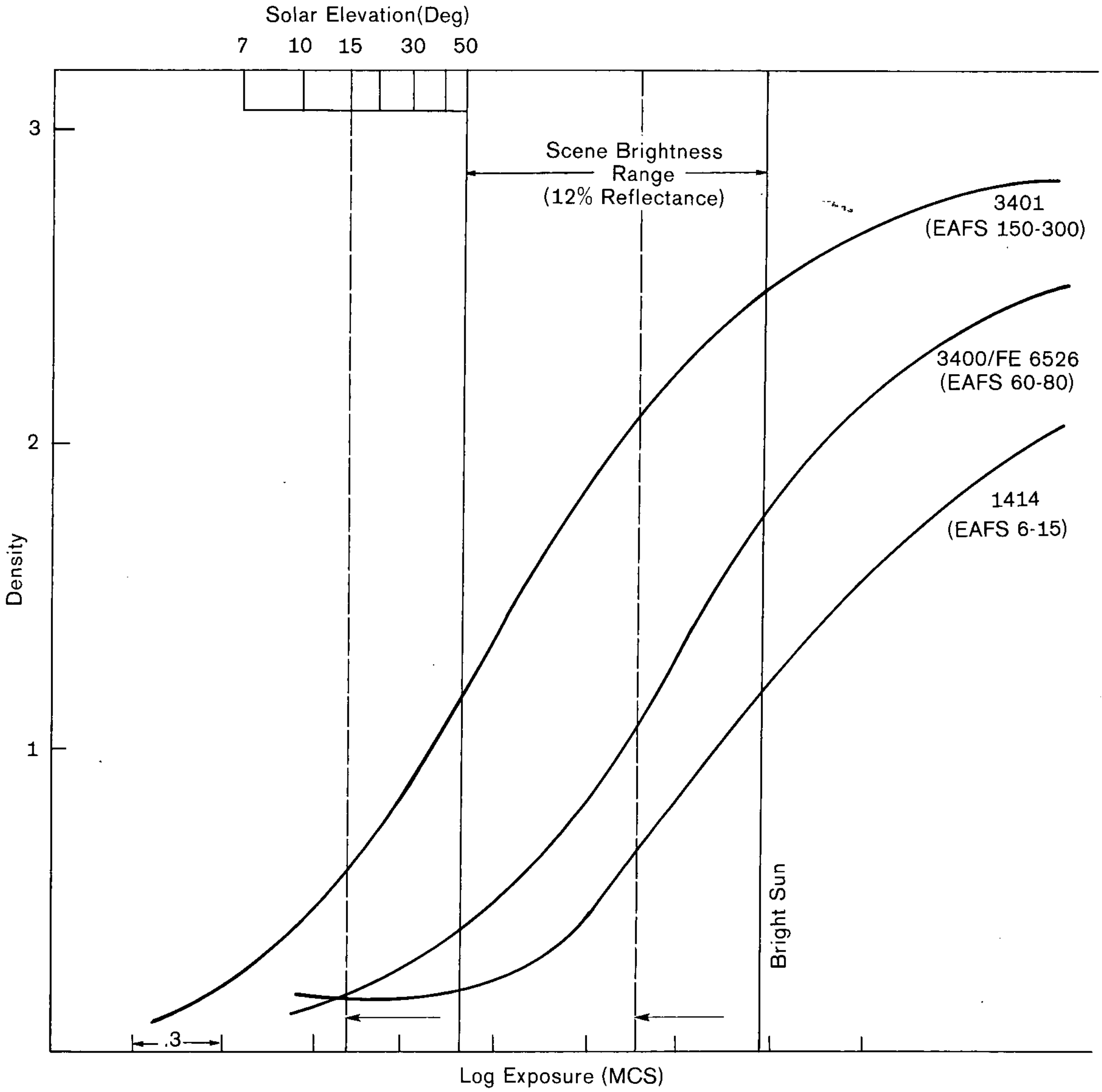

FIGURE A8. Graph of Predicted Target Brightness/Exposure Range and Film Estimates

~~ADMINISTRATIVE INTERNAL USE ONLY~~

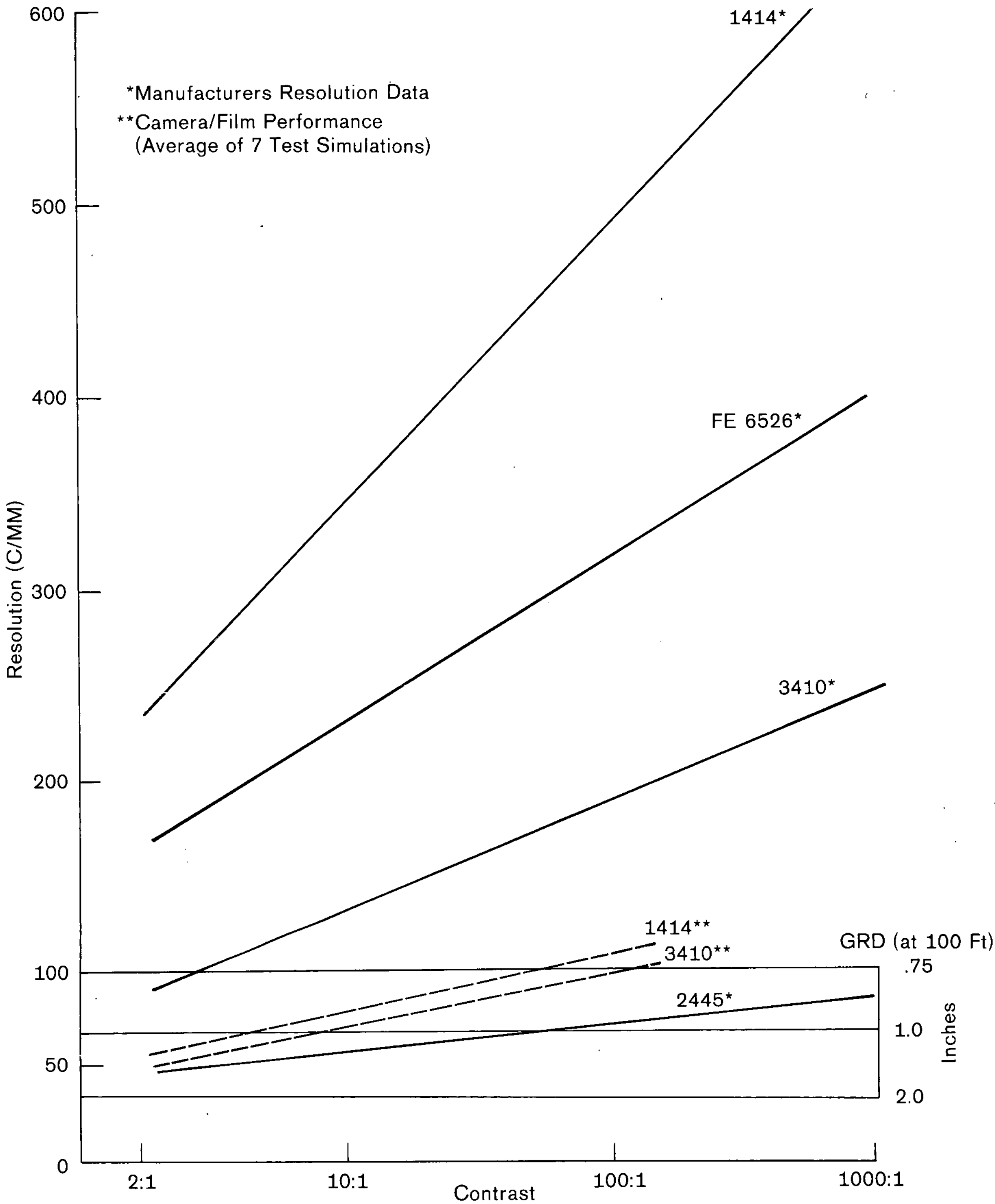

FIGURE A9. Graph of the Camera/Film Performance Evaluation and GRD Estimates

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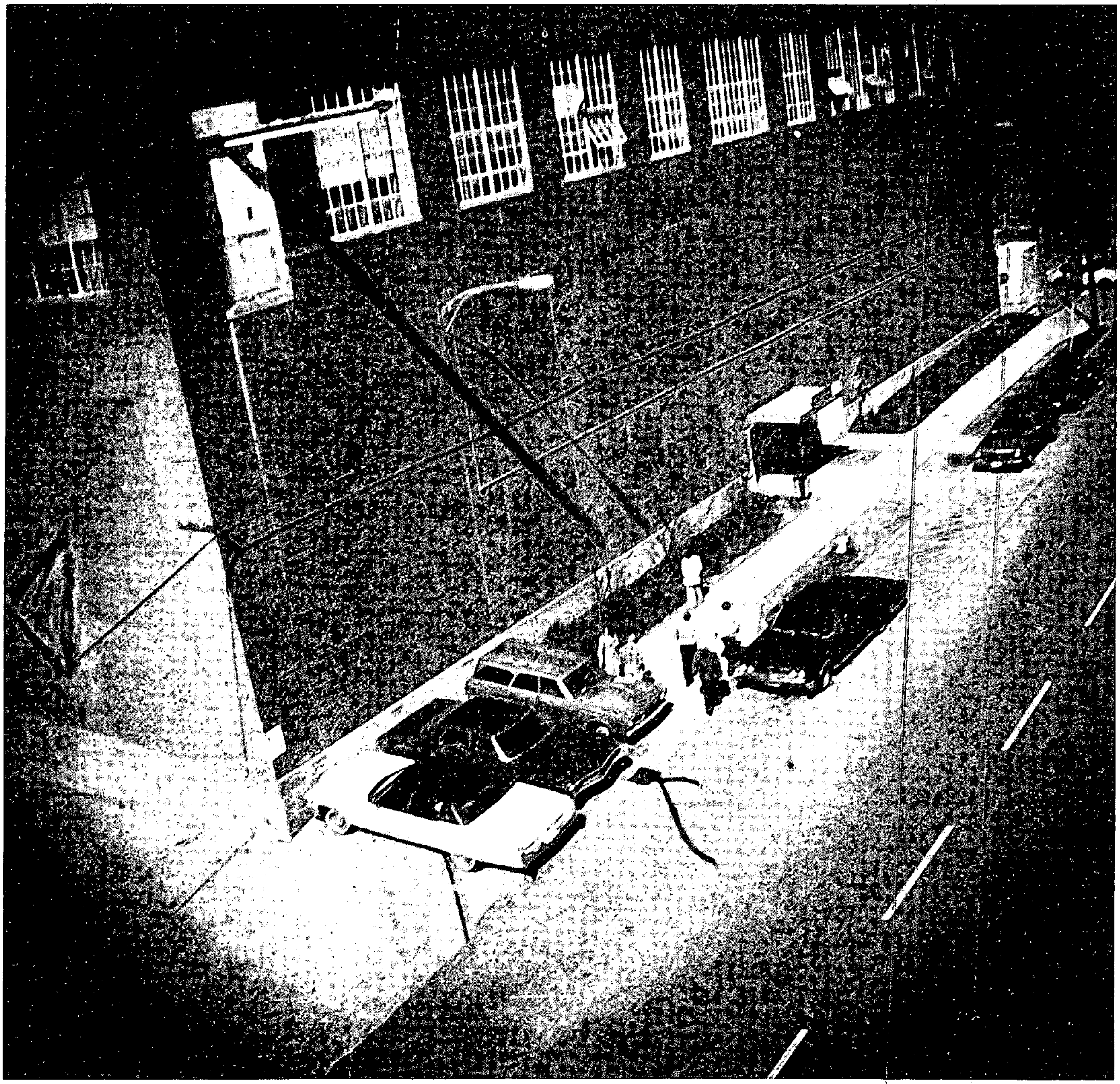

FIGURE A10. Washington Navy Yard—3/17/77
Rated NIIRS 9

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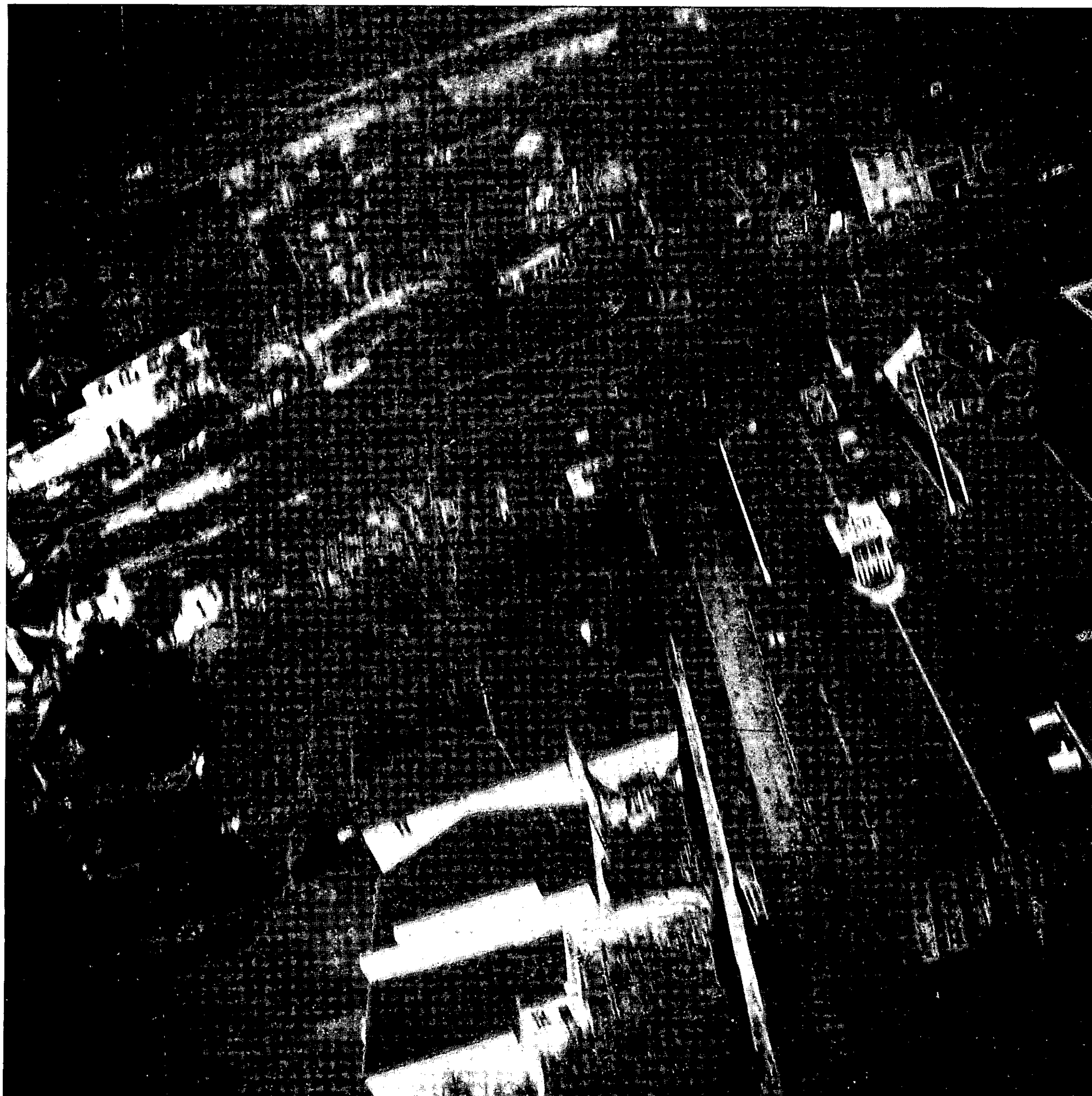

FIGURE A11. Washington Navy Yard—3/17/77
Rated NIIRS 6

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FIGURE A12. Washington Navy Yard—3/17/77
Rated NIIRS 7

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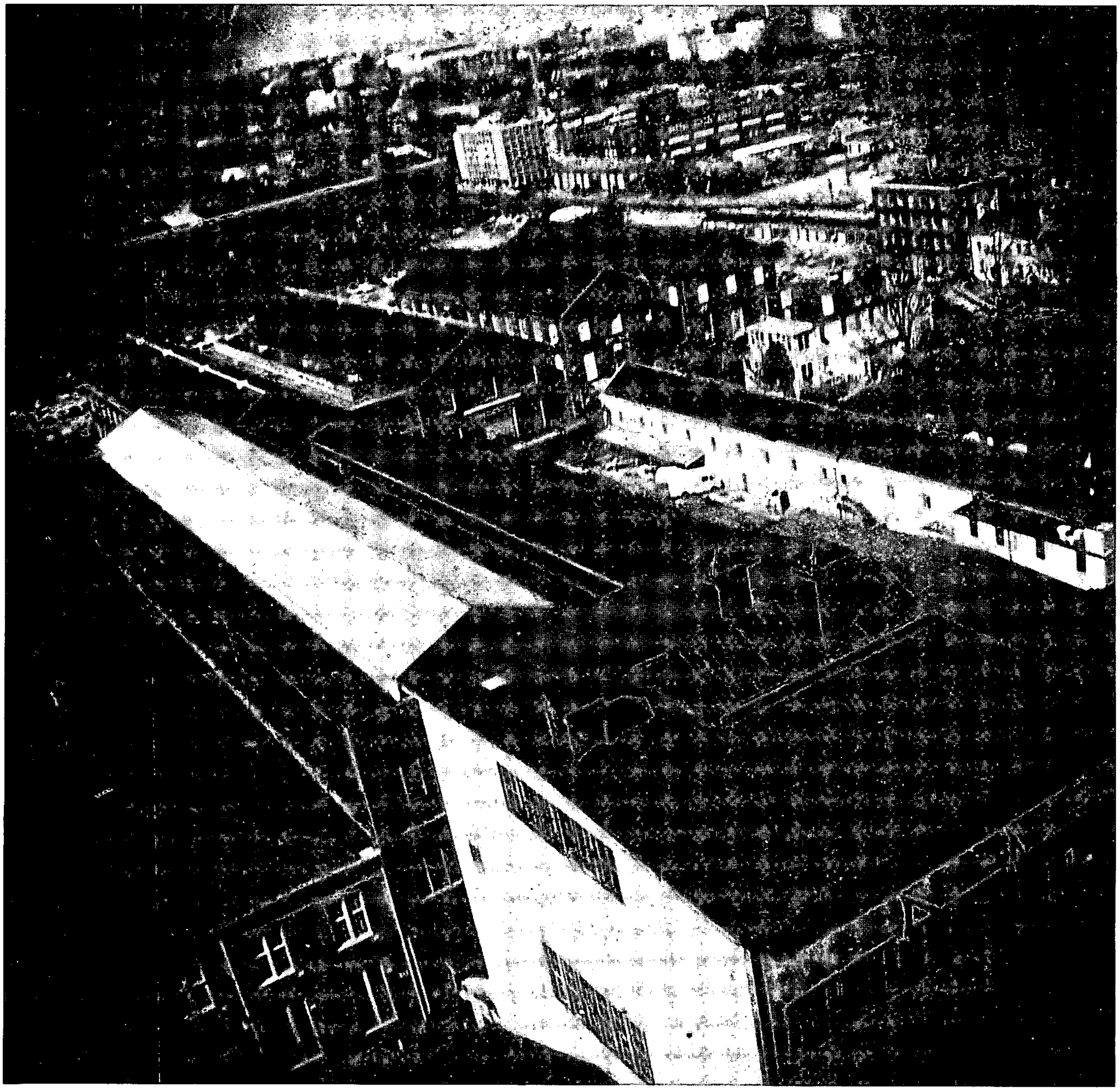

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FIGURE A13. Washington Navy Yard—3/17/77
Rated NIIRS 7

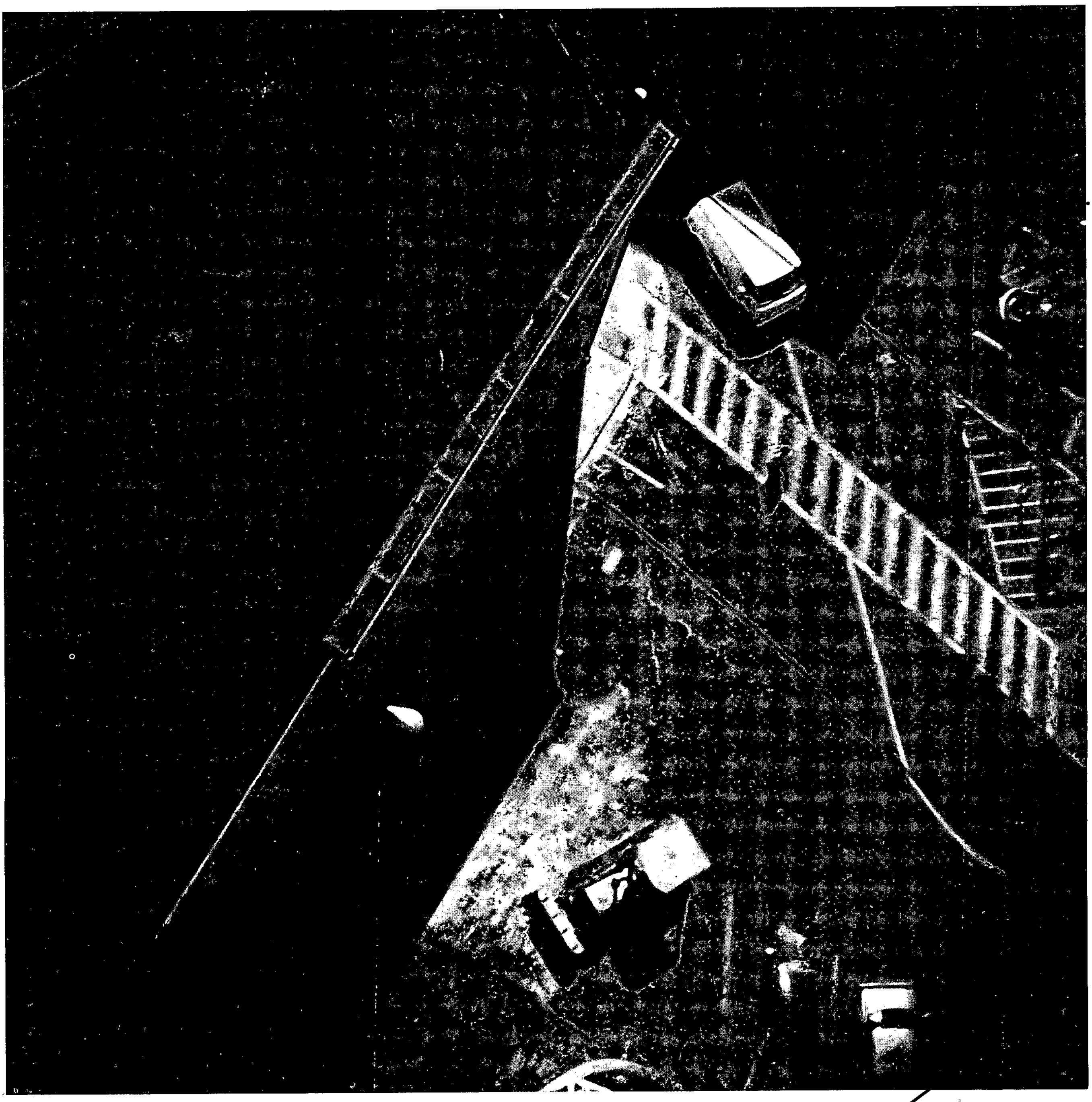

FIGURE A14. Washington Navy Yard—3/17/77
Rated NIIRS 8

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FIGURE A15. Washington Navy Yard—3/17/77
Rated NIIRS 8

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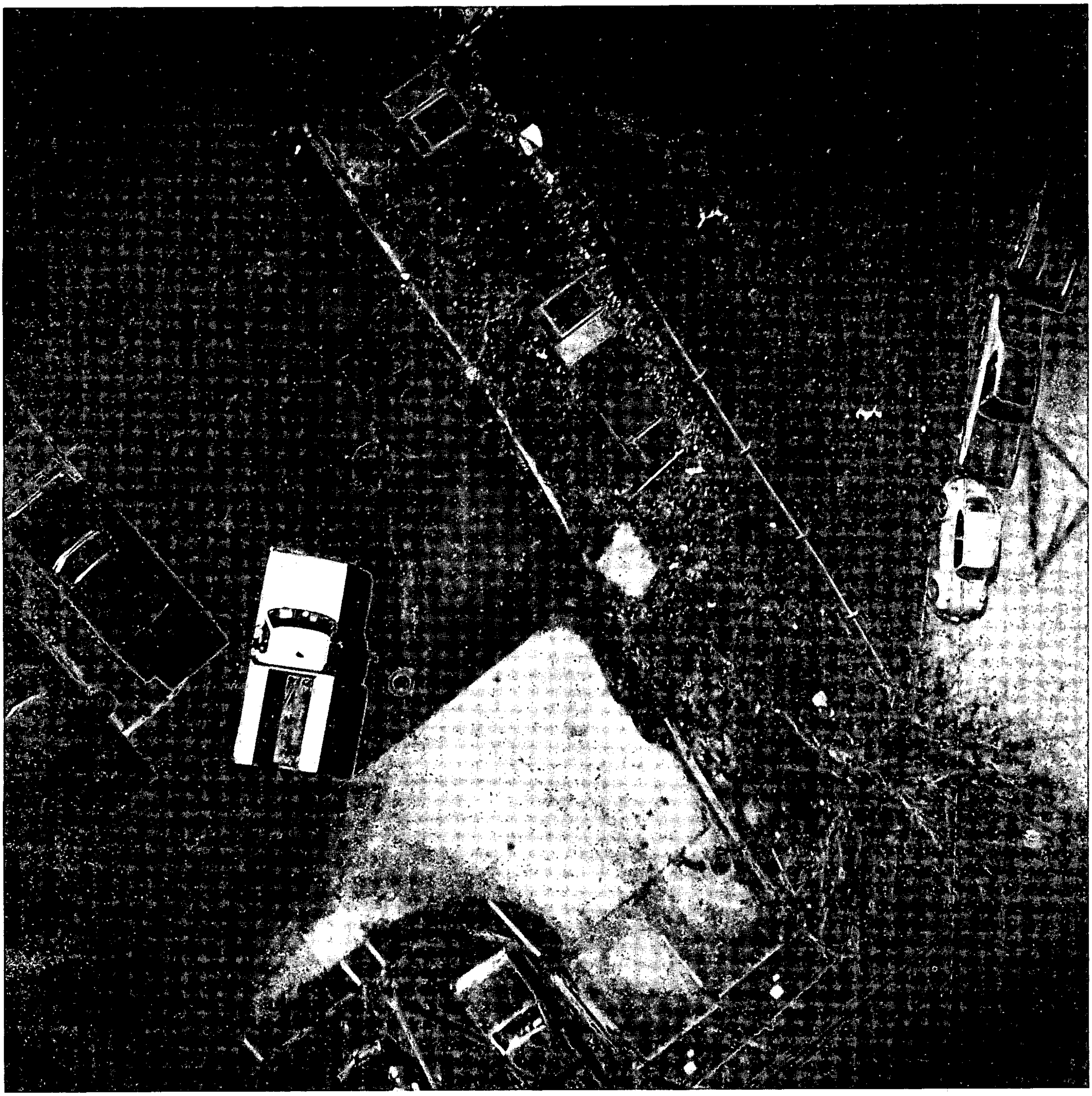

FIGURE A16. Washington Navy Yard—3/17/77
Rated NIIRS 9

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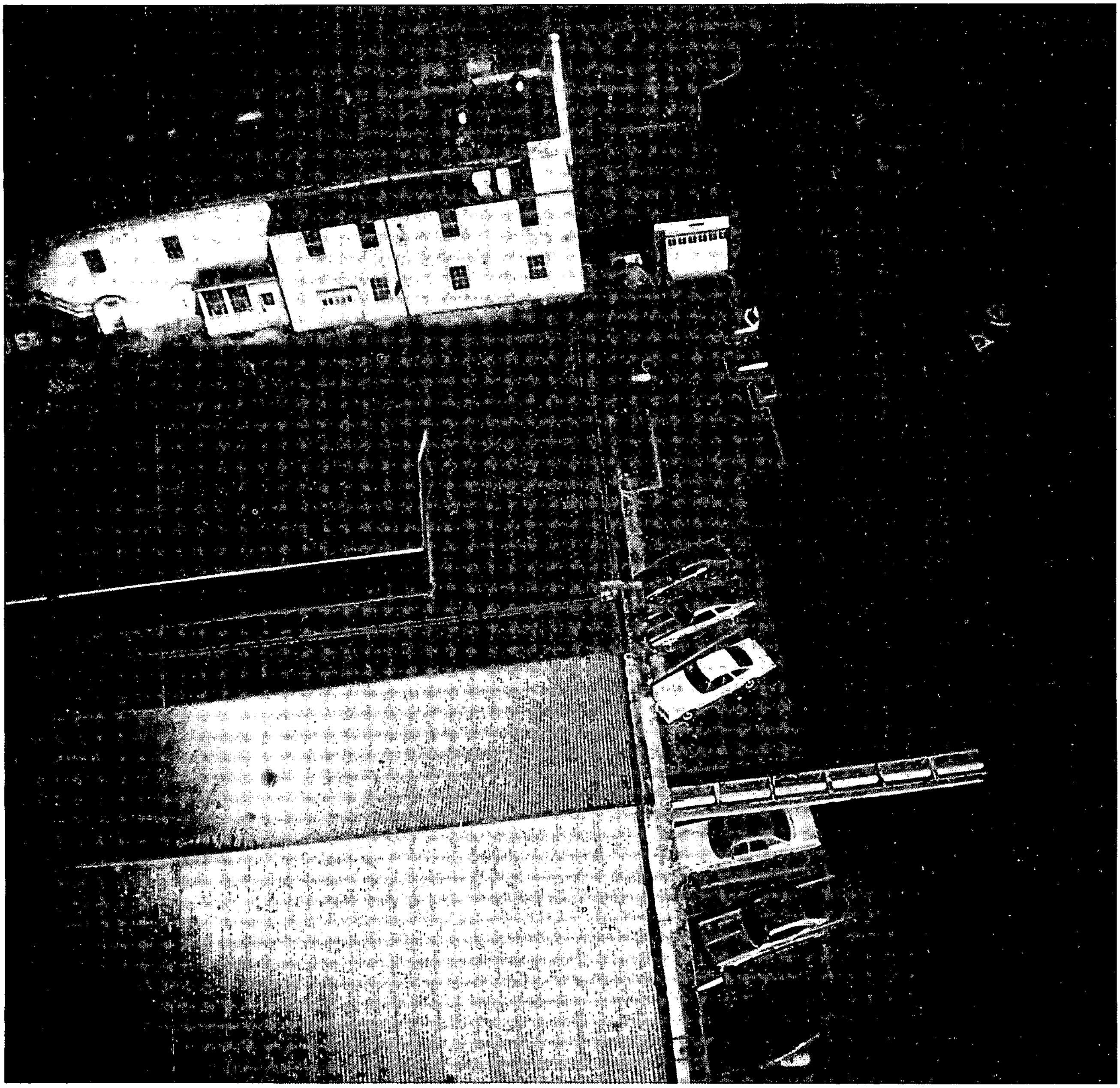

FIGURE A17. Washington Navy Yard—3/17/77
Rated NIIRS 9

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FIGURE A18. Washington Navy Yard—7/7/77
Maximum Observed Flying Height
300 Ft. (91 M.)

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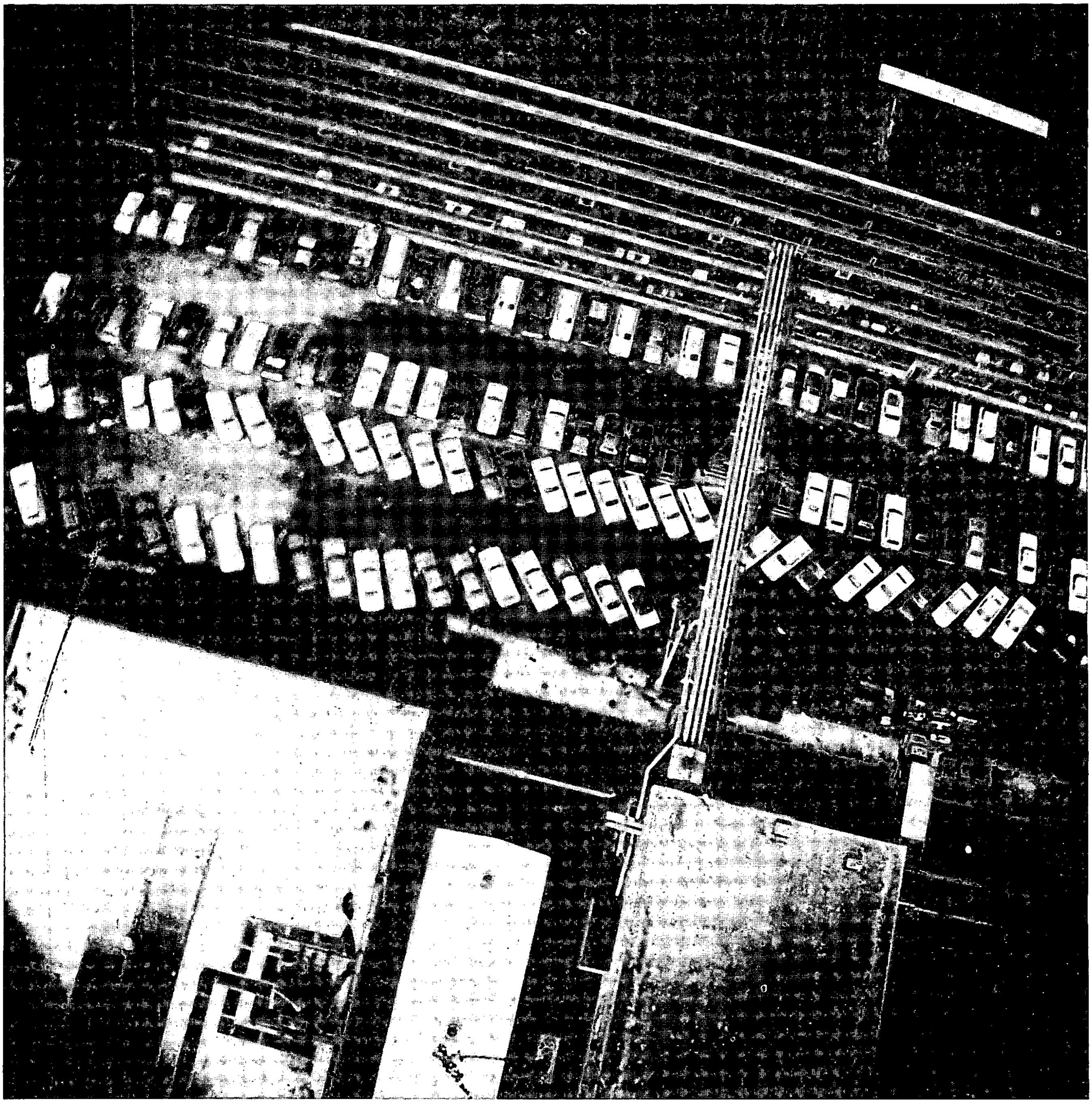

FIGURE A19. Washington Navy Yard—7/7/77
Maximum Observed Flying Height
300 Ft. (91 M.)

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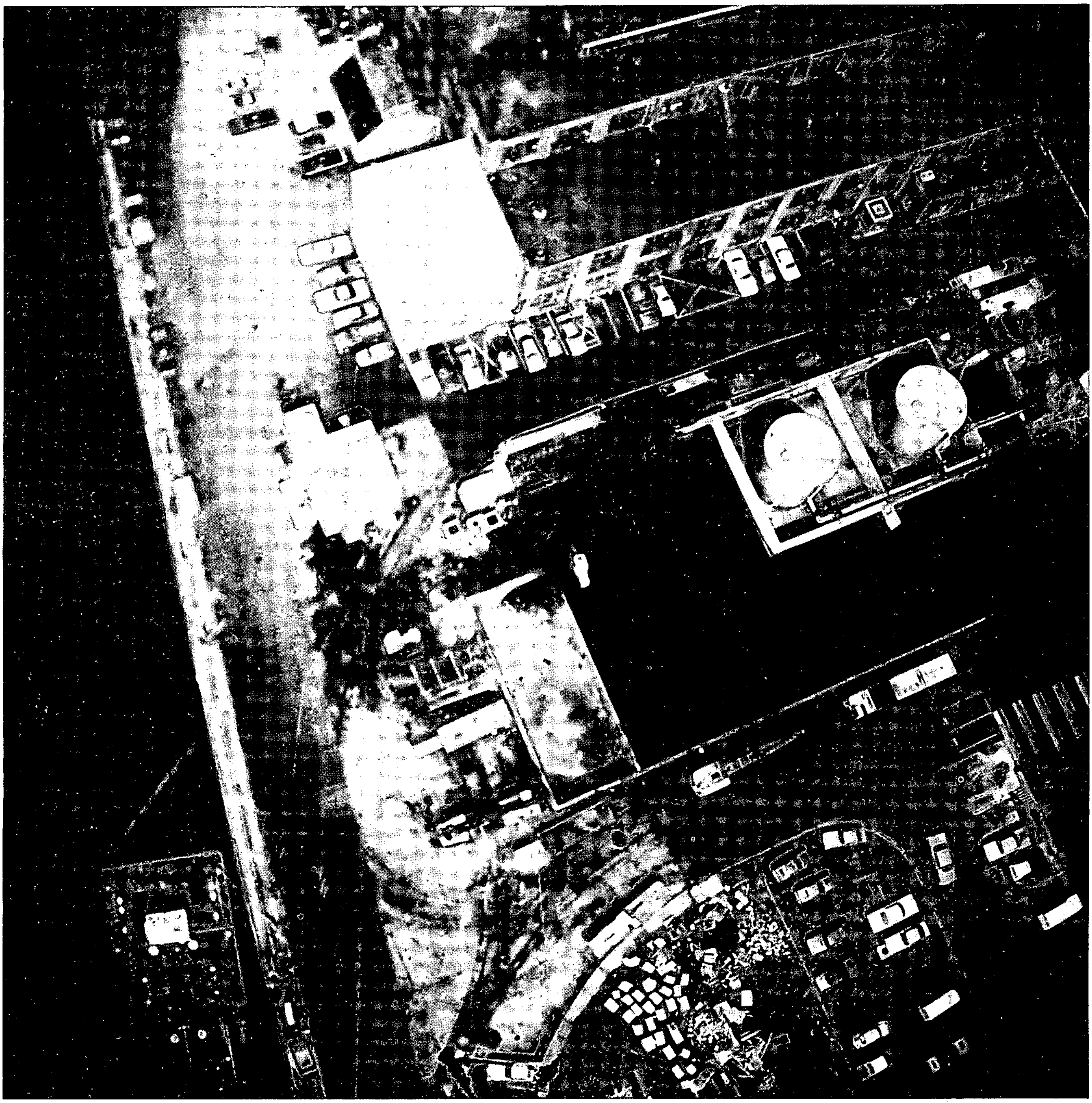

FIGURE A20. Washington Navy Yard—7/7/77
Maximum Observed Flying Height
300 Ft. (91 M.)

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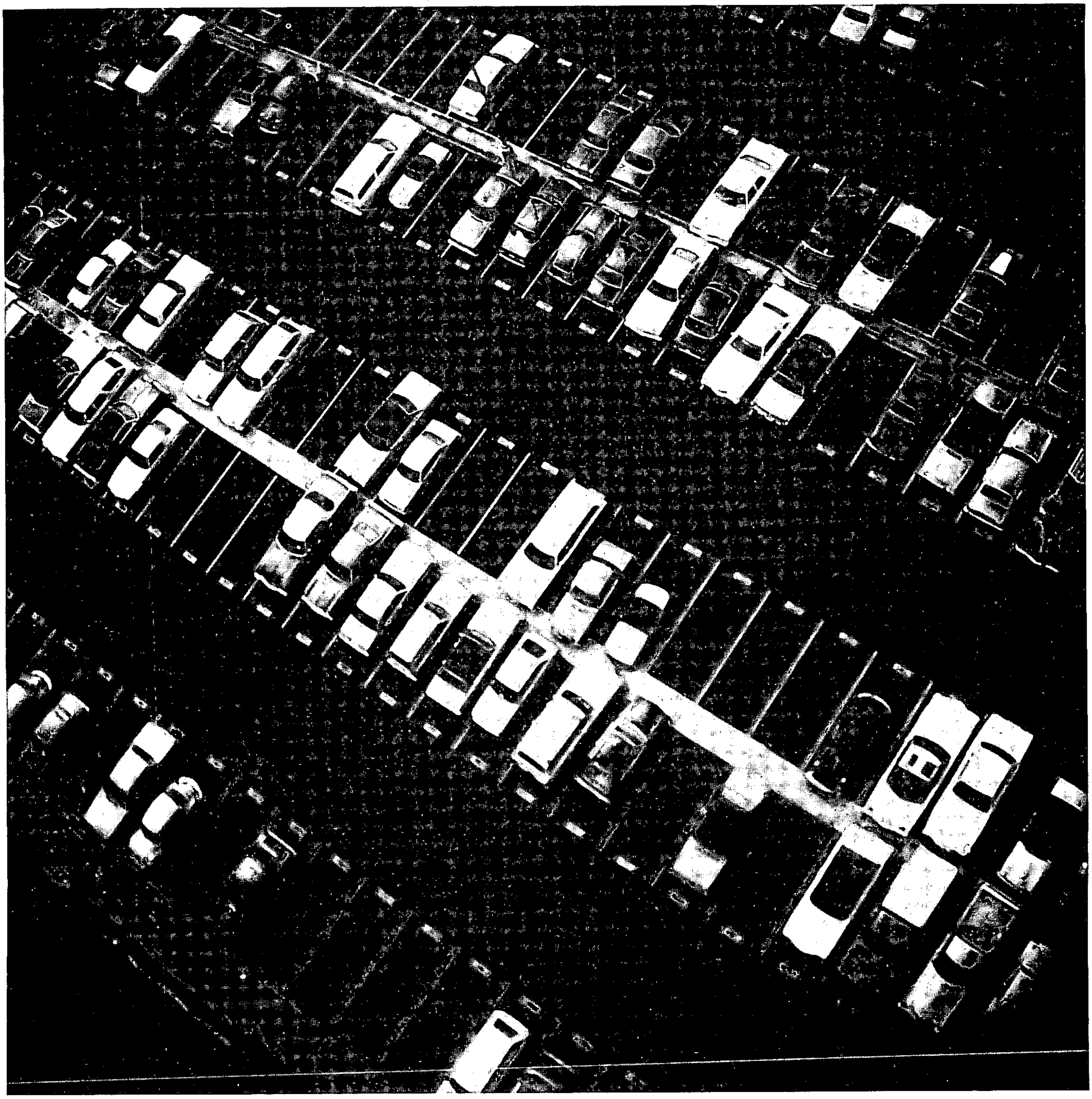

FIGURE A21. Washington Navy Yard—7/7/77
Adjacent Frames (with Figure A22)
Showing the Effect of Platform
Dynamics on Image Quality

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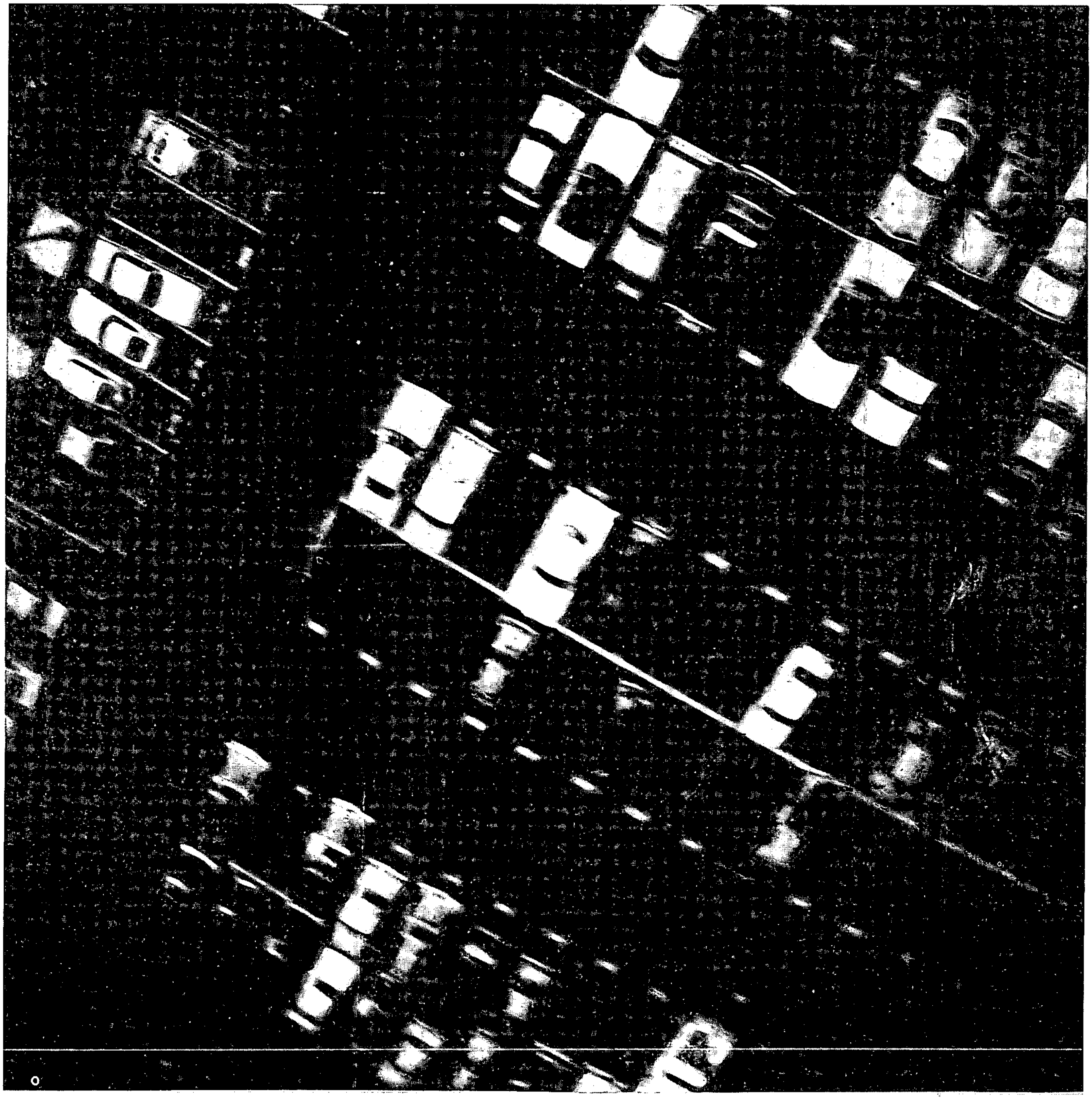

FIGURE A22. Washington Navy Yard—7/7/77
Adjacent Frames (with Figure A21)
Showing the Effect of Platform
Dynamics on Image Quality

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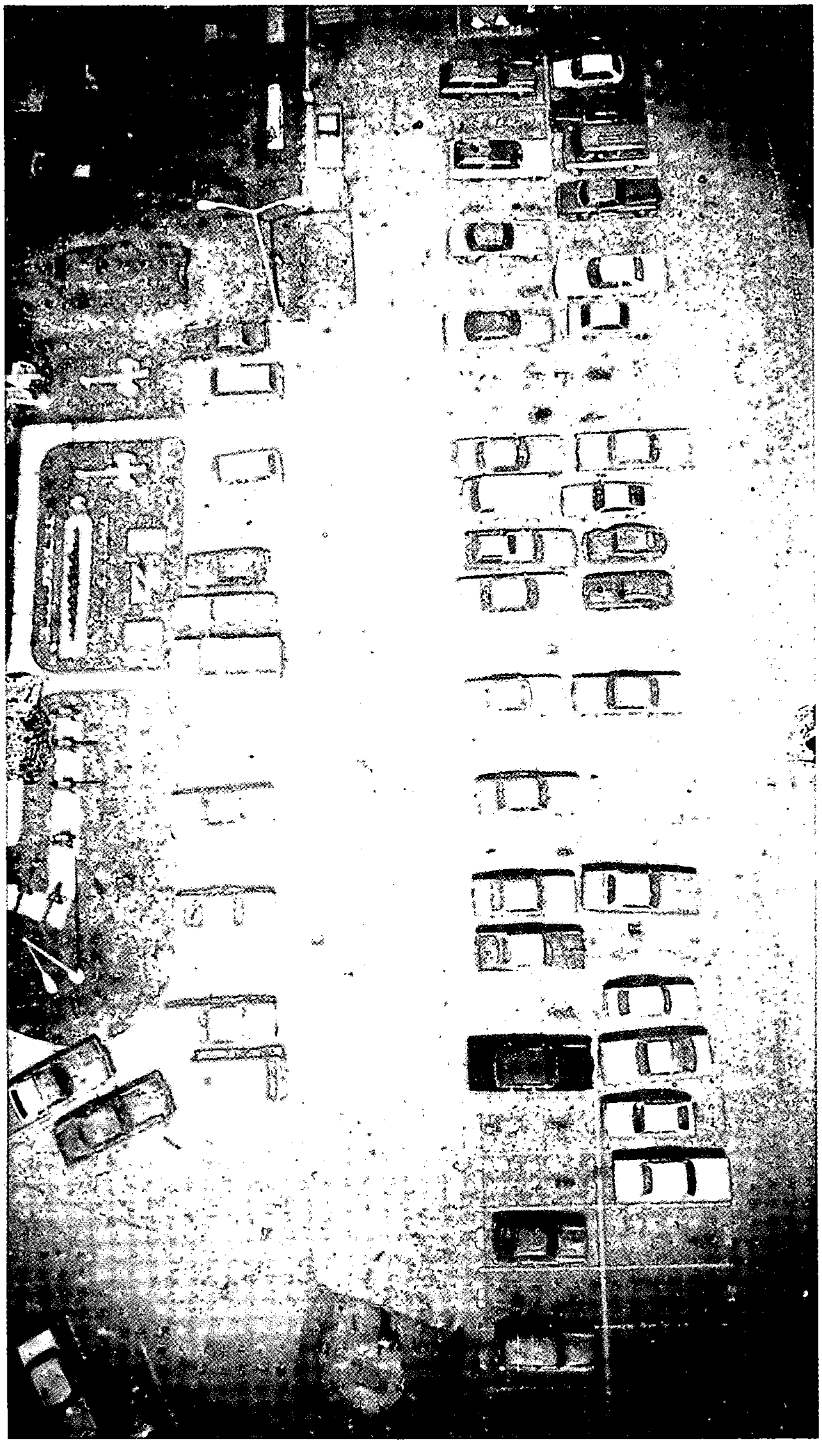

FIGURE A23. Successive Frame Coverage of the Navy Yard Target Display Area (Figure Series A23-A27)

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FIGURE A24. Successive Frame Coverage of the Navy Yard Target Display Area (Figure Series A23-A27)

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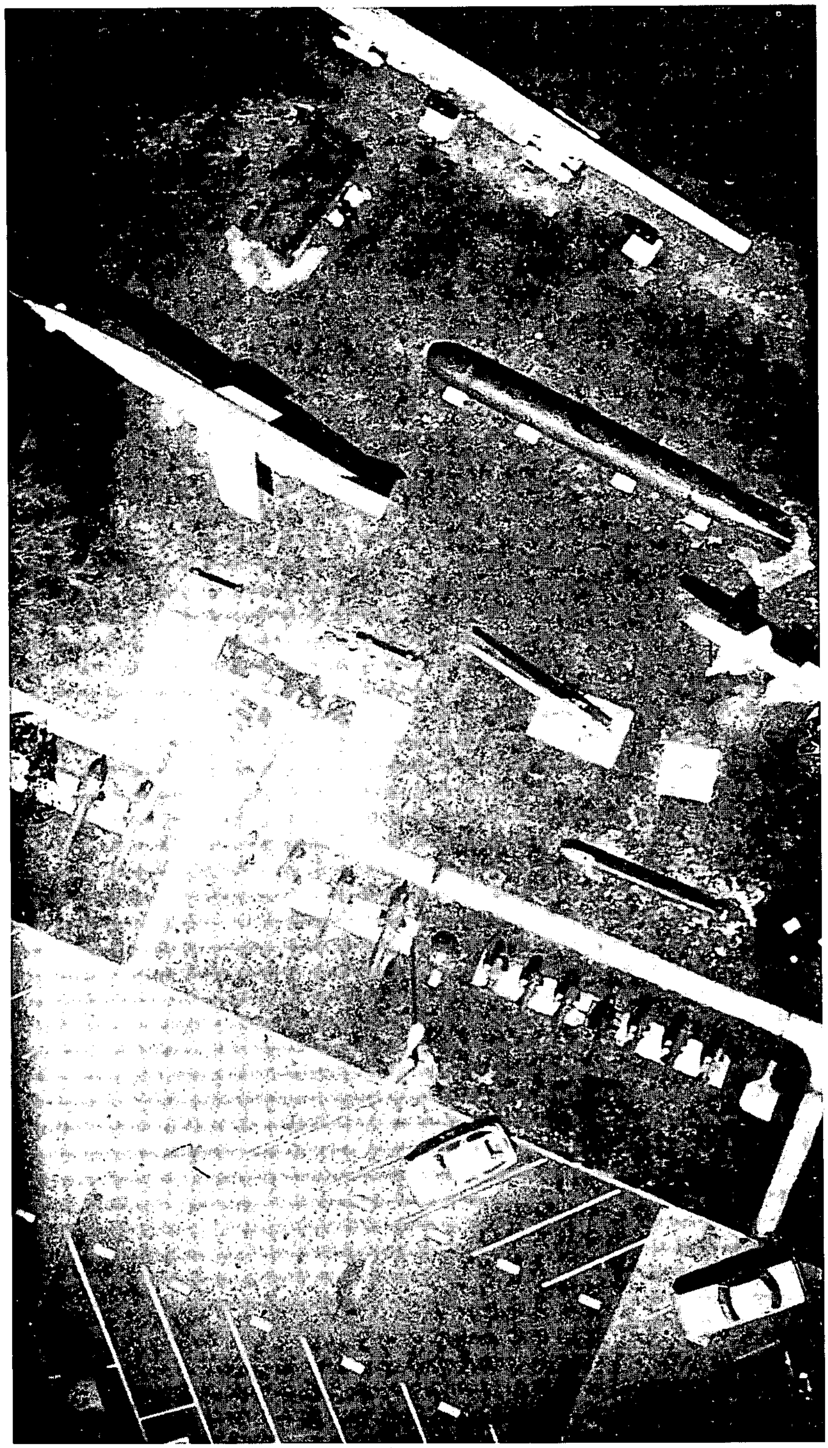

FIGURE A25. Successive Frame Coverage of the Navy Yard Target Display Area (Figure Series A23-A27)

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FIGURE A26. Successive Frame Coverage of the Navy Yard Target Display Area (Figure Series A23-A27)

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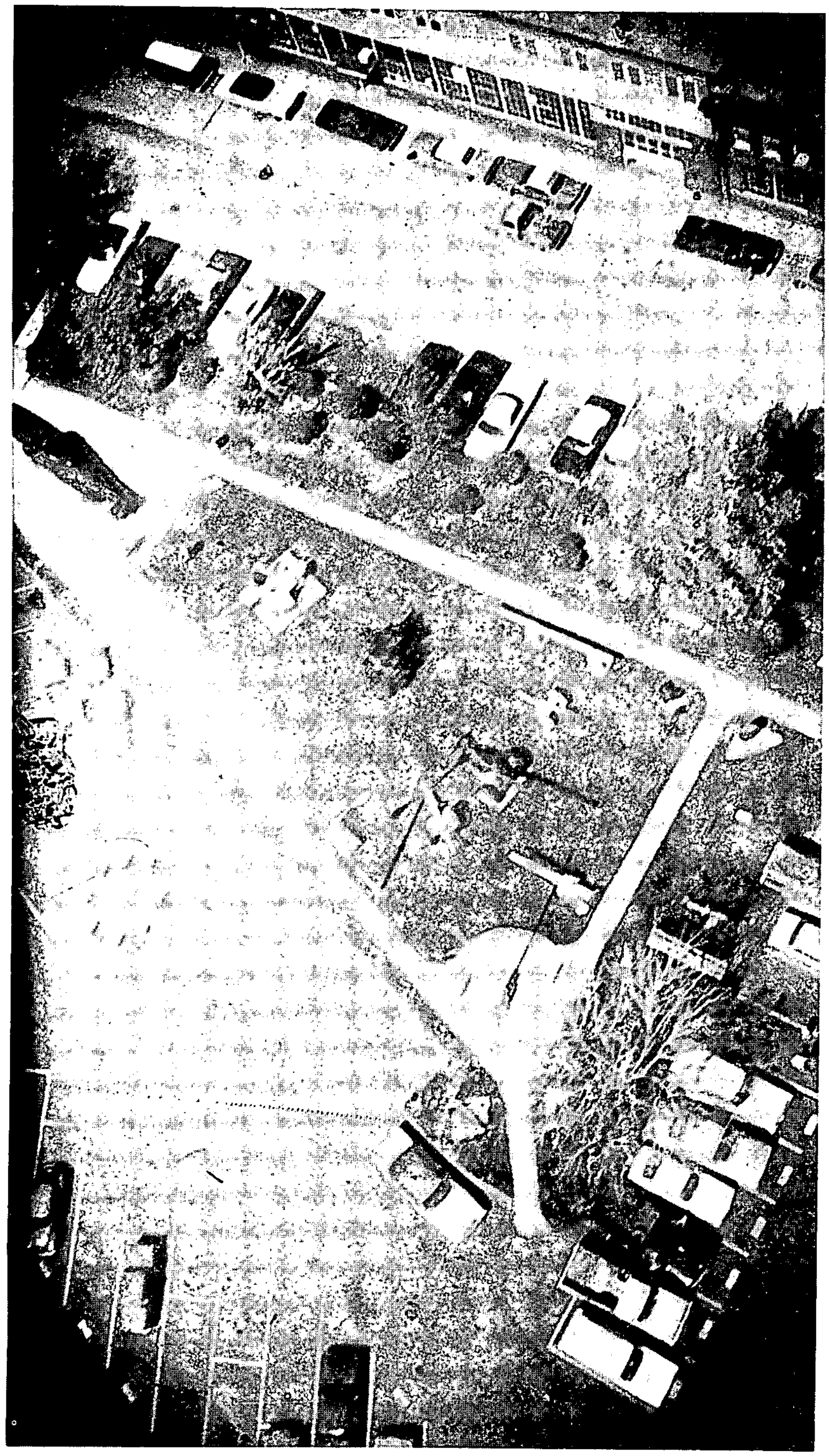

FIGURE A27. Successive Frame Coverage of the Navy Yard Target Display Area (Figure Series A23-A27)

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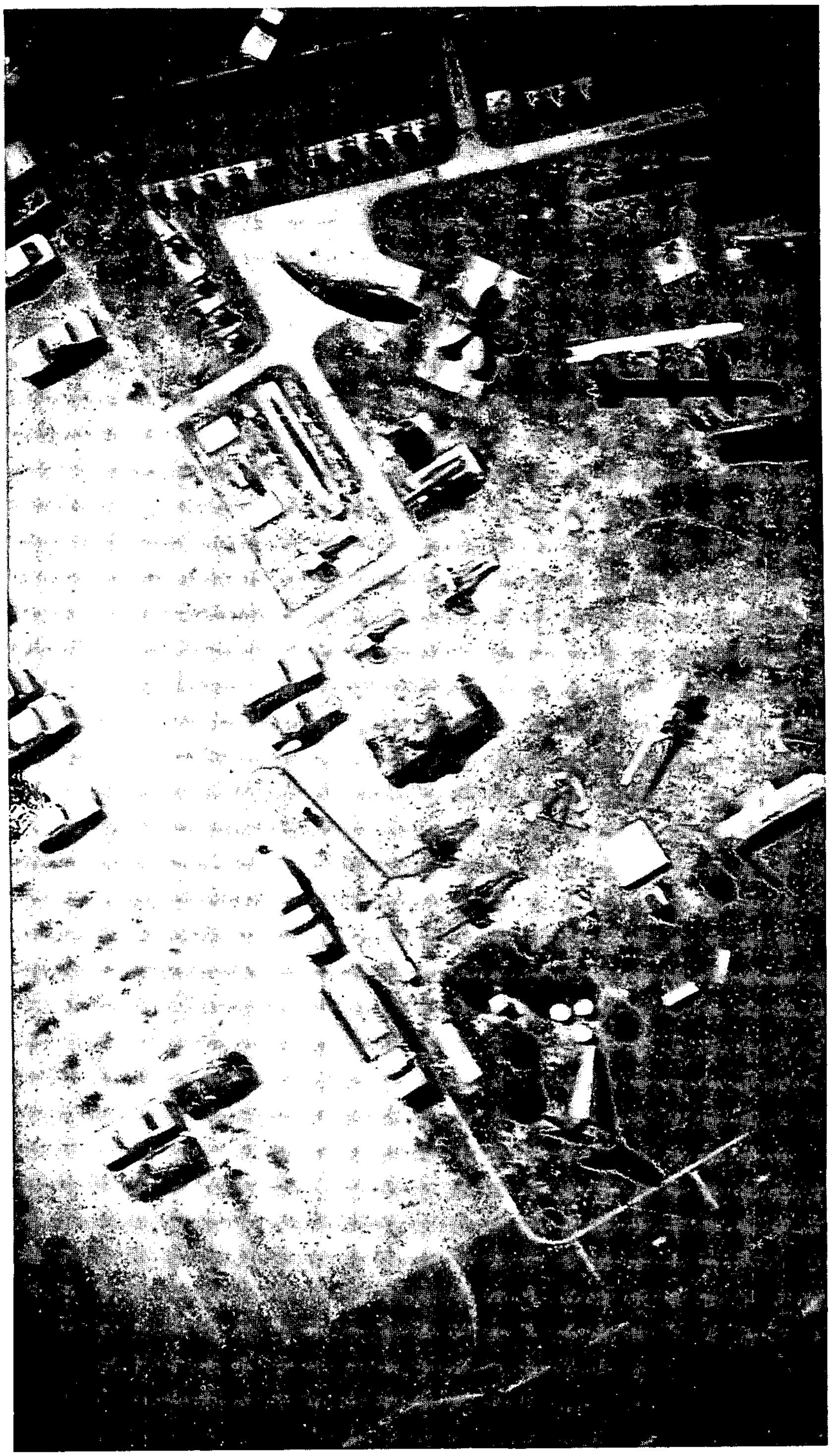

FIGURE A28. Navy Yard Display Area
..... Not Mensurated .....

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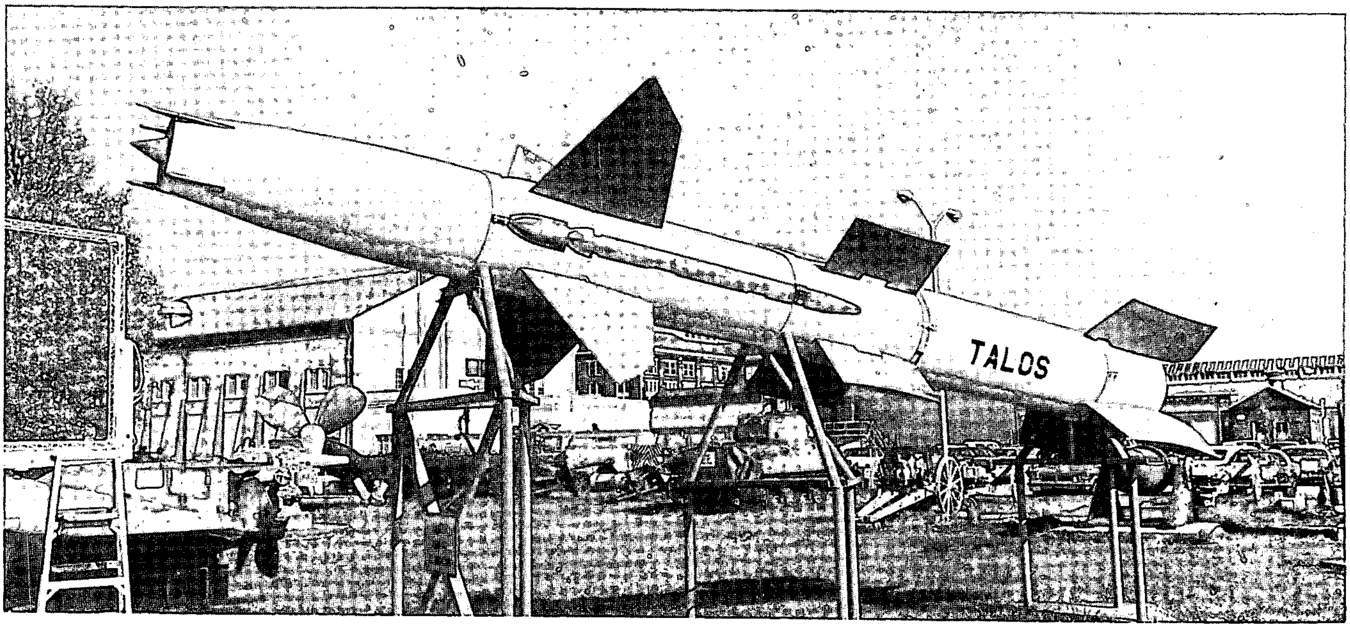

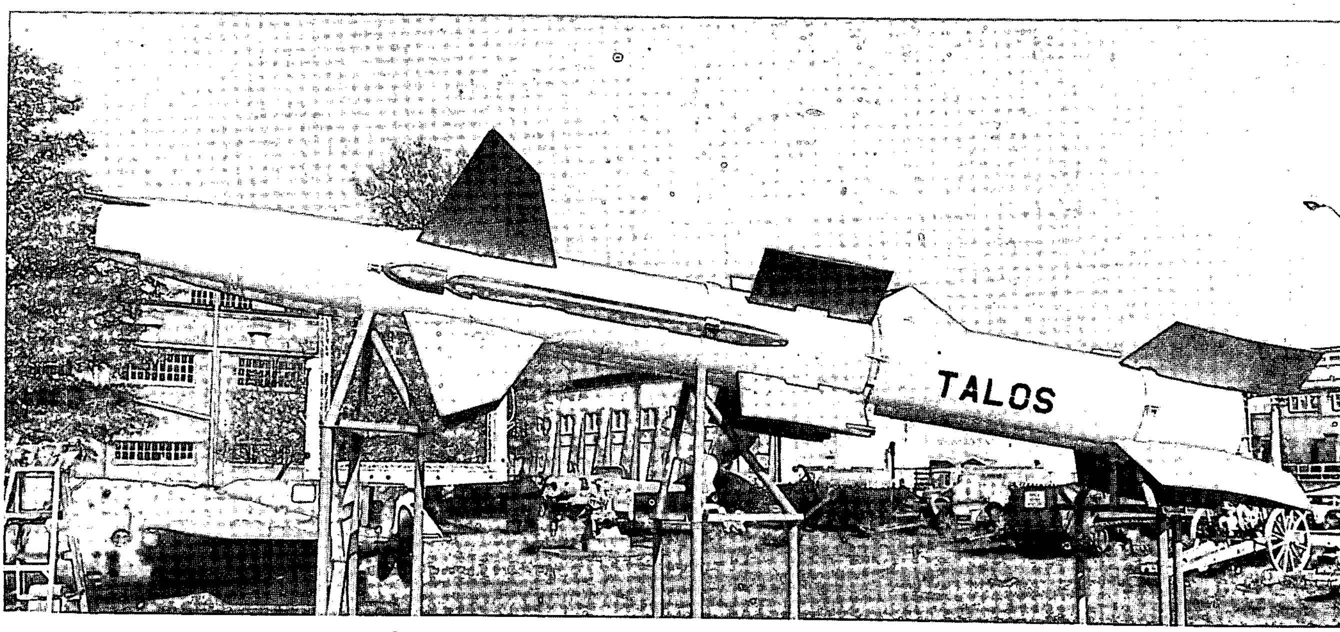

FIGURE A29. Ground Views of Talos Missile at the Washington Navy Yard

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FIGURE A30. KH-8 Coverage of the Navy Yard
Target Display Area

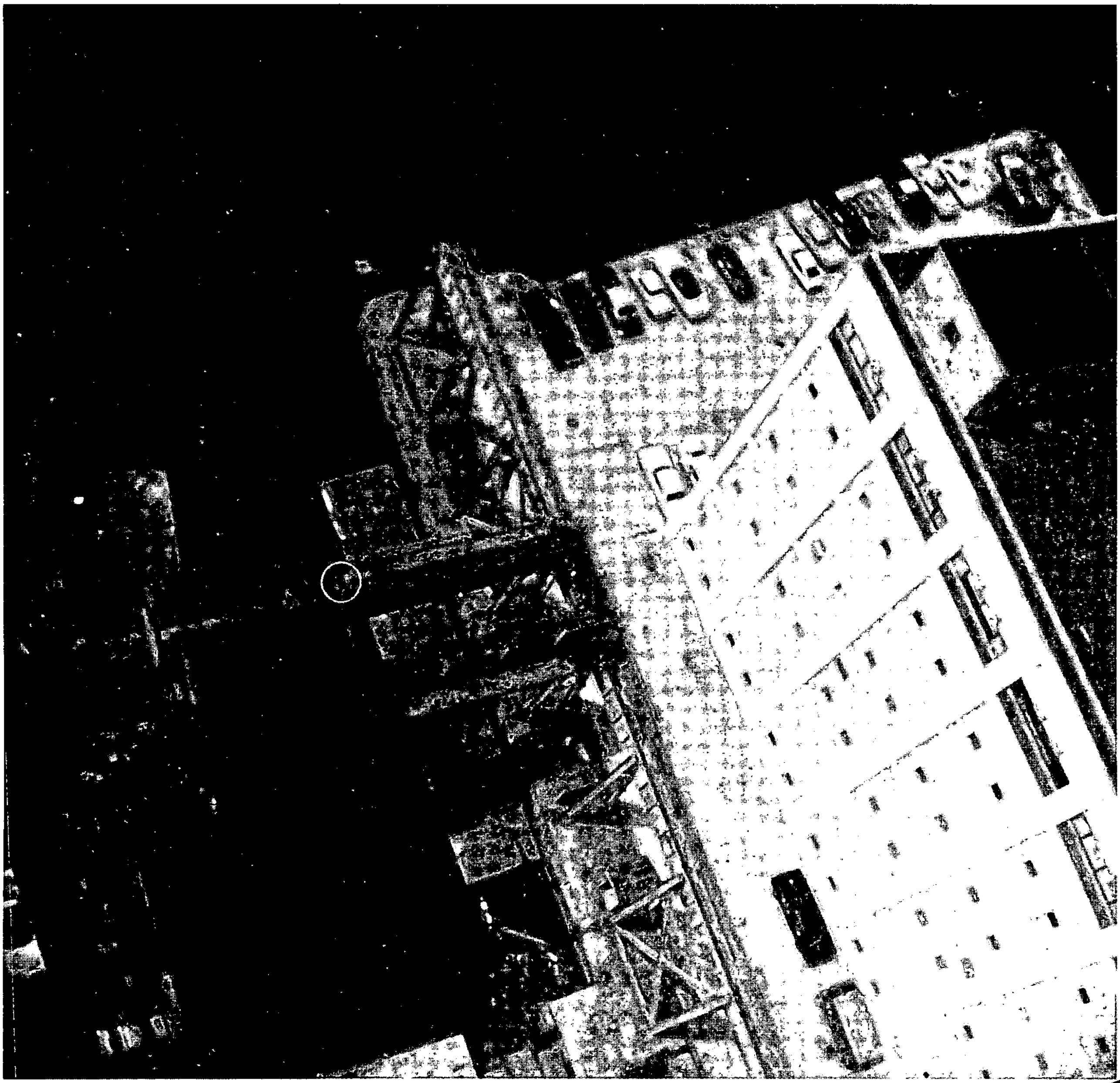

FIGURE A31. The Washington Navy Yard—7/8/77

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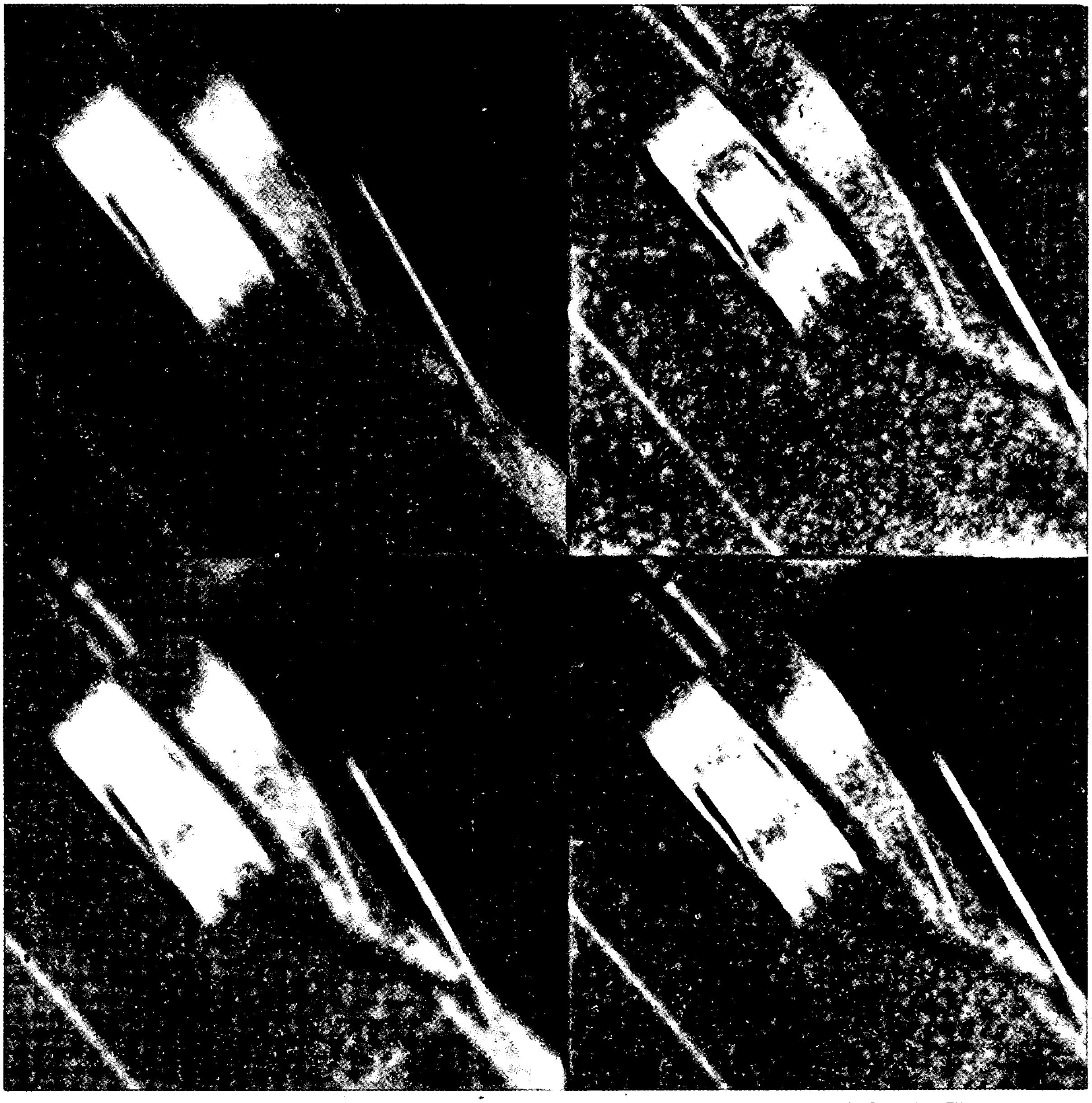
32(a). Original Scene Micro-d Scan

32(d). Rooting (Exp 0.5) 5x5 Convolution, TTC



32(b). Rooting (Exp 0.7) Gaussian Filter

32 (c). Rooting (Exp 0.7) Gaussian Filter Edge Enhancement

FIGURE A32. IDIMS Effect on Smeared Imagery

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FIGURE A33. Camera/Film Analysis Test Imagery SECRET NOFORN
(From the Balloon Platform)

APPENDIX B

CAMERA DETAIL AND SPECIAL DEVICES

~~(S)~~ This section gives some additional detail on avian cameras including results of some preliminary low temperature tests and a quote from Mallory on a lithium battery for use in extremely cold climates. Also discussed are the camera timer box, the camera harness, the small avian DF transmitter, and a Skinner box experiment for investigating the visual response of pigeons in the infrared. As a result of the success of the Skinner box experiment, an IR strobe was modified for use as a remote signaling device for calling the birds into the loft.

Camera

~~(S)~~ Figures B1 and B2 are assembly drawings for the MCW-24 camera and the new [redacted] camera. Low temperature tests were conducted on each camera. It should be kept in mind, however, that

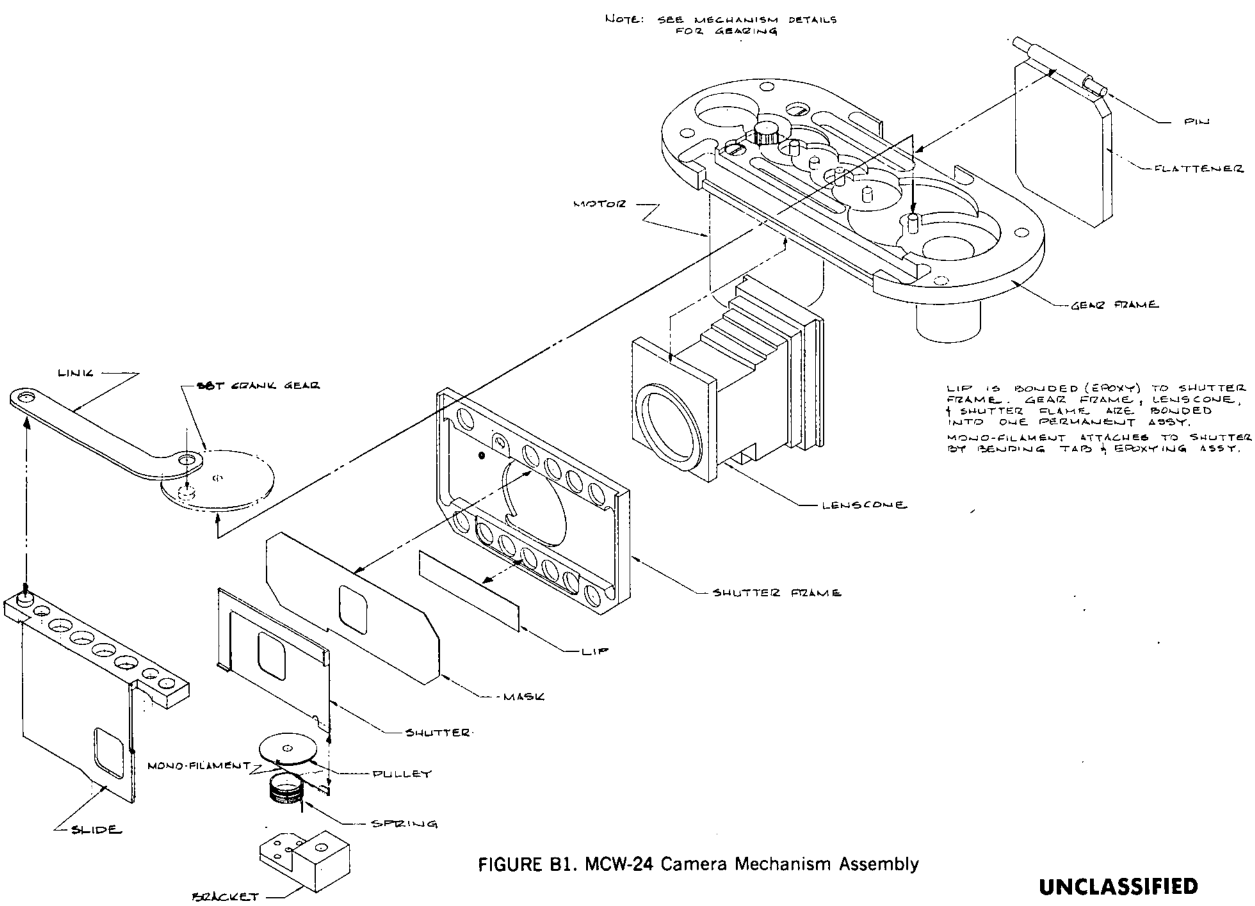

FIGURE B1. MCW-24 Camera Mechanism Assembly

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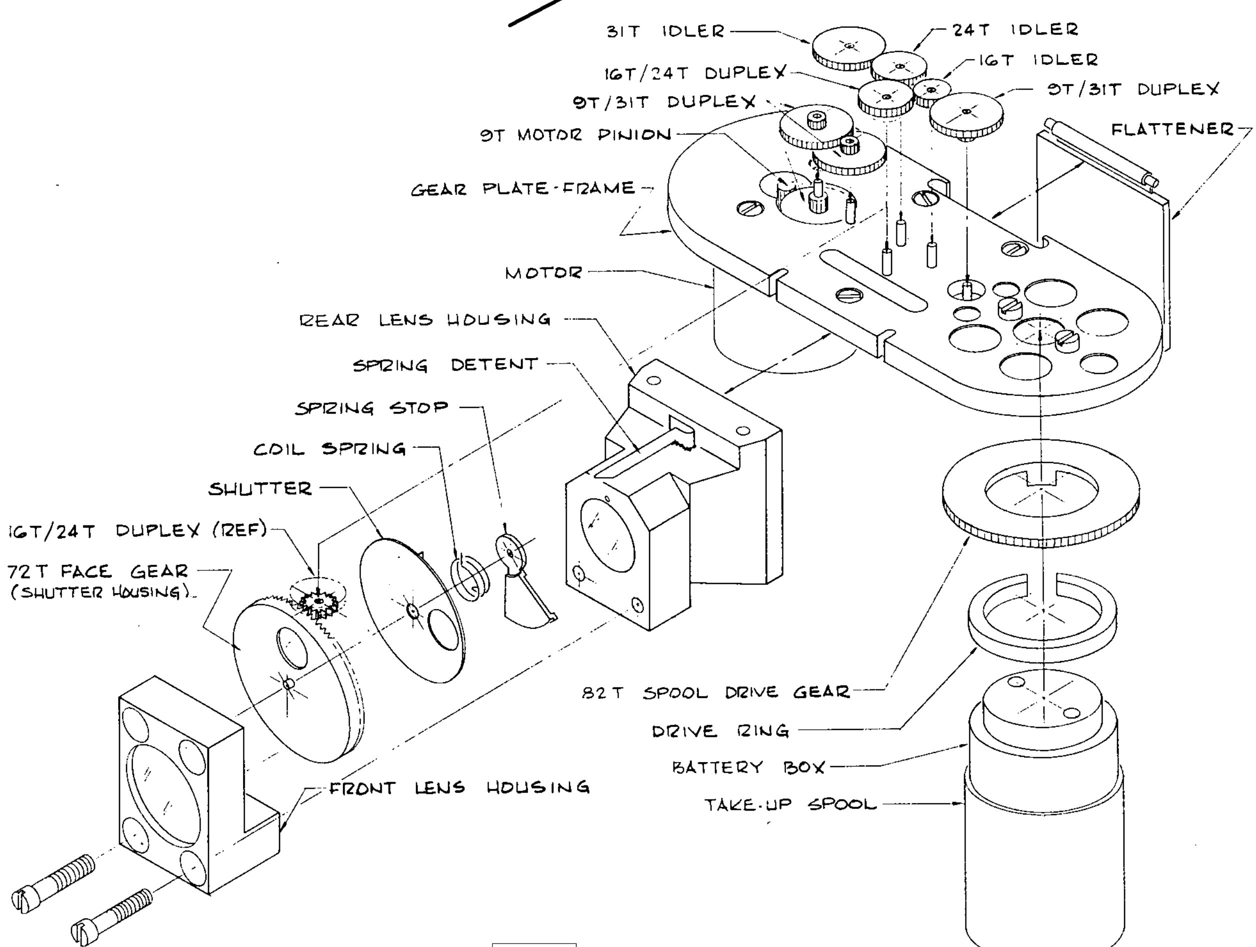

FIGURE B2. Camera Mechanism Assembly

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the MCW-24 was flown 12 times over Andrews Air Force Base during one of the coldest winters on record; typical temperatures were in the low twenties (°F).

~~(S)~~ The first low temperature test was with the MCW-24 camera, using two Mallory 10L14B silver cells. The unit was placed in a (−5°F) freezer with a three-minute delay in the timing unit. A thermocouple attached to the side measured camera case temperature. After three minutes, the camera started (case temperature 52°F) and ran for an additional four minutes (case temperature 40°F) at which time it stopped.

~~(S)~~ A second test was run under the same conditions, but with a 30 mph wind blowing over the unit. Here, the case temperature was (35°F) after three minutes (when the camera started) and was (23°F) after five minutes (when the camera stopped).

~~(S)~~ In both the above experiments, the camera did not pull a full load of film through before stopping. It is apparent that the (107°F) body temperature of the bird kept the camera sufficiently warm to work properly during the flights over Andrews Air Force Base.

~~(S)~~ An additional temperature test was performed on ths MCW-24 using a constant three volt power supply. Here, the camera stopped when the case temperature reached (32°F) and the current drain was approximately double that at normal temperatures. The 10L14B silver cells were tested at low temperatures through a 39 ohm resistor. The voltage varied from 3.2 V (60°F) to 2.8 V (32°F) to 2.0 V (0°F).

~~(S)~~ The [redacted] camera was tested (no timer) with a constant 3-volt supply and continued to operate down to (−1°F). The current drain increased from 36 ma (28°F) to 92 ma (−1°F). This, however, was after considerable attention had been given to selecting a low temperature gear lubricant.

(U) Three factors contribute to the low-temperature performance of the camera:

1. The current drain of the motor as a function of load and voltage.
2. The viscosity of the gear lubricant at low temperatures.
3. The performance of the battery at low temperature.

(U) A 6-volt motor was found which had considerably better efficiency than the current 3-volt motor. Tests with the 6-volt motor gave 18 to 22 ma at (20°F) and 45 ma at zero. However, once a suitable low-temperature lubricant is found, the critical item in the systems is battery performance.

~~(S)~~ It is known that lithium cells have twice the voltage as silver cells with virtually no performance degradation at low temperature. Therefore, if lithium cells could be made in the same size containers as the present 10L14B silver cells, the high efficiency 6-volt motor could be used to compose a system with adequate performance at zero degrees Fahrenheit (or lower). This problem was given to Mallory with the following response:

1. ***Size.*** Same as the 10L14B silver cell.
2. ***Weight.*** 2.6 grams/cell (same as 10L14B).
3. ***Current Drain.*** 100 ma at 2.6 v/cell for 15 minutes.
4. ***Cost.*** $180/cell recurring (in lots of 50), and $12,000 nonrecurring.
5. ***Availability.*** Four to six months.
6. ***Shelf-life.*** One to two years.

Camera Time Box

~~(S)~~ The camera timer box is used to program the camera timer electronics, which contains two E-cells for providing the "delay" and "run" times. Figure B3 is a schematic, and Figure B4 is a photograph of the control panel and the three timer leads. Figure B5 is a picture of the camera electronics showing the positions for connecting the timer leads. The following is a list of steps for using the timer box:

1. With S-1 on and S-2 in "volts" position, the condition of the batteries in the box can be determined. It should be three volts, read on lower scale above the meter.
2. With S-1 on, S-2 in "milliamp" position, and S-6 in "open" position, the camera should not run. If it does, it is because there is accumulated time (charge) in the E cells of the camera timing circuit. This should be allowed to run out before proceeding further, preferably with the camera not attached to the E cells, so as to save wear and tear on the shutter.
3. With S-1 on, S-2 in "milliamp" position, and S-6 in "short" position, the camera should start running and continue running until S-6 switch is placed in "open" position.
4. To put run or delay time in camera, S-1 must be on, S-2 must be in "microamp" position, and S-3 must be in "time"

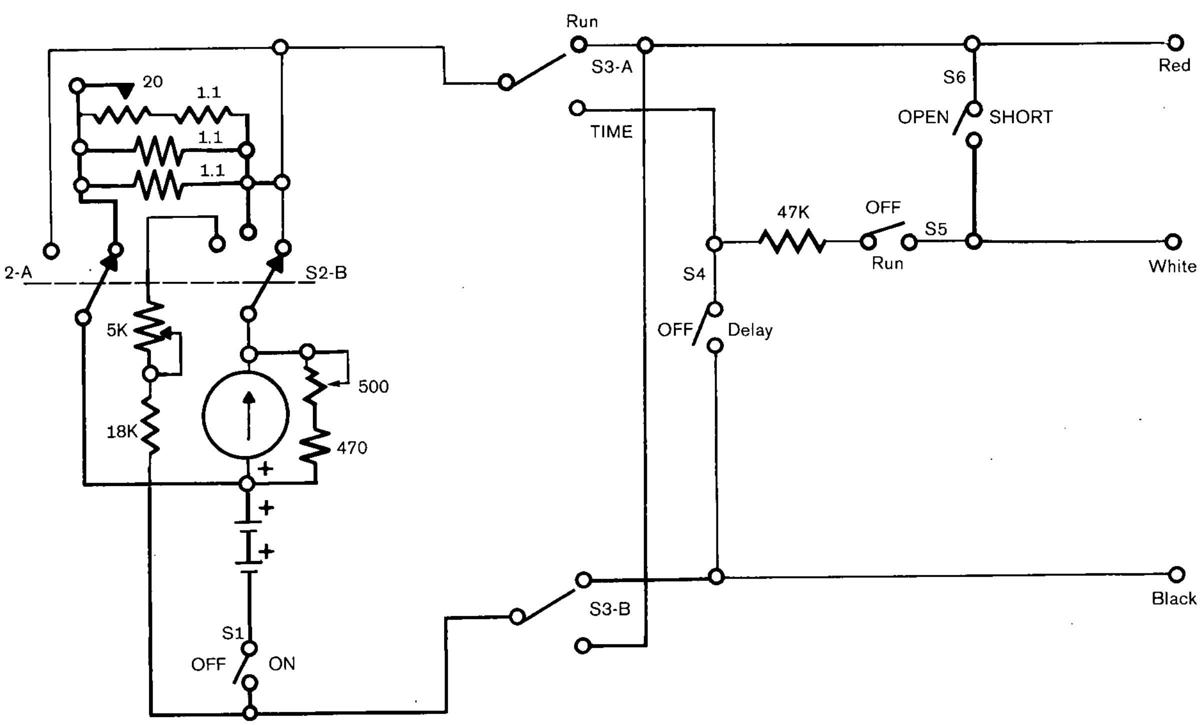

FIGURE B3. Timer Box Schematic

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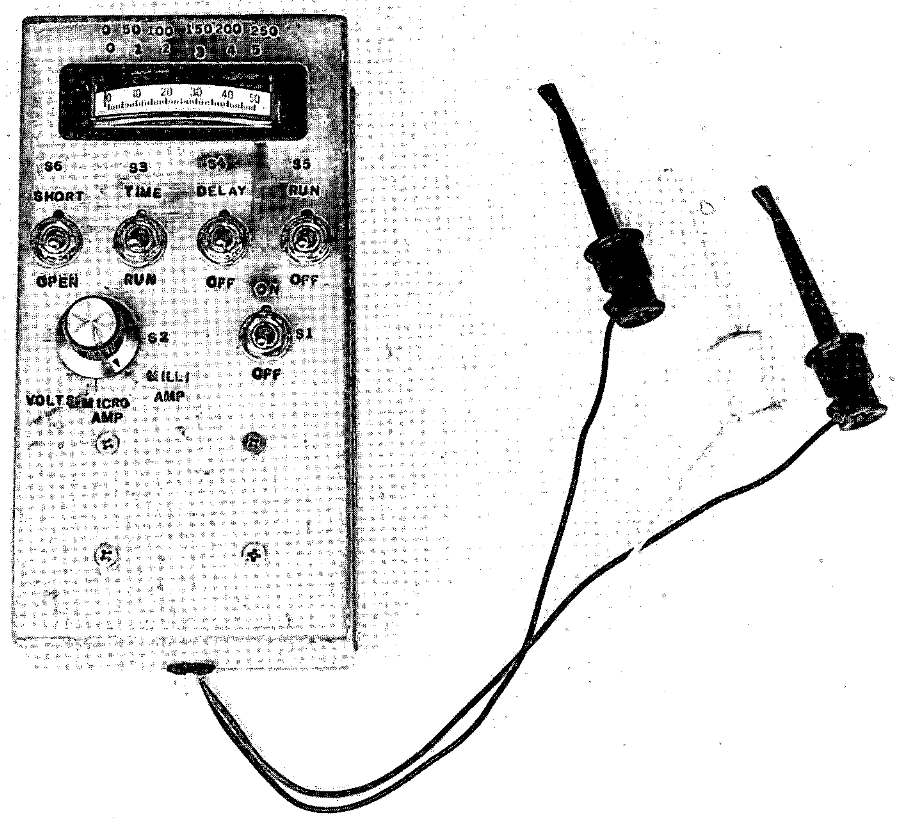

FIGURE B4. Timer Box Controls

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position. Further, if this is for an actual flight, batteries must be in camera and a tab must be between ground and contact points leading to batteries on camera.

5. ***Putting Delay Time in Camera:*** With timer set as described in 4 above, S-4 switch is put in "delay" position for amount of time desired. The meter should read approximately 175 microamps (upper scale above meter) while delay time is being put in. At the end of that period, S-4 switch should be put back in "off" position.

6. ***Putting Run Time in Camera:*** With timer set as described in 5 above, and with S-4 switch in "off" position, turn S-5 switch to "run" position for desired length of time. Meter should read approximately 60 microamps (upper scale above meter) while time is being put in. At the end of that period, switch S-5 to "off" position.

7. To check delay and run time, disconnect three leads from the camera and pull tab. Camera should delay running until delay time is over, then run the amount of time programmed.

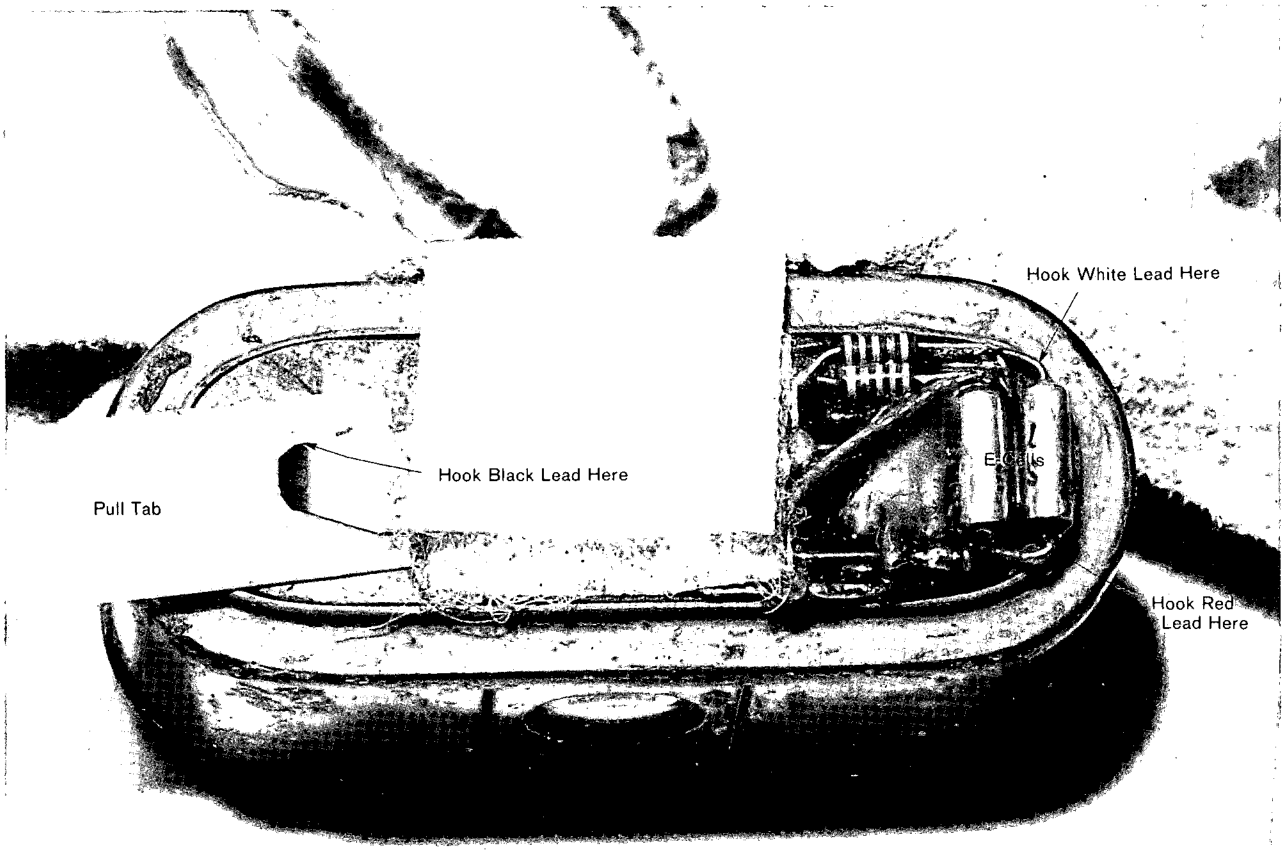

FIGURE B5. [redacted] Camera Electronic Timer

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8. To heal E cells, first disconnect the E cell portion from the rest of the camera. Then with S-1 on and S-2 in "milliamp" position, leave it for a period of time, first in "open" position for S-6, then in "short" position for S-6.

9. After camera is loaded with film and prior to putting in time for actual flight, five seconds of delay time and five seconds of run time should be put in to test if camera is functioning properly.

10. Unloaded, camera should be pulling around 75-85 milliamps when running. Loaded, it should be pulling around 100-125 milliamps when running.

Camera Harness

(S) Figure B6 shows a bottom- and top-view sketch of the harness. Several types of material were used with varying degrees of success. The weight should not exceed 4.5 grams and a soft leather, such as suede, is preferred which does not stretch with use or after becoming wet. A heavy chammy was tried (the long axis of the harness must be aligned with the direction that does not stretch much), but it must be prestretched prior to cutting out the harness and is prone to stretching with excess use.

(S) The harness is connected (and adjusted) by use of Velcro tabs on each end. The right side in Figure B6 winds up on top, pointing aft, so that aerodynamic pressure does not peel the tabs apart. On at least one occasion, the bird reached back and peeled the tabs apart with its beak. For safety, the tabs should be tied together with lacing cord after the final adjustment. Since the harness will loosen after the bird preens and works it into its feathers (it becomes almost invisible from the bottom), the final adjustment should be made in about ten to twenty minutes after first being put on the bird. A light blue or gray colored material will blend in well with the underside of the bird. The cameras were painted with a dull gray "automotive primer" which worked well.

(S) The Velcro camera tabs were used for rapid and convenient attachment and removal of the cameras and weights from the harness. However, this increased the total weight considerably and was responsible for the loss of at least one camera. The first designs of the MCW-24 cameras used small metal clips. Though this was less convenient, it weighed less and was far safer.

(S) A loose harness will cause the camera to bang against the breast bone of the bird (a severe source of irritation) and result in excessive photographic blurring due to high-angular rates. If the

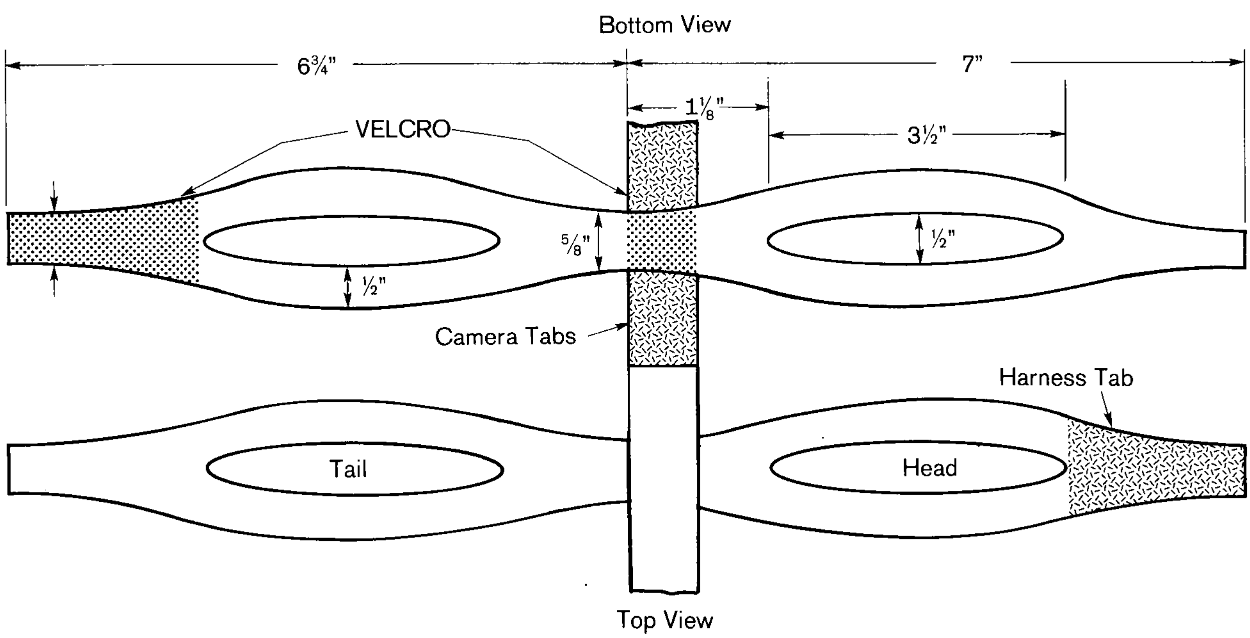

FIGURE B6. Camera Harness

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bird has a deep keel (breast bone), a small piece of foam should be wedged between the harness and the belly. This will act as a shock absorber for the vertical acceleration due to flapping. The bird will move up and down about an inch, six times a second.

~~(S)~~ One size harness will not fit every bird. At the beginning of the project, a large- and medium-size harness was used. As the birds lost body fat and put on muscle, a third small-size harness was necessary. It was found convenient to put the bird's number on its harness. It is important to remember that the camera pull tab in Figure B5 goes forward.

Avian Transmitter

~~(S)~~ Two types of avian transmitters (SM1 and SB2) were obtained from: [redacted]

Figure 12 shows the SB2 (with batteries, antenna, and ground plane wire) attached to the harness. The SM1 weighs less than a gram (no battery, antenna or ground plane wire) and can be detected (ground-to-ground) at about one mile range; the typical life is over one month. The SB2 weighs about 6 grams and can be detected at several miles (ground-to-ground) with a life of about 10 days.

~~(S)~~ The SB2 was used with every [redacted] camera flight at the beginning of the project and was responsible for the recovery of one camera. However, it was noticed that the birds' performance with the [redacted] camera was not as good as with the MCW-24 or the simulated camera weights. On several occasions, the birds would go down before returning home and pull the antenna and ground wires off. Also, it is felt that the combination of the heavier [redacted] camera and the transmitter weight affected performance. Toward the end of the program, no transmitters were used and performance improved, though still less than with the MCW-24 or weight. Both irritation (wires or floppy transmitter) and excess weight degrade performance. If a transmitter must be used, the lighter the better for performance.

Skinner Box Experiment

~~(S)~~ The loft in Missouri was managed primarily by [redacted] with a degree in psychology, was familiar with much of the classic "Skinner Box Experiments" with pigeons, had access to most of the scientific reports, and had several professional acquaintances at the State

University at Roanoke. Her ultimate goal was to train the pigeons (on the loft or in the air) to respond to an infrared flashing light by quickly coming into the loft. Her experiments progressed in several stages listed below:

1. There are three "light buttons" in the Skinner box which can be illuminated with red, white, and green light. These buttons close a contact switch when pecked by the birds. A small computer was programmed to randomly illuminate one of the buttons with red light and to feed the bird when the red button was pecked. Figure B7 shows the bird about to peck the red button, and Figure B8 shows the bird receiving its food reward. The computer also recorded data pertinent to the rate of learning and differences between individual birds. The TV camera in these two figures was used for remote observation of behavior.

2. Once all the birds were trained to the visible red light, it was replaced with an invisible (to humans) infrared light with no detectable change in learned behavior. The wave length was about 0.9 microns.

3. In the next experiment, an IR flashing light was installed over the feeder in the pigeon loft. This was a commercial IR

FIGURE B7. Bird Responding in Skinner Box

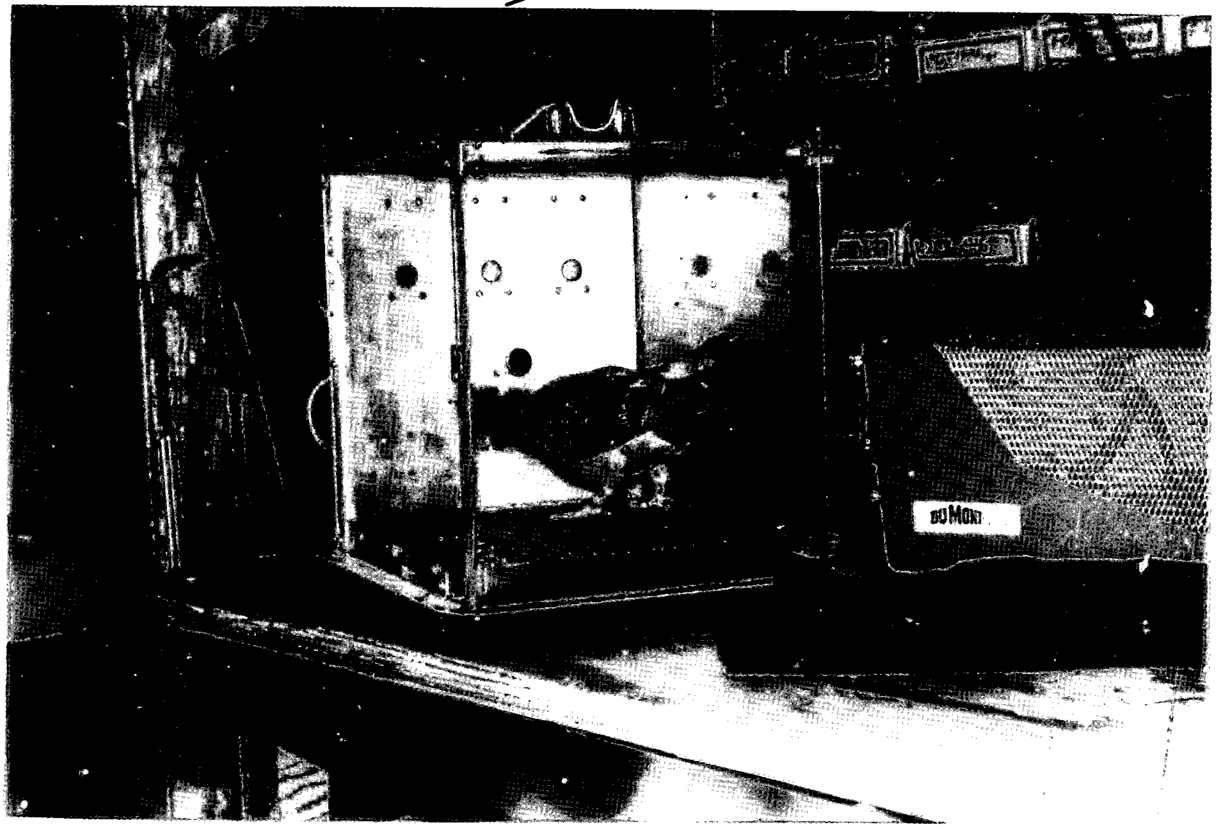

FIGURE B8. Bird Receiving Food Reward

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camera strobe (see Figure B9) fitted with a two-second strobe timer. The purpose was to form an association between the flashing light and dinner time. This concept worked well with the "dinner music" tape used by all the project lofts (also developed by [redacted]

4. The last phase was to place a flashing light outside the loft as a cue to the birds that food was being served. The project terminated before this phase was completed, but it appeared that some birds did make the transfer in cue while others did not. A pair of squabs (very young birds), raised during experiment three, did come into the loft in response to the flashing light after they had returned from their first flight and looked as though they intended to spend the night on the roof.

~~(S)~~ Whether it is a young bird out for the first time or a relocated bird at its new home, the outside of the loft is strange and unfamiliar compared to the inside. The IR flashing light could be used as a signal of home. A similar method was used by the U.S. Army. A particular colored symbol was used on top of each of the small mobile lofts (which were moved as much as 20 miles a day) so that the birds could not only find home, but distinguish one loft from another. This method, or some other visible cue, could aid greatly in relocation. It was also noticed that there was some correlation between the rate of learning in the Skinner box and the flight performance in the field. Since the learning and recordkeeping in the Skinner box is automated, a large number of birds could be "graded" in a fairly short time.

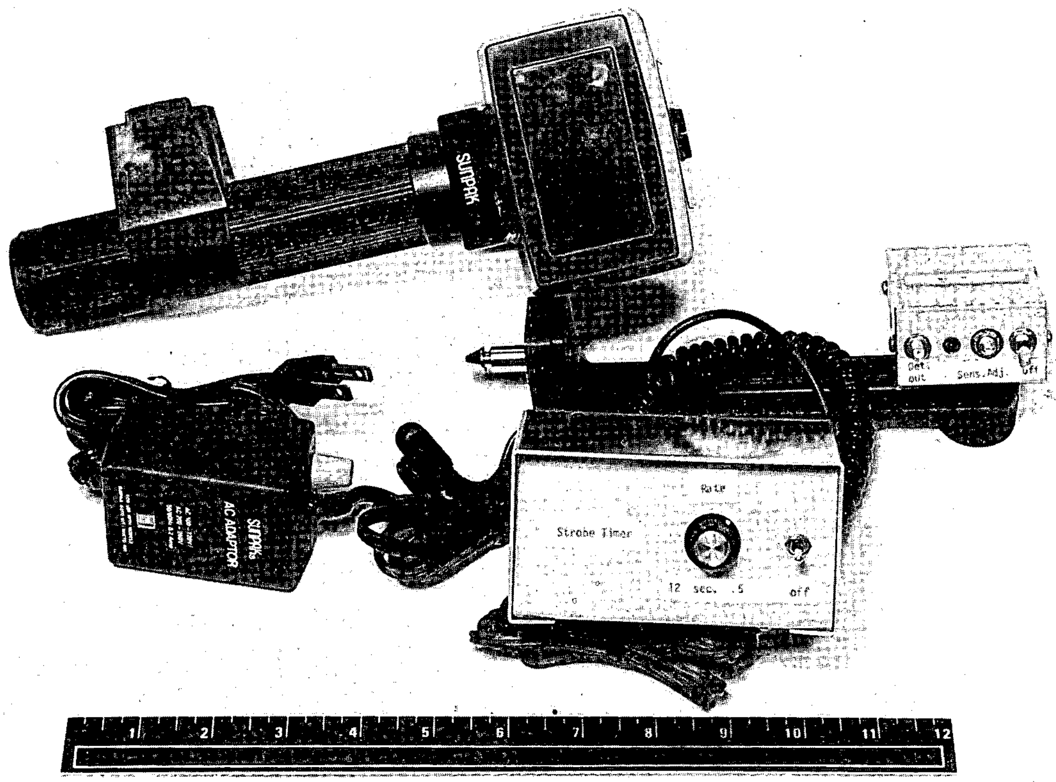

FIGURE B9. Infrared Strobe and Timer

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APPENDIX C

CARE AND HANDLING OF HOMING PIGEONS

Sanitation and Disease Prevention

(C) One of the most important aspects of this project has been guaranteeing the health of the pigeons involved. This effort has not been a total success because initially we were operating out of a local existing loft and did not have complete control over our pigeons. Consequently, during the project, we encountered three of the most common pigeon diseases: Canker, Pigeon Pox, and Roundworms. We lost two birds to Canker but survived the Pox and Roundworms with no casualties; the birds were out of form for several days. At one point during the project, Paratyphoid was present in the loft, but our birds were not affected. A list showing the symptoms and recommended treatment for these four diseases, plus another very common pigeon disease, Coccidiosis, is given at the end of this section. With complete control over our birds and their environment, most if not all of these diseases could almost certainly have been prevented. Over 90 percent of most pigeon diseases can be prevented outright through proper methods of sanitation and care.

(C) Following are some of the most basic tenants of sanitation and disease prevention:

1. The pigeon loft should have good ventilation with no drafts. This ensures a constant source of fresh, clean air and helps to keep the floor dry, which is imperative for pigeons to thrive.
2. It is essential that pigeons receive fresh water at least once, and preferably twice, a day. Water should be placed in the loft so there is no possibility of contamination by pigeon faeces, which contain the bacteria for most common pigeon diseases.
3. Pigeons need fresh, clean grain that is fed in the proper quantity (overfeeding leads to overweight, out-of-condition birds), and that cannot be contaminated by the birds' feet, which come in frequent contact with faeces. (Feeders can be built which almost entirely eliminate the possibility of pigeons walking in the grain the eat).

4. Fresh grit should be provided daily, though this is not mandatory. Pigeons use grit to digest their food. It is also a source of vital minerals that the birds can get in no other way. If grit is kept before the birds, it should be checked periodically to be sure it has not turned rancid.

5. The loft must be kept clean and should be scraped daily, which takes only a few minutes.

6. Common body insects must be controlled. This is imperative. Birds afflicted with lice and mites cannot perform properly. If they do not become anemic, they will be worn out from the constant drain of pecking at the source of irritation. Affected birds can be heard stomping their feet at night in an effort to rid themselves of the pests. Pigeons have been known to desert their eggs rather than sit in an infested nestbox. Virtually all body pests can be eliminated completely by the application of roost paint in the loft once a month and by hanging a Vapona bar (Shell Pest Strip) in the loft. (It should be replaced every three months.) The above six points are basic to proper loft management. In the project loft, constructed for kit 2F, these points were adhered to and not one of the diseases present in the first loft appeared. These and other important points of loft management are treated in greater detail in Chapter 15 of Dr. Leon F. Whitney's book, Reference 9. Several books and periodicals are given in the list of references which contain useful material on the care of homing pigeons.

(~~C~~) In addition to basic sanitation methods, some fanciers have established a system of disease prevention by treating their birds quarterly for Canker, Coccidiosis, Paratyphoid, and worms. This type of treatment is the same as treating for the disease itself as discussed later. These and other supplies can be purchased from the following pigeon supply companies:

1. Racing Pigeon Bulletin
   94-G Compark Road
   Centerville, Ohio
   45459

2. Foy's Pigeon Supplies
   Box 166
   Golden Valley, Minn.
   55427

3. Charles Siegel and Son
   1011 E. Middle Street
   South Elgin, Illinois
   60177

4. C. A. Hammer Company
   1512 S. 34th Street
   Milwaukee, Wisconsin
   53215

(U) A very useful plastic-colored marking band, that cannot be obtained from the above supply houses, was used extensively in the project. It can be ordered from:

Boddy-Ridewood
41 Aberdeen Walk
Scarborough Yorks
United Kingdom

Factors Affecting the Performance of Project Birds

1. (C) The Moult. Pigeons renew all of their feathers once a year. The moult is continuous from the daily moulting of the fluff feathers until the heavy moult in the fall of the year. It takes at least six months to moult the entire body of feathers. The moult should not affect the performance of pigeons over short distances, with the possible exception of the #10 primary feather—the last and longest feather on each wing. It can be very painful for a pigeon to fly when this feather is coming in.

(C) At one point during the project, one of our best birds had three or four of the primary feathers on one wing broken off, and we were unable to fly her for several months. These were pulled out over the course of several weeks, except for the #10 (which should never be pulled). After the bird grew new feathers in their place, we resumed flying her.

2. (C) Laying Hens. A hen about to lay should not be sent to any distance. More than likely she will stay someplace along the route home for several days until she has laid both eggs. After laying the second egg, she will desert them and come home when her cock does not relieve her at the time when he is supposed to come on the eggs. The cock in a mated pair will begin to drive the hen to the nest about five days prior to laying (this is called a "driving cock"). The hen can be successfully flown up to two to three days before laying. The hen can be successfully flown to short distances within one or two days after laying. Most sitting hens are highly motivated to return home at some point while they are sitting on eggs—usually about 14 days—and again when the eggs begin to hatch.

3. (C) Raising Young. Both hens and cocks usually fly well to their young, and their performance under this condition will usually meet or exceed normal expectations.

4. (C) Driving Cocks. A driving cock should not be flown. He may follow the first hen he sees to wherever she is headed.

5. ~~(C)~~ Hunger. Virtually all pigeons will respond well to motivation through a restricted diet and will hurry home and trap quickly once they learn food awaits them there.

6. ~~(C)~~ Launch Site Familiarity. The more familiar with the launch site, the more uniform the departure for home will become. After 5-10 tosses, a bird will depart in a fairly predictable manner, although not nscessarily covering the same ground as before. The danger of launch site familiarity is that as the bird tires of the harness and weight routine, he will be more inclined to land in the increasingly familiar area of the release site, unless proper motivation, (i.e., hunger) is maintained.

7. ~~(C)~~ Wind. Winds under 10 mph do not seem to affect bird performance. Pigeons tend to tack into the wind, however, when it is over 10 mph. This can be advantageous where winds are coming from the target area, resulting in a slower ground speed.

8. ~~(C)~~ Single Tossing. Pigeons are very gregarious and when single-tossed tend to remain in the area of the release waiting for other birds with which to fly home. This could be advantageous if lingering in the area were desirable. Double tossing was used with good success in the project to get the birds to move out quickly for home.

9. ~~(S)~~ Harness and Payload Devices. When initially fitted with a harness inside the loft, most pigeons in the project either went into wild gyrations trying to get it off or sulked quietly in a corner. After the harness had been on a day, all birds were functioning normally around the loft, except for occasional picking at the harness with their beaks. Later, when a 40 gram weight was attached to the bottom of the harness, it did not seem to have any affect on their performance on the ground, other than a high "goose-stepping" walk as their feet brushed the sides of the weight. Most birds even successfully sat on their eggs with the weight on without breaking them. The weight definitely slowed them down on the wing, however. The harness alone seemed to have little effect on their desire to fly once the birds became used to it. Some harness and weight training can be done in the loft.

Relocation

~~(C)~~ Because of its strong urge to "home," a good homing pigeon will make every effort to do so when released in strange territory. Nevertheless, for various reasons fanciers periodically attempt to relocate homing pigeons to a new loft at some distance from the old. It has been done successfully many times, but the danger of losing the bird is high. Dr. W. E. Barker in his book, Pigeon Racing, (see Reference 6) mentions the following points as essential in relocating pigeons:

1. The better the bird, the easier it will be to settle to a new home.
2. It is generally useless to attempt relocating birds which have bred elsewhere to a new home until they have been allowed time to breed again amidst their new surroundings.
3. Birds to be relocated should be given the opportunity of becoming acquainted with the outside appearance of the new loft and as much as possible with the new neighborhood.
4. Birds in the process of being relocated must be handled with great care and gentleness. They should never be startled when allowed out for the first time.
5. Do not attempt to relocate hens between eggs or cocks while driving. Rather, give them their liberty while sitting and allow them to find their own way out of the loft without interference.
6. Never attempt to relocate birds that have small youngsters in the nest. They will almost invariably return to their original home.
7. So long as relocated pigeons are allowed to remain undisturbed in their new quarters, they frequently exhibit little tendency to return to their old surroundings. Once they are disturbed or unsettled in any way, however, for instance being sent to races, the desire to return to their old home is apt to reassert itself, and they may return to their original home.

~~(S)~~ With relationship to this project, the difficulty of relocating pigeons is especially evident from point 7 above, inasmuch as relocated project birds were "disturbed" when fitted with a harness and weight and released in unfamiliar surroundings.

~~(S)~~ Following are the methods used in this project to assist in relocating pigeons:

1. All birds were kept in confinement a minimum of three weeks.
2. Birds were not allowed to see the outside of their new loft prior to release because of operational considerations.
3. Some birds were allowed to raise a round of youngsters before being released in an effort to cement the bond to

their new home. However, most were not on eggs at the time of release.

4. Some birds had one wing "hobbled" with a rubber band the first few times out until they became familiar with their immediate surroundings.
5. Three birds were placed on the "Widowhood" system of flying (to be explained later) in an effort to relocate them.

~~(S)~~ Most of the birds that we attempted to relocate were eventually lost, most likely for the following reasons:

1. They were not able to familiarize themselves with the outside of their new loft and, consequently, many were lost almost immediately upon release.
2. Those birds kept in confinement the shortest period of time (three weeks) were the most likely to be lost. In general, the longer the birds were kept in the new loft, the better the chance of successful relocation, although still poor.
3. Many of those birds that survived the initial release were subsequently lost when fitted with harnesses and weights. Generally, they did not leave while "in harness" but did so on training flights while not harnessed or without weights. In other words, they were disturbed and left at the first opportunity when they were not encumbered with a harness or weight. In terms of initial success in the relocation process, the best statistics were obtained with the three cocks on the Widowhood System—three out of three. Nevertheless, two of these birds were subsequently lost—one off the loft just prior to a severe thunderstorm and the other, while wearing a harness only, from the nine-mile training station (again, see Barker's point #7).
4. A contributing factor in the loss of many birds was the location and appearance of the new loft compared to the old. In no case were the two similar. Moreover, in at least one relocation series, the loft was so surrounded by trees that most birds were lost as soon as they took flight. Hobbling at this location gave better results.

The Widowhood System

~~(C)~~ The following is a brief and over simplified description of the system:

1. Allow X number of mated pairs to pick their own nest boxes in the loft (no other birds are allowed in the loft) and raise

one round of youngsters; two rounds is better if the birds are yearlings, but it takes a long time (about two months).

2. After the birds go back down on eggs, allow them to sit for about one week, then remove the hen and throw the eggs away.

3. Hens should be kept in a place where the cocks can neither see nor hear them. After separation, do not allow the cocks to see their hens for at least a week, then take the cocks out of the loft, lock the hens in half of the nest box, and leave the other half open (so the cocks cannot get to the hens when they are allowed in the loft). When the cocks are allowed to enter the loft they will be in a high state of excitement when they see their hens. Let the cocks in with their hen but for no more than five minutes. Do not allow the cocks to mate with their hen or the system will be ruined. After five minutes remove the hen and put her back in her loft.

4. After several weeks of doing this, the cocks will learn that when they are taken from the loft, the hen will always be waiting for them when they return. When the cocks are let out for daily exercise, they will fly long and far searching for their hen and will come into excellent physical shape. When taken away for a race (or whatever) cocks will speedily come home and trap in quickly, assuming the system is working at its best. The disadvantage to the system is that there are many variations, each quite complicated. Hens play a vital role; if they are not good, the cocks will not work properly. Moreover, the system takes too long to implement. It is recommended that widowhood not be considered for operational use at this time.

Disease

~~(C)~~ The following is a list of the symptoms, medication, and methods of treatment for five of the commom pigeon diseases:

1. Canker (Trichomoniasis):

Symptoms— Failure of bird to swallow larger grains; swelling of the throat; cheesy growths in the mouth area; loss of flesh and ambition, loss of appetite. Navel in youngsters occasionally becomes infected and fills with the cheesy deposits.

Medicine — Emtryl powder for flock treatment. Tricoxine tablets made by Fabry for individual treatment.

Treatment— Powder: 1 Tbsp. per gal. of drinking water. Leave in loft for 5 days.

2. Coccidiosis:

Symptoms— Droopy, diarrhea (which may be bloody), lack of energy, loss of weight, anemic appearance. Appetite diminished but not thirst. Loss of ambition. Leg weakness, i.e., bird prefers to rest on heels rather than stand.

Medicine — NFZ Soluble (powder).

Treatment— Add powder to drinking water according to directions on packet. Keep treated water before birds for 2-3 weeks. Clean loft daily. Change water at least once a day. Apply roost paint once every month or so and install Vapona pest strips in loft.

3. Paratyphoid:

Symptoms— Old Birds: Loss of weight, decrease in appetite. Droopy, green, loose droppings. Slight lopsidedness in flight. Swelling in wing and leg joints.

Young Birds: Copious diarrhea; dizziness or evidence of brain inflammation. Twisting the head sidewise. Disease worse in damp weather. Caused by unsanitary conditions.

Medicine — NFZ Soluble.

Treatment— Same as above. On old birds lance swellings and disinfect as often as necessary.

4. Roundworms (Ascaridia Columbae):

Symptoms— Droopy appearance. Loss of weight.

Medicine — Piperazine Citrate. Also sold with an additive for hairworms (Capillaria).

Treatment— 8 grams per gallon of drinking water of Piperazine Citrate over a period of 60 hours. Scrupulous sanitation to prevent reinfection.

5. Pigeon Pox:

Symptoms— Wart-like lesions on unfeathered portion of body.

Medicine — Pox vaccine prior to infection.

Treatment— Vaccinate prior to disease. No cure.

APPENDIX D

A BRIEF HISTORY OF THE PIGEON

(U) Most of the following is taken from Chapter I of Reference 7, which is an encyclopedic treatise on every aspect of pigeons.

(U) The earliest recorded use of the pigeon (or dove) to obtain information was by Noah, who sent out a dove knowing it would return if it found no land. Instead, it did find land and returned with an olive leaf, a demonstration of its love for home which remains the most endearing quality of pigeons to this day. It is speculated that King Solomon (about 1000 B.C.) used pigeons, but the first documented evidence of their use in war begins with the conquest of Gaul (over 2000 years ago) by Julius Caesar.

(U) During the War of Independence in Holland (1574), the besieged people of Leyden were saved by messages of relief carried by pigeons. Pigeons were also used by the Venetians during the siege of Venice in 1849.

(U) It was during the siege of Paris (1870-71), during the Franco-Prussian War, that the modern day Homer came into international note. Balloons were released from Paris containing, among other things, Parisian pigeons. These birds were retrieved and taken to London, Tours, and other cities and subsequently released with messages to the besieged Parisians. It was here that one of the first uses of microphotography enabled the transport of as many as 40,000 messages by a single homing pigeon. During the four-month siege, 150,000 official and 1,000,000 private communications were carried into Paris by homing pigeons.

(U) In 1909, an international photographic exhibition was held in Dresden, Germany. As invited delegates began their speeches, pigeons with automatic miniature cameras harnessed to their bodies made low-altitude photo passes over the exhibition hall. The exposed film was quickly processed and converted into souvenir-postcard enlargements for immediate sale to the delegates. This photo, and a picture of the pigeon with camera, can be found on page 28, first edition, of the "Manual of Remote Sensing," Volume 1, 1975, published by the American Society of Photogrammetry.

World War I

(U) The Germans developed military lofts as early as 1887 and were quite prepared for the First World War, as were the French and Belgians. It was the Belgians who first developed the modern-day racing homing pigeon during the Industrial Revolution for the purpose of carrying detailed messages of financial import between England and Europe. Over 1,000,000 Belgian pigeons were taken by the Germans during their occupation. To this day, many of the better racing pigeons come from Belgium.

(U) It was not until 1916 that the first British birds were sent to the front. British air force records show that 717 messages from planes fallen in distress upon the seas were delivered by pigeons and about 95 percent of several thousand pigeons came through with messages. By the end of the war, British war Homers numbered 9,000 to 10,000 birds.

(U) When the United States entered the War, we had no organized pigeon force. By 1916 birds were being trained to mobile lofts. It was found that the birds soon came to recognize distinctive markings on the roof of their lofts, which could be moved some distance before their return. War Department records show, during the Aisne-Marne offensive, mobile lofts enabled 72 birds to carry 78 important messages with no losses. In the St. Mikiel drive, 90 important messages were delivered by pigeons. Twenty-four of 202 birds were lost or killed, but every message was delivered since it was sent in duplicate. In the Meuse Argonne offensive, 442 birds delivered 403 messages safely from distances of 12 to 30 miles; not a single message was lost. One bird, Cher Ami, was credited with saving the "Lost Battalion," and his body was mounted and placed on exhibition in the Smithsonian. A second bird, "The Mocker," was awarded the D.S.C. as well as the French Croix de Guerre for several outstanding feats of performance.

World War II

(U) The British were well prepared by the outbreak of World War II. British breeders gave over 200,000 young birds to the National Pigeon Service between 1938 and 1945. They were used by the R.A.F. (standard equipment on all bomber and reconnaissance planes) and the Army and Intelligence Services. Special Section of the Army Pigeon Service (Secret Service) parachuted 16,554 birds onto the continent. An outstanding example was the location of German buzz-bomb sites. Pigeons were standard equipment for both paratroopers and agents. Through the use of microphotography, large quantities of plans and information could be delivered without the severe risk of radio communication. The British furnished our

U.S.A. Signal Corps, based in England, with 46,532 pigeons.

(U) Early in 1938, the U.S. Signal Corps had completed 20 lofts for a new pigeon center at Fort Monmouth, New Jersey. Shortly after Pearl Harbor, the War Department issued a call for champion homing pigeons, one qualification being they must have flown 200 miles. The pigeon corps grew until, at its peak, it contained 54,000 pigeons, 3,000 enlisted men, and 150 officers. Major Otto Meyer, as Commander of the Signal Pigeon Corps, supervised preparation of the Army Technical Manual No. 11-410, "The Homing Pigeon," and also Field Manual 11-80, "Pigeons for Combat Use."

(U) Pigeons were used extensively in the North African and Italian campaigns. Here, pigeons were used by G-2 section (Intelligence), and command posts who were so near the enemy that it was impossible to string wire or use radio. They were also used by armored patrols, night patrols, Ranger raids, etc. During the year 1944, the pigeons of the 209th Signal Pigeon Company serving with the Fifth Army carried 10,286 messages. Of the 20,202 birds used during this year, only 266 were lost.

(U) During the Luzon campaign, 2,594 messages were carried by birds of the first Combat Platoon, 281 Signal Pigeon Company. All messages were sent in duplicate, and not one was lost in spite of mountainous terrain, rain, fog, hawks, and enemy shotguns.

Office of Strategic Services

(U) The O.S.S. made outstanding use of pigeons in the Burma campaign. One detachment, O.S.S.S.U. 101, operated behind Japanese lines in Burma and was commanded by Captain Morris Y. Lederman. It was with this detachment Jungle Joe and Captain Lederman achieved their renown. After only ten weeks in the location, birds returned 225 and 250 miles when released by agents who parachuted into the vicinity of Mandolay, Shwebo, and Maymayo. The most outstanding flights were made by two five-month old youngsters from a point near the Thailand border to the loft at Bhamo. The distance was 325 miles.

(U) All agents, parachuted behind enemy lines, carried pigeons. During January, 1945, nine groups were parachuted in and pigeons either beat the radio or were the only means of contact for seven of these groups. The distances flown were 175 miles, 225 miles, and 300 miles. The pigeons were held in jump containers from one to three days. On another occasion, a pigeon was tossed from 150 miles after 11 days on location and, although a resettled pigeon, it returned in six and a half hours. A new shoulder message carrier was developed, and pigeons flew 50 miles with a full roll of negatives. Out of hundreds of messages flown, only four were lost and all were from distances greater than 150 miles. On several occasions, pigeons were received from agents with urgent messages for radio replacement parts.

Two-Way Pigeons

(U) These are pigeons which were trained to fly between two lofts, eating at one and sleeping or drinking at the other. The U.S. considered the method of training as Secret, though it is described in the German Army Technical Pigeon Manual, published about 1925. The records of the 1308 Signal Pigeon Company shows they flew two-way birds 55 miles.

Korea

(U) Pigeons were used by G-2 (Intelligence) of the Eighth Army. During a four-month period, pigeons were used by seven groups of agents parachuted from 75 to 200 miles north of enemy lines. During this operation, not a single message was lost.

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Feasibility Research on a System to Provide High Resolution Photography Over Denied Areas

(Supplement)

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Feasibility Research on a System to Provide High Resolution Photography Over Denied Areas

(Supplement)

A Research Study

By

Charles N. Adkins

Operations Technology Division

Office of Research and Development

APPROVED:

Chief, Operations Technology Division, ORD

April 1978

Date

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This supplement contains high resolution prints of the Avian Photography shown in the main report. The following table of contents includes the page numbers of the main report where these figures are printed at lower resolution.

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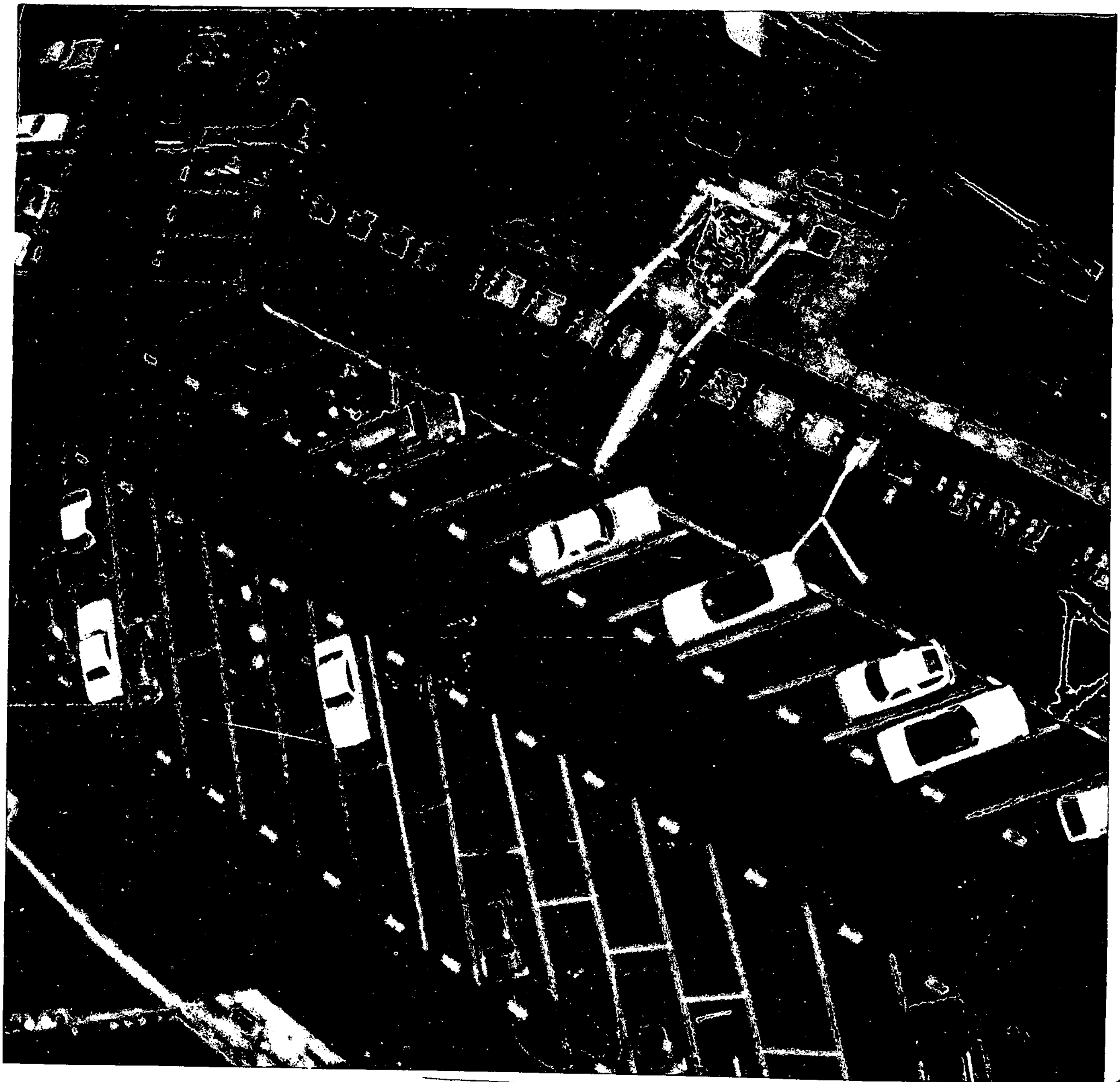

2445 Color of Museum Park

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FIGURE 10. Balloon Picture Using 3400 Film

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FIGURE 14. Mobile Home Complex on Andrews Air Force Base

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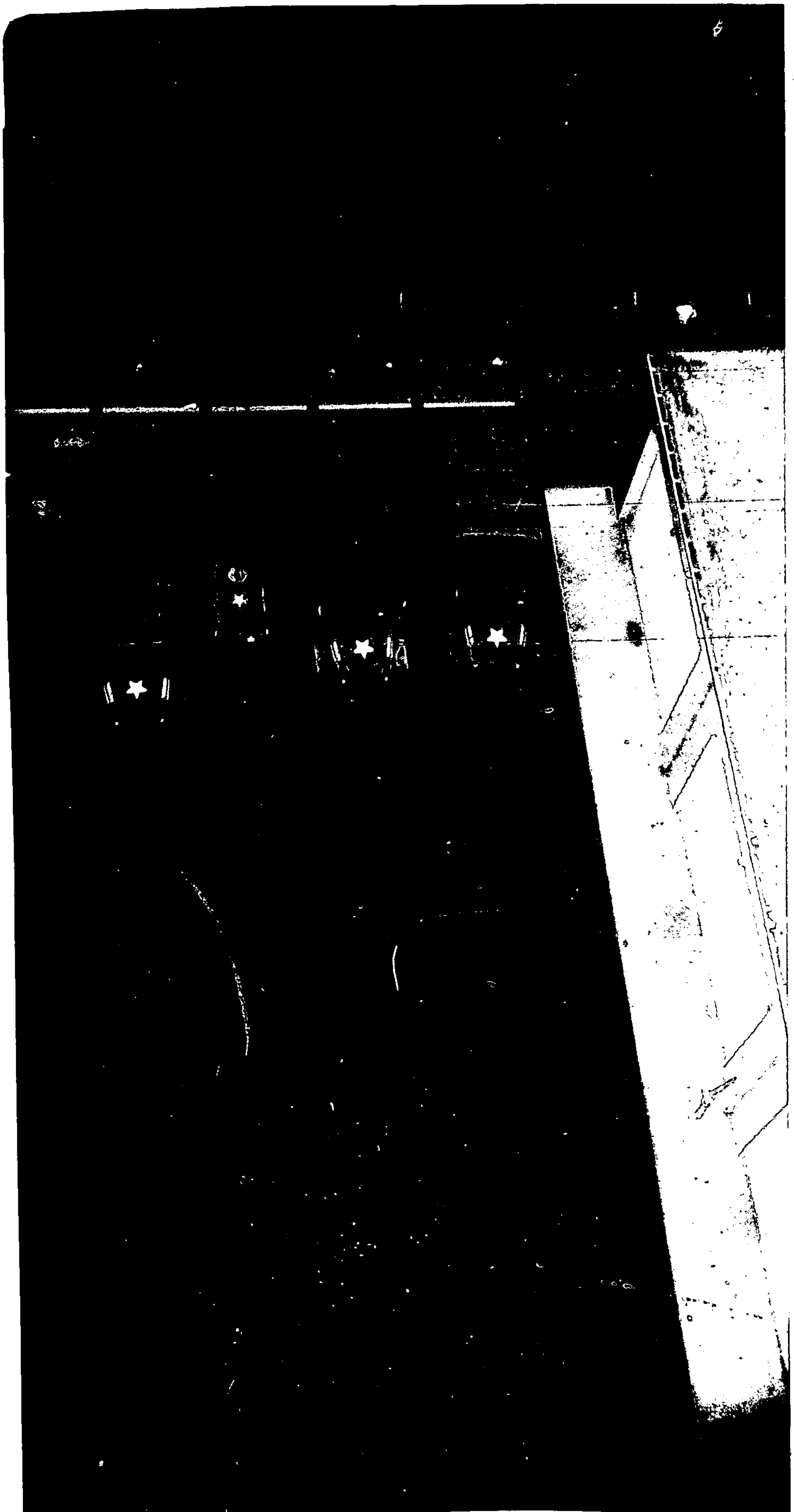

FIGURE 15. Military Trucks on Andrews Air Force Base

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FIGURE 16. Incinerator Plant on Andrews Air Force Base

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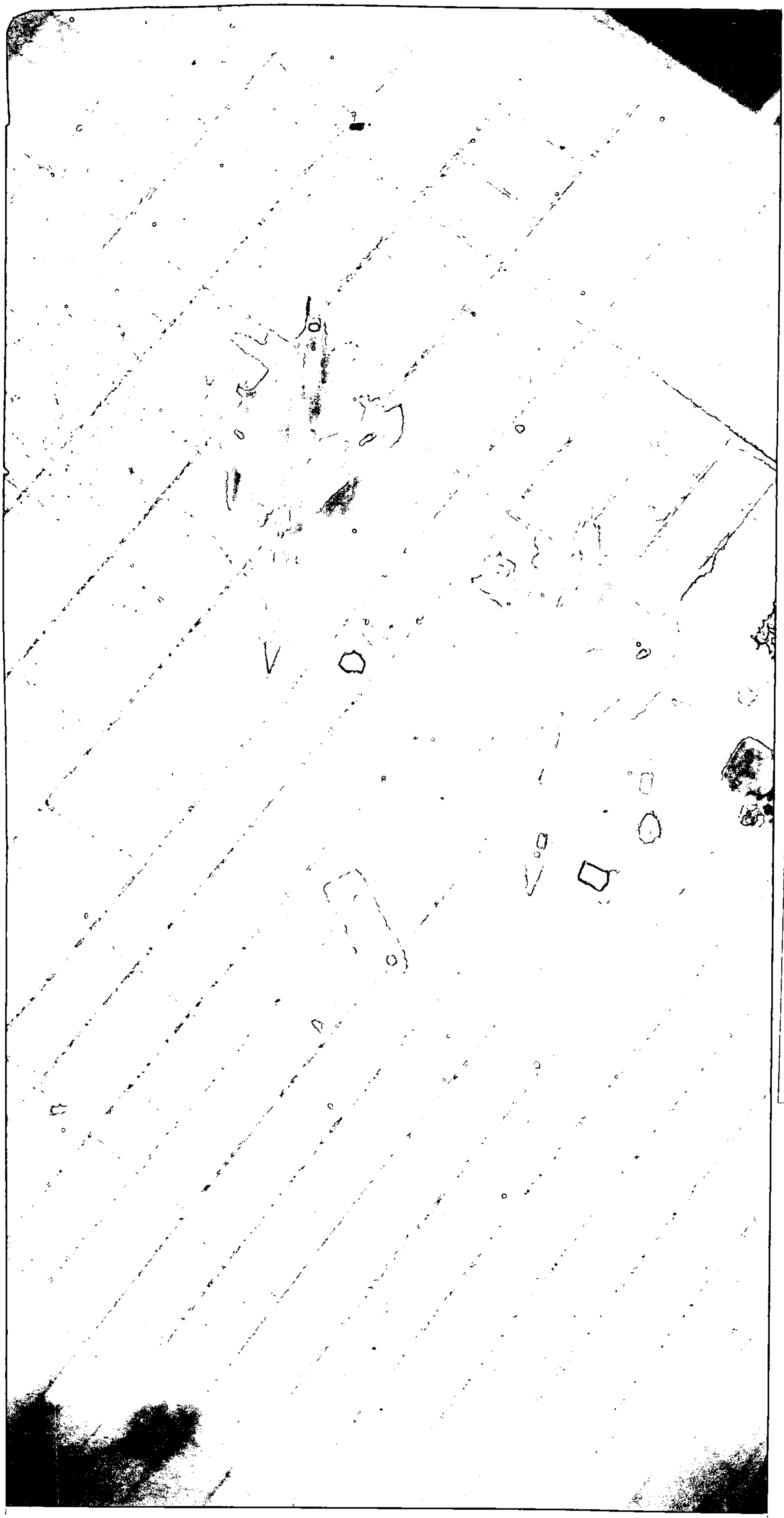

FIGURE 17. Military Aircraft on Andrews Air Force Base

FIGURE 20. Corner with People Walking to Work

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FIGURE 21. Alley Way

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FIGURE 22. Roof Top with Air-Conditioner

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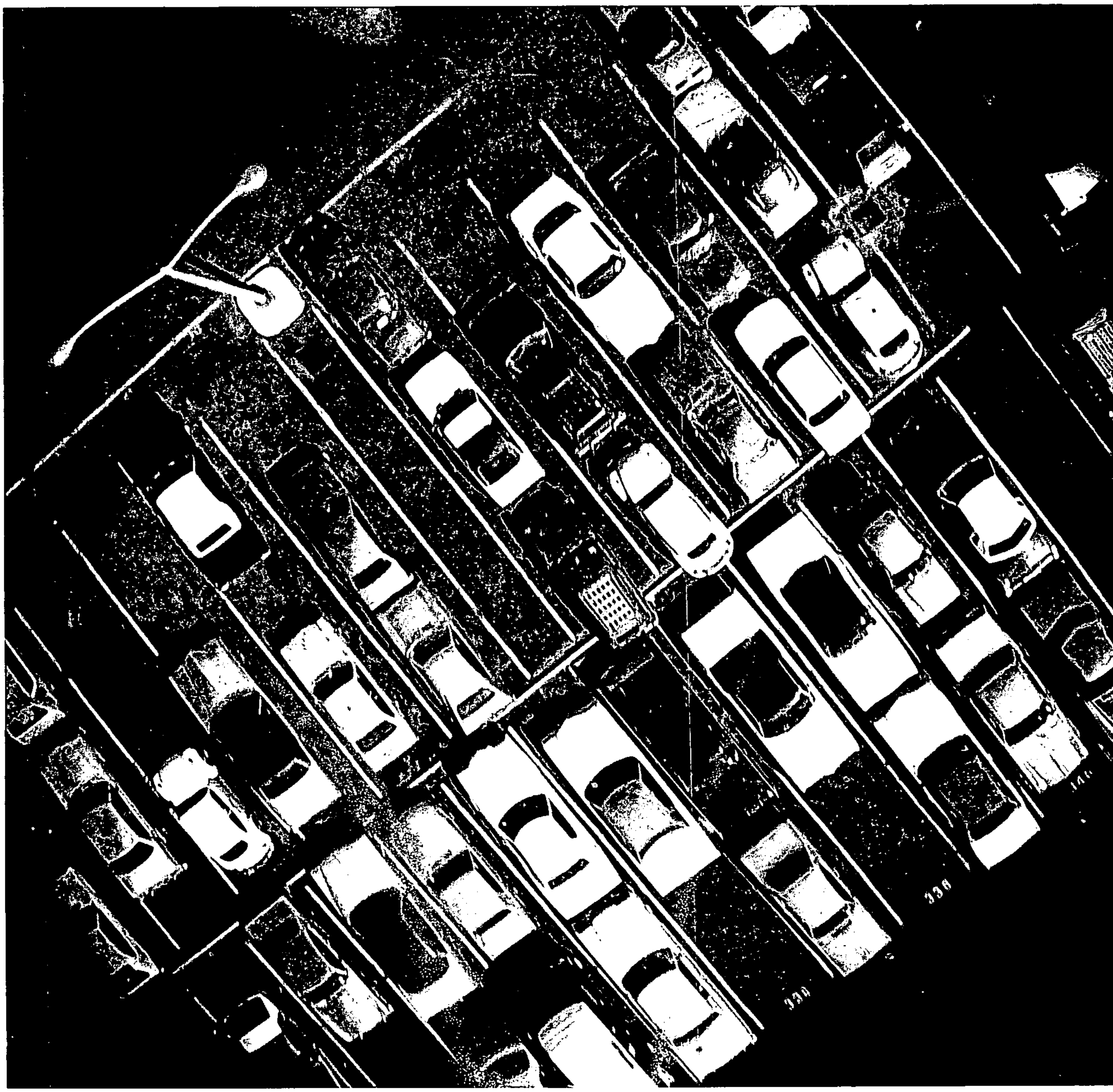

FIGURE 23. Parking Lot

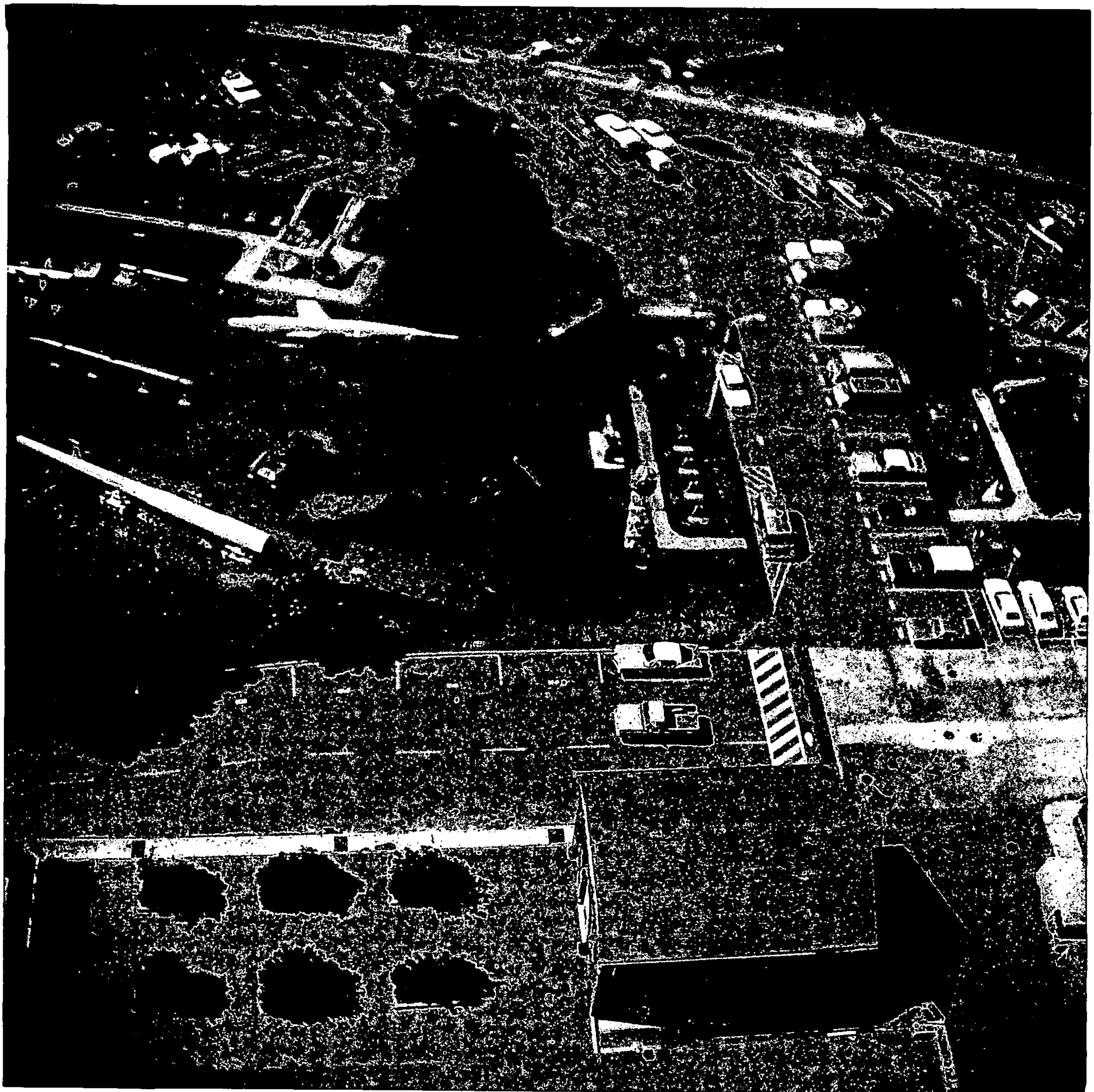

FIGURE 24. Oblique Shot of Museum Park

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FIGURE 25. Navy Yard Main Gate

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FIGURE 26. Old Naval Gun Factory

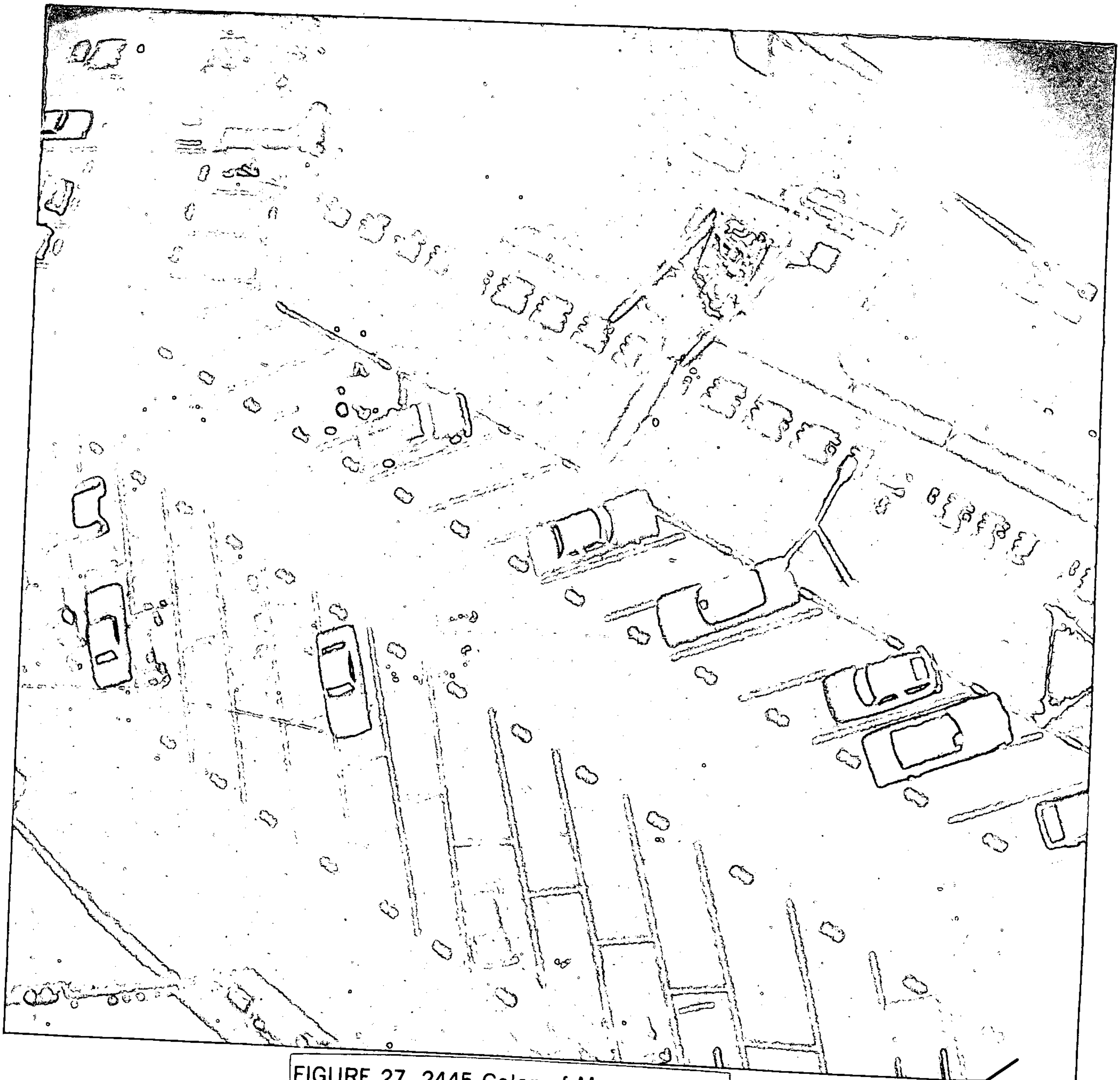

FIGURE 27. 2445 Color of Museum Park

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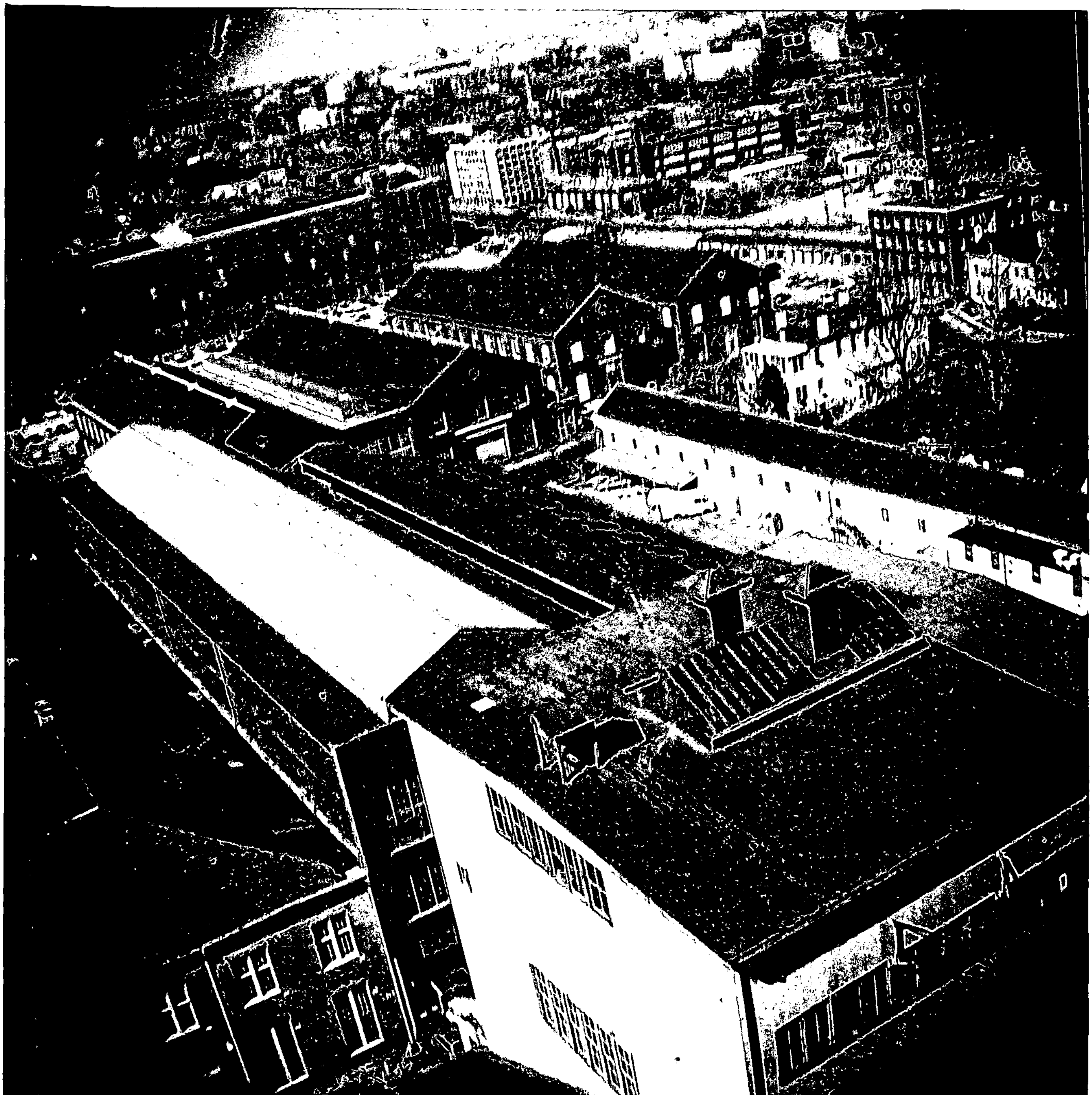

FIGURE 28. Oblique Photograph Over the Navy Yard

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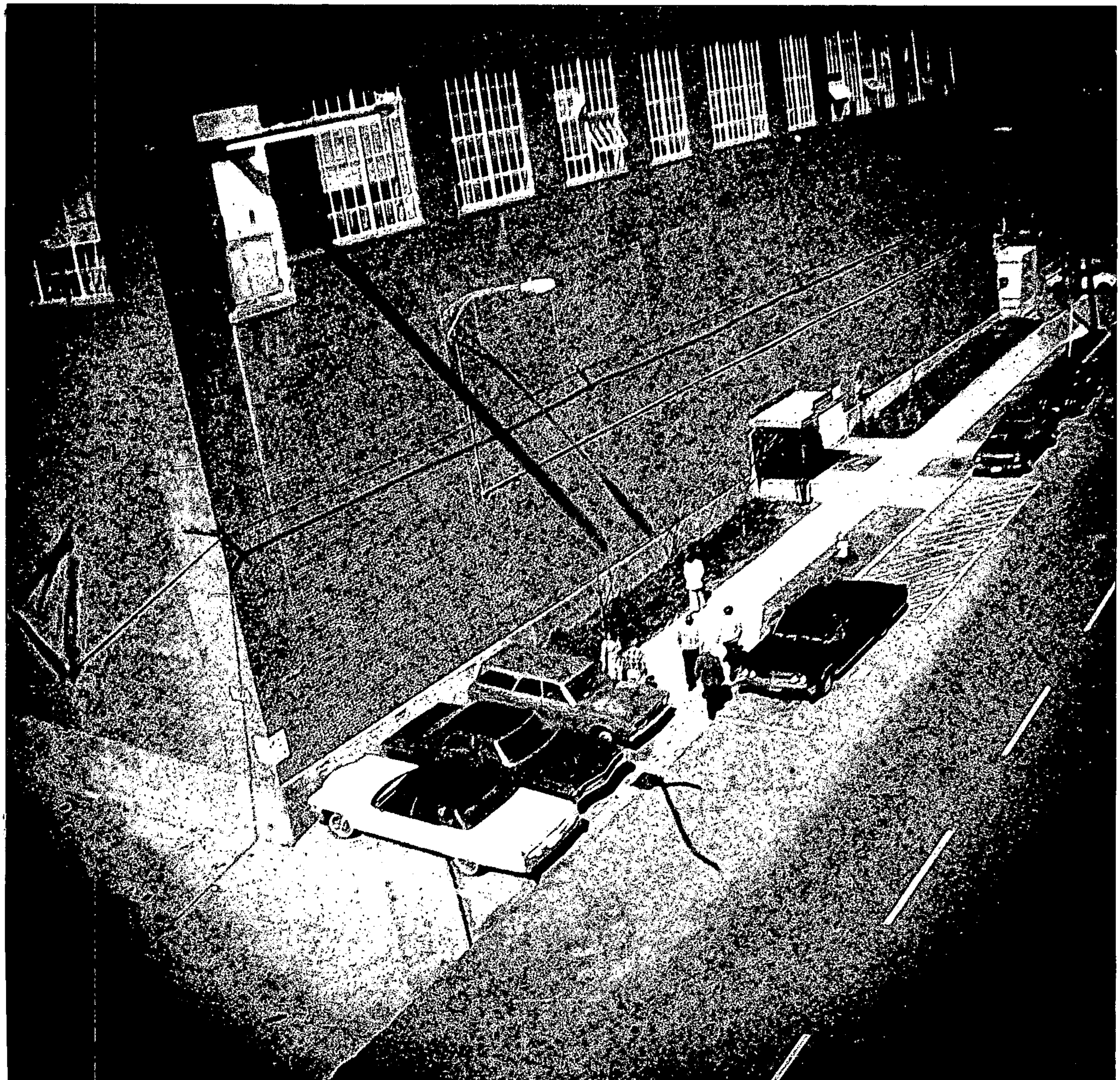

FIGURE A10. Washington Navy Yard—3/17/77
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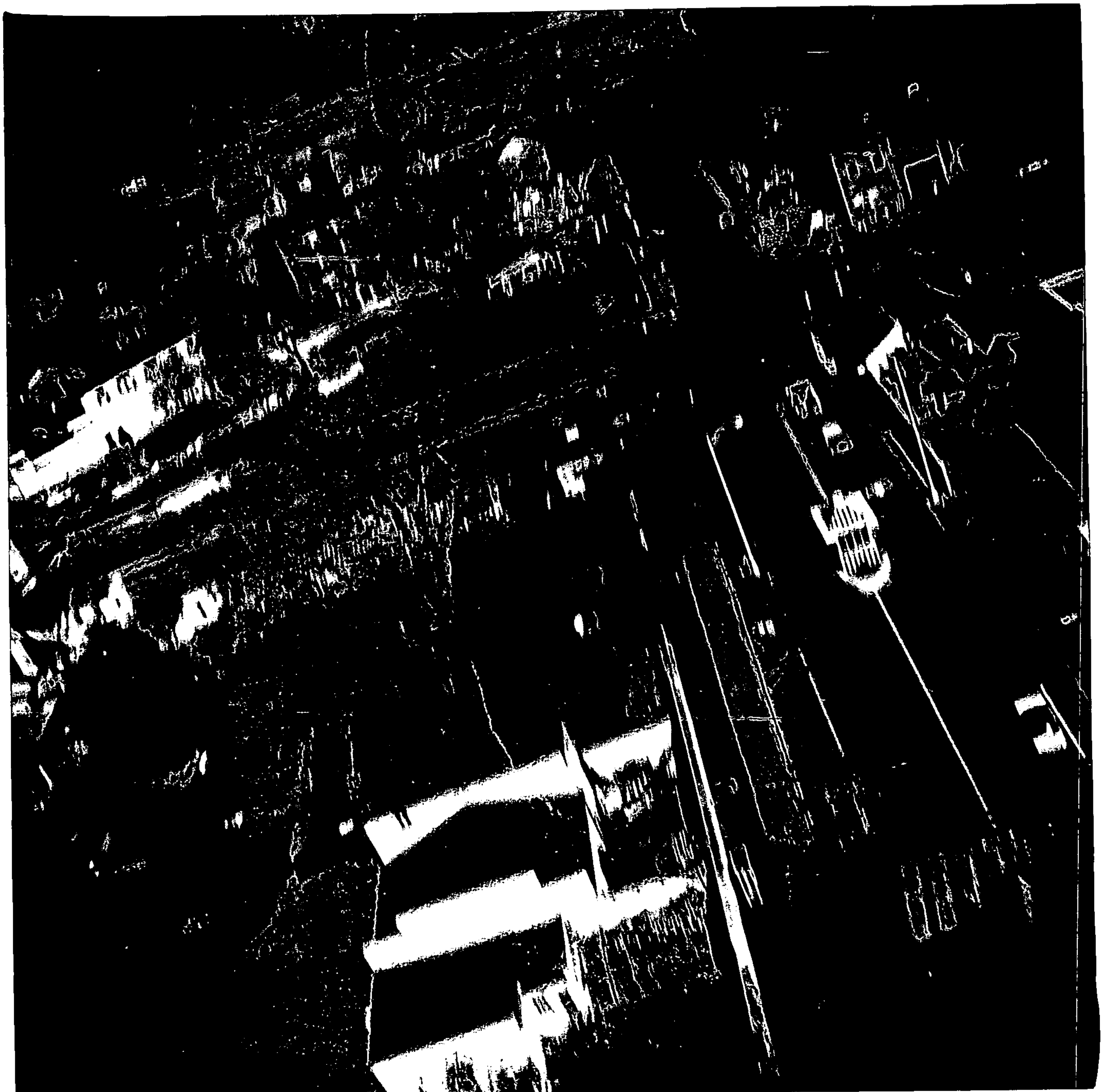

FIGURE A11. Washington Navy Yard—3/17/77
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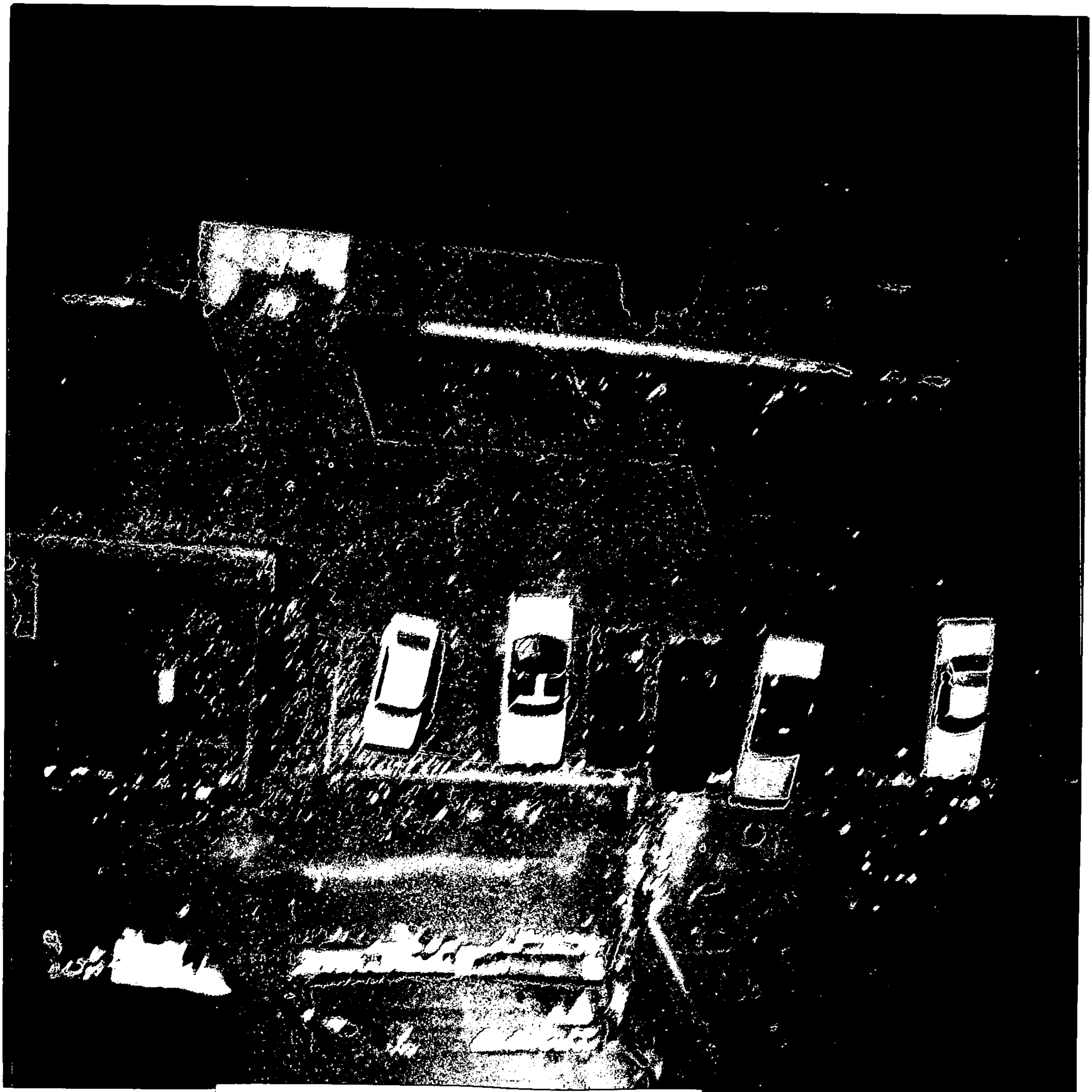

FIGURE A12. Washington Navy Yard—3/17/77
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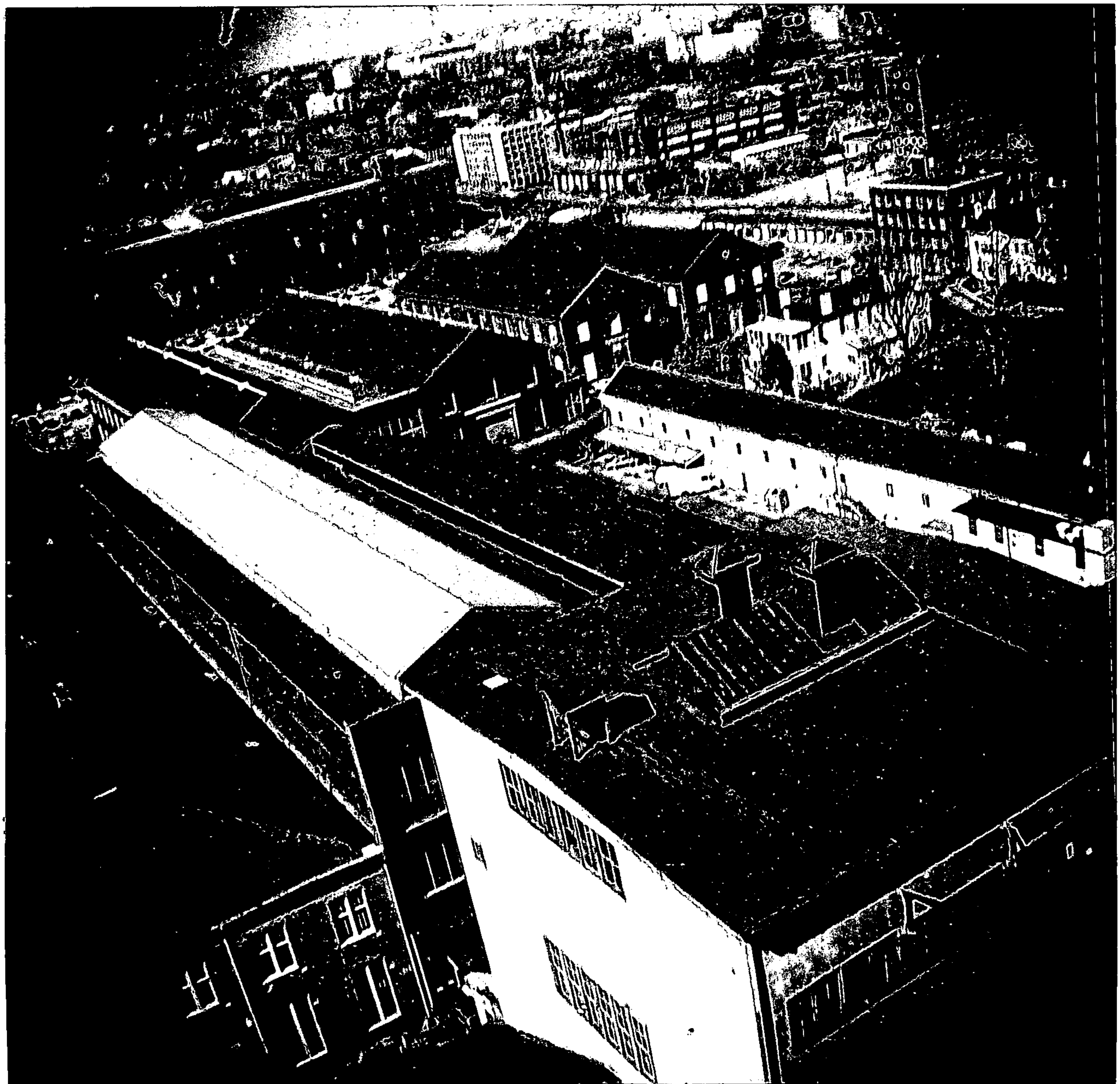

FIGURE A13. Washington Navy Yard—3/17/77
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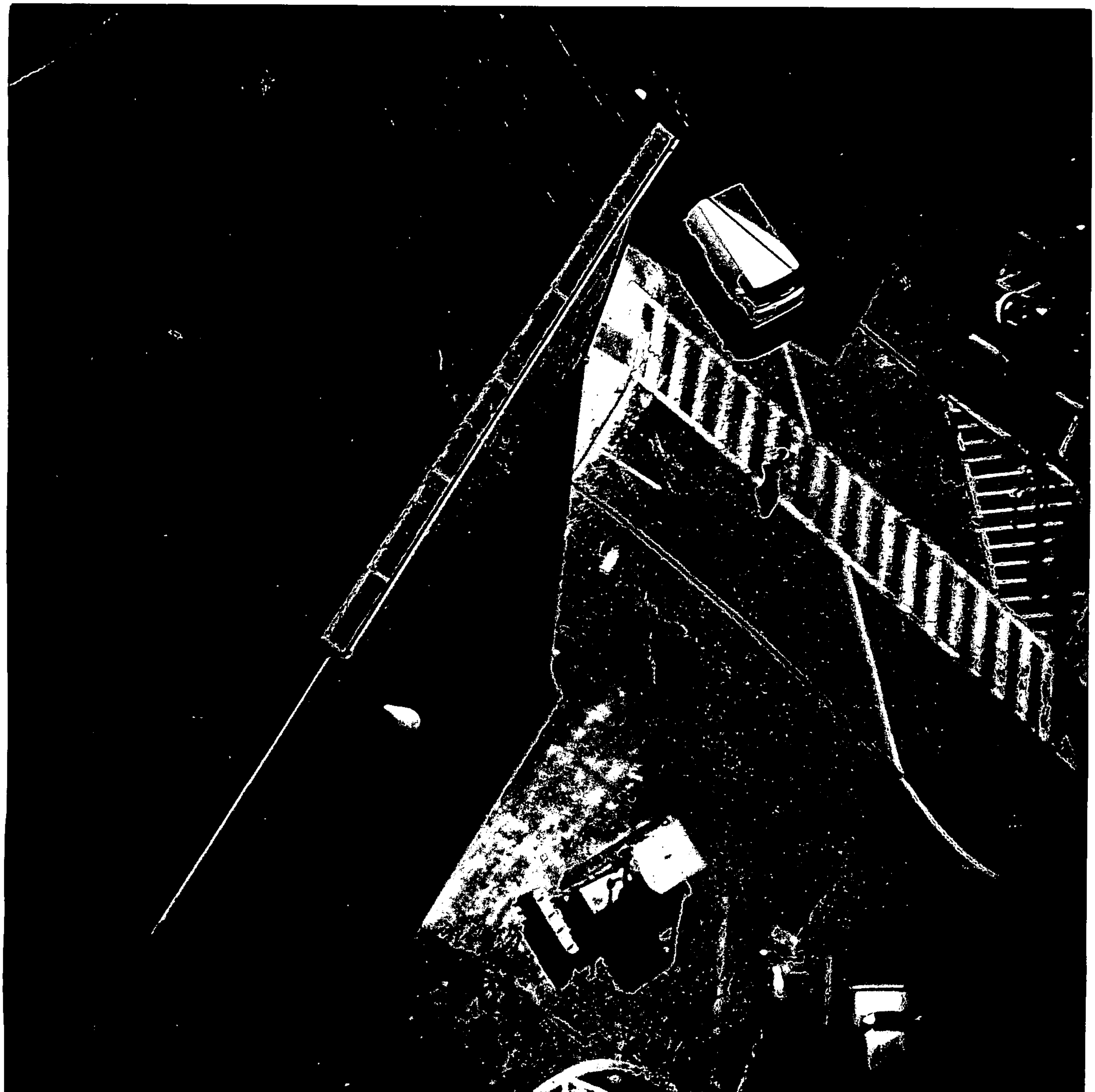

FIGURE A14. Washington Navy Yard—3/17/77
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FIGURE A15. Washington Navy Yard—3/17/77
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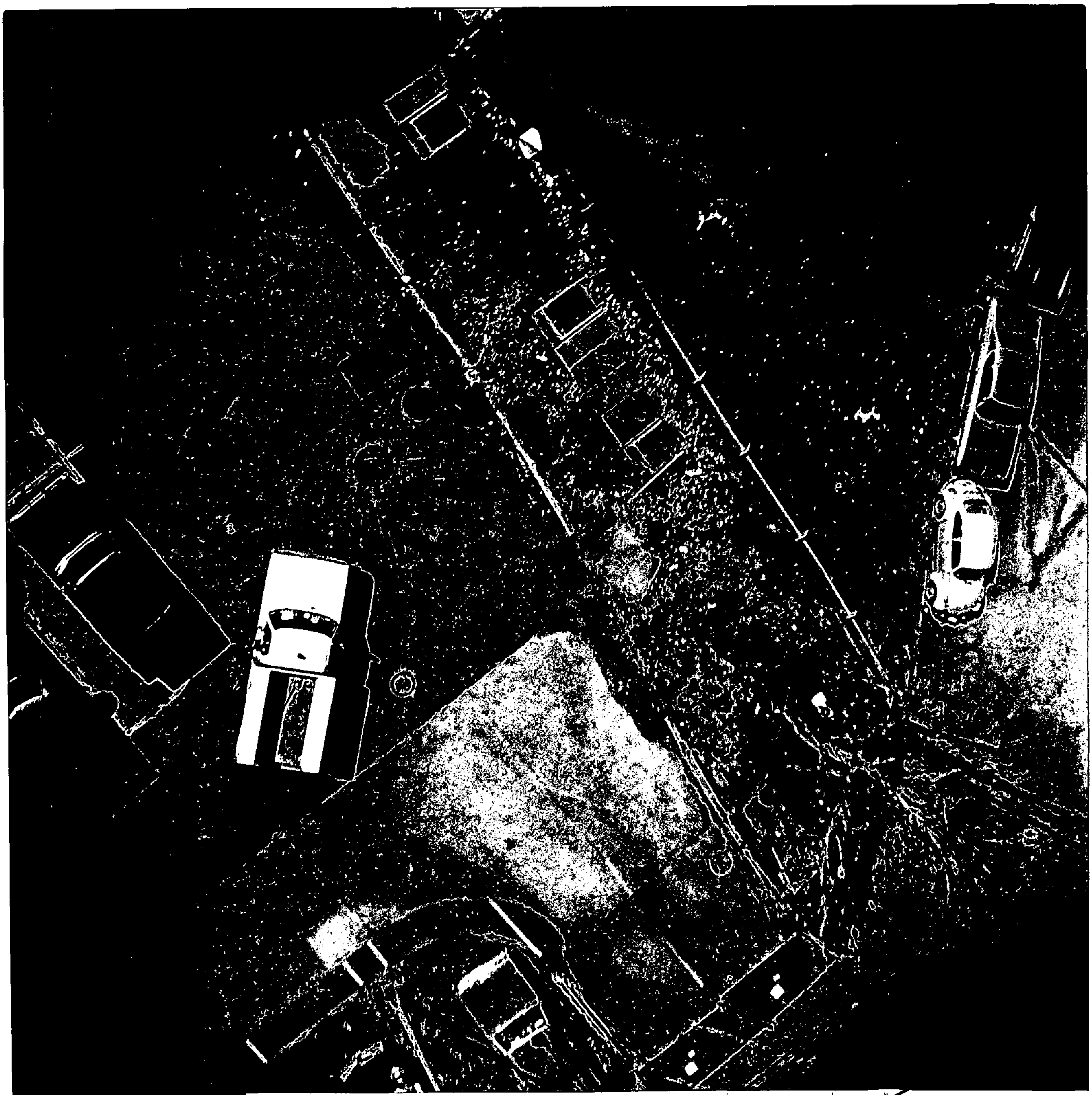

FIGURE A16. Washington Navy Yard—3/17/77
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FIGURE A17. Washington Navy Yard—3/17/77
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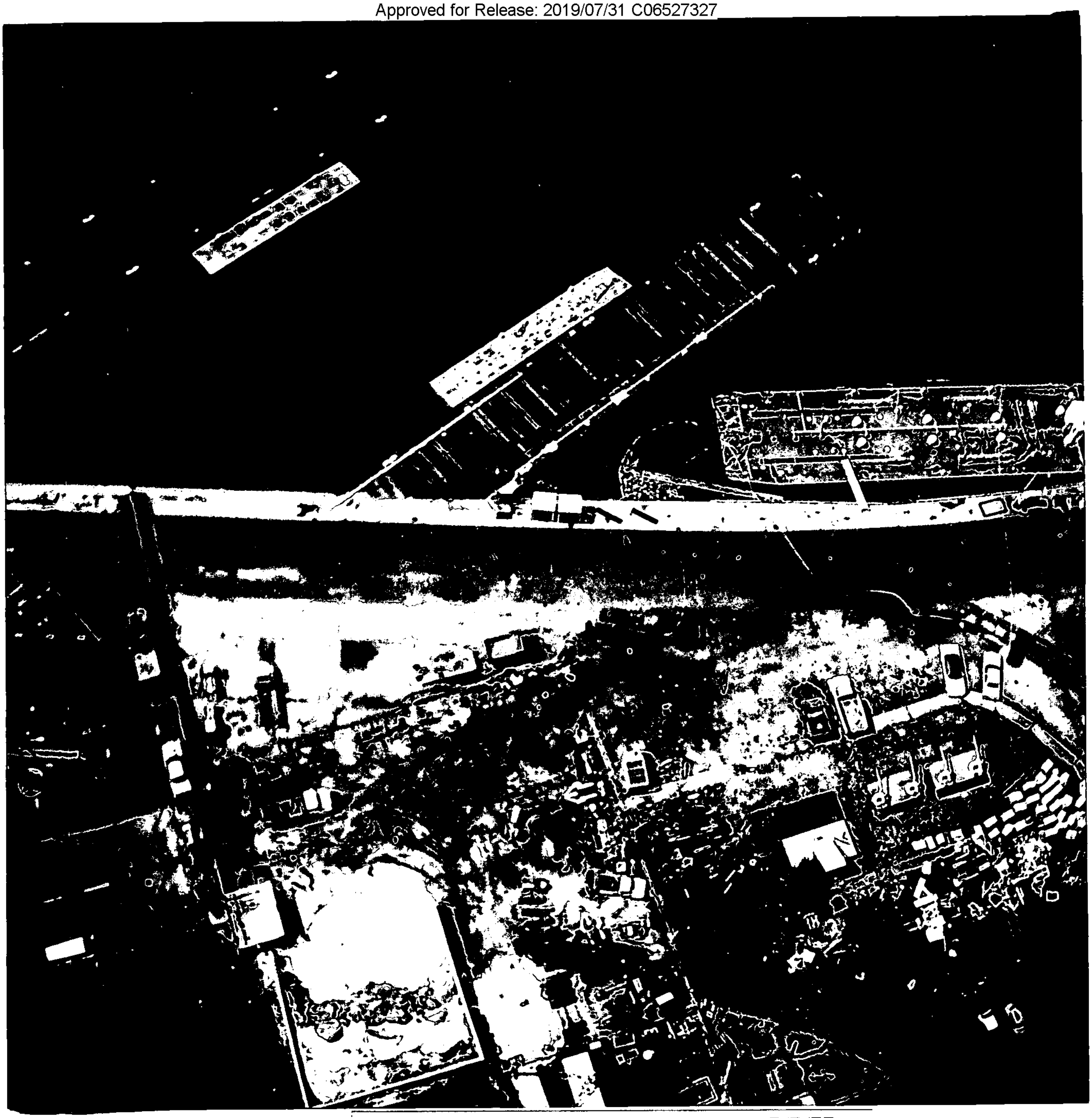

FIGURE A18. Washington Navy Yard—7/7/77
Maximum Observed Flying Height
300 Ft. (91 M.)

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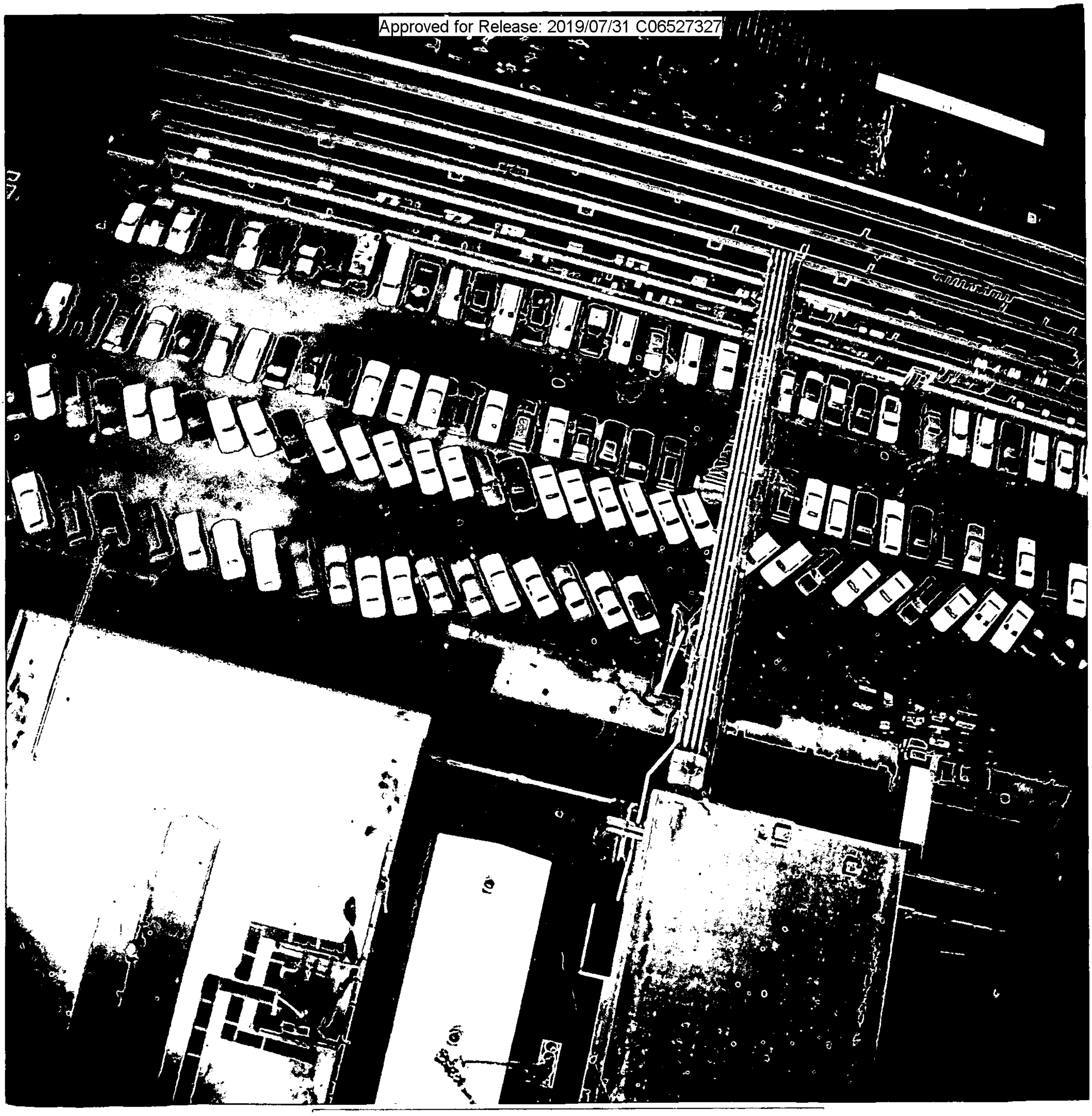

FIGURE A19. Washington Navy Yard—7/7/77
Maximum Observed Flying Height
300 Ft. (91 M.)

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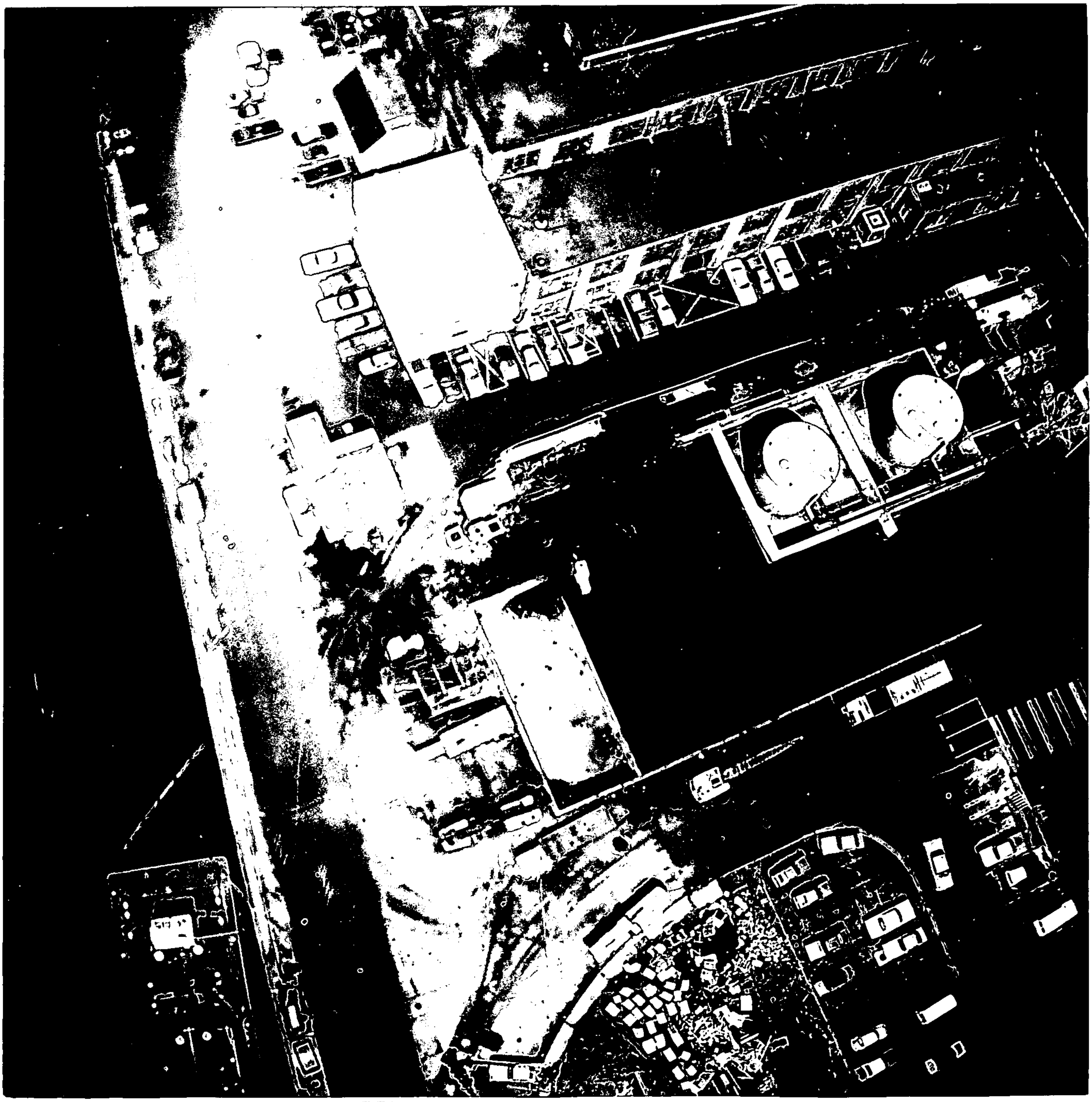

FIGURE A20. Washington Navy Yard—7/7/77
Maximum Observed Flying Height
300 Ft. (91 M.)

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FIGURE A21. Washington Navy Yard—7/7/77
Adjacent Frames (with Figure A22)
Showing the Effect of Platform
Dynamics on Image Quality

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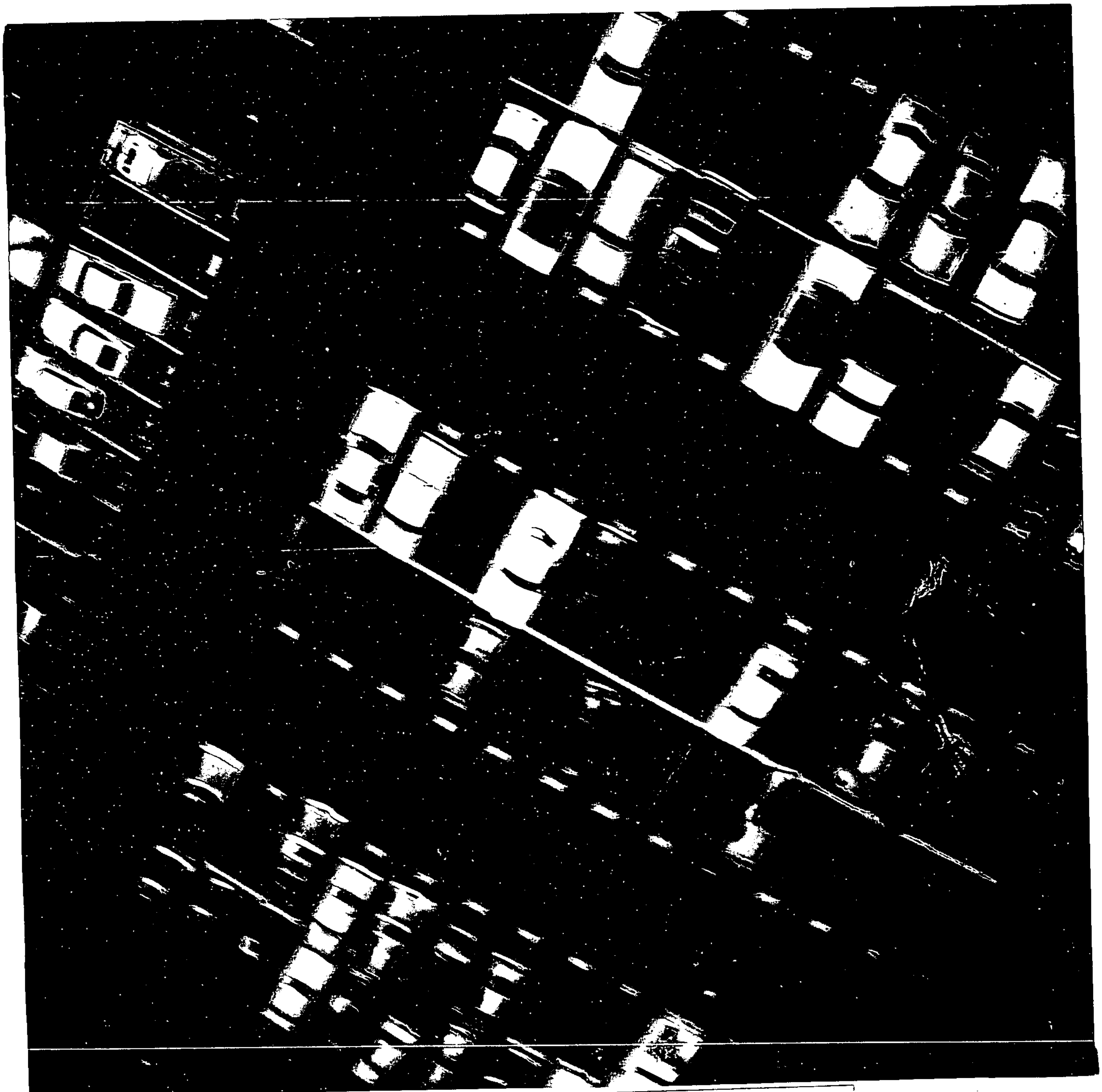

FIGURE A22. Washington Navy Yard—7/7/77
Adjacent Frames (with Figure A21)
Showing the Effect of Platform
Dynamics on Image Quality

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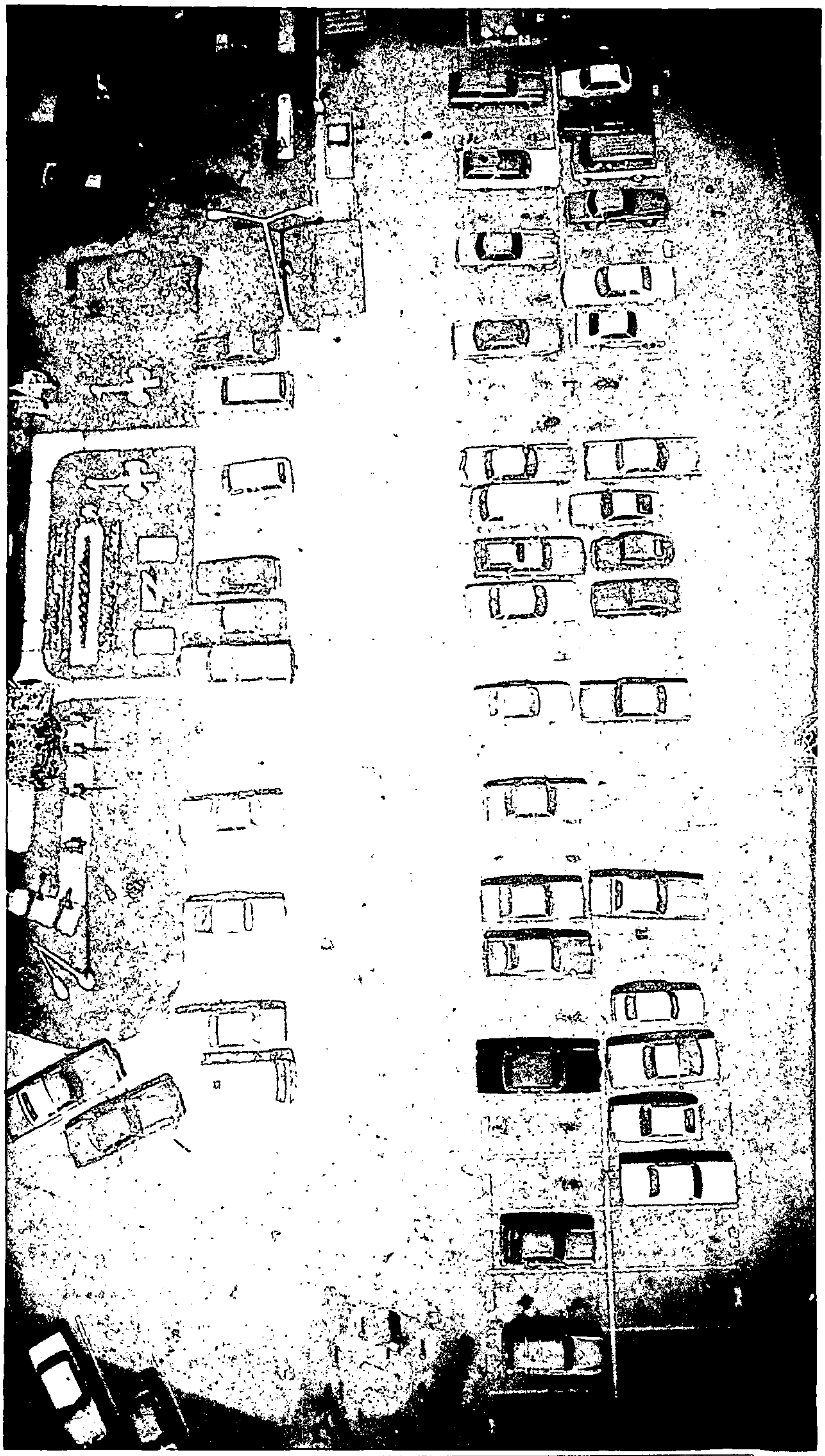

FIGURE A23. Successive Frame Coverage of the Navy Yard Target Display Area (Figure Series A23-A27)

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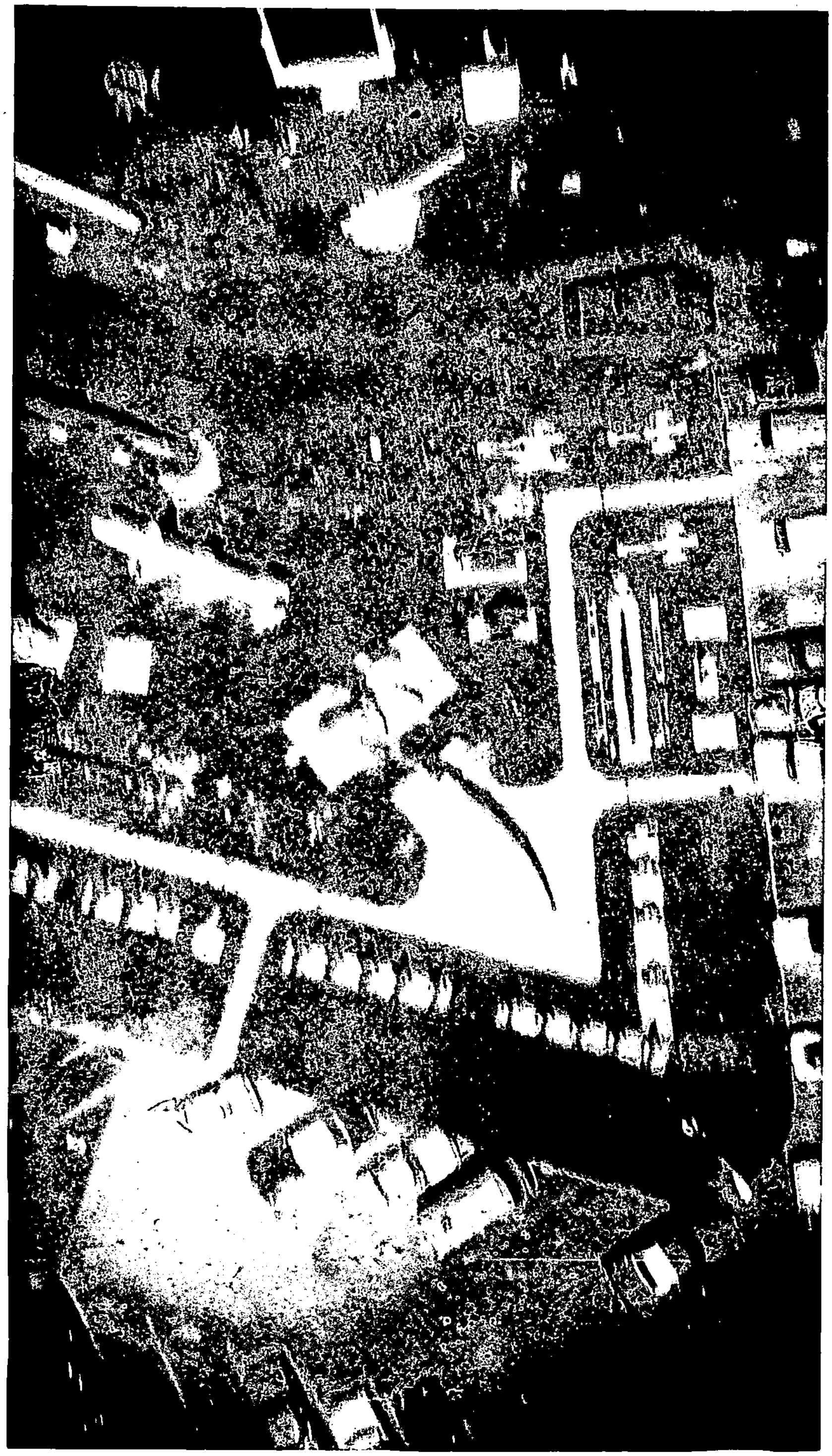

FIGURE A24. Successive Frame Coverage of the Navy Yard Target Display Area (Figure Series A23-A27)

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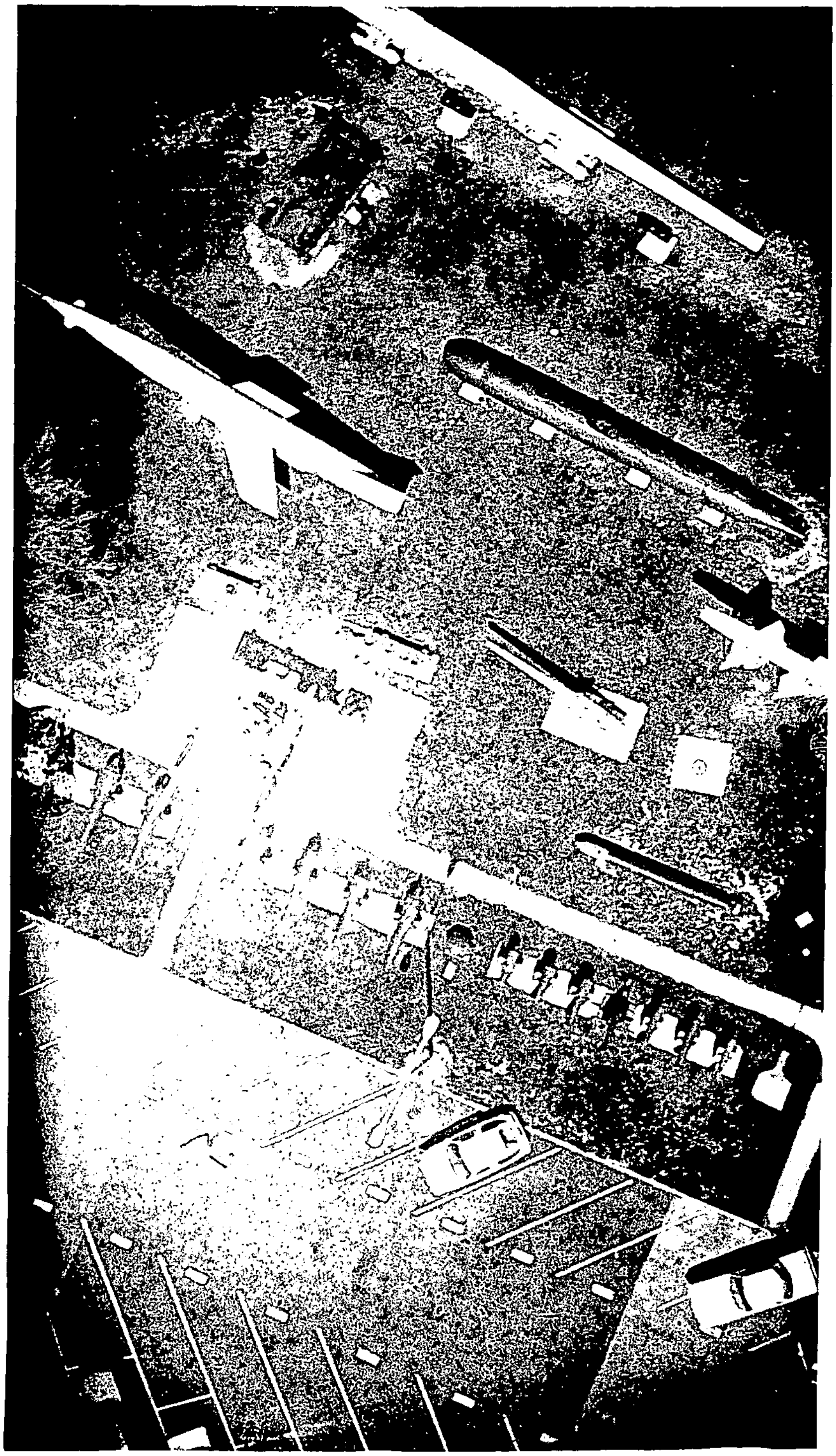

FIGURE A25. Successive Frame Coverage of the
Navy Yard Target Display Area
(Figure Series A23-A27)

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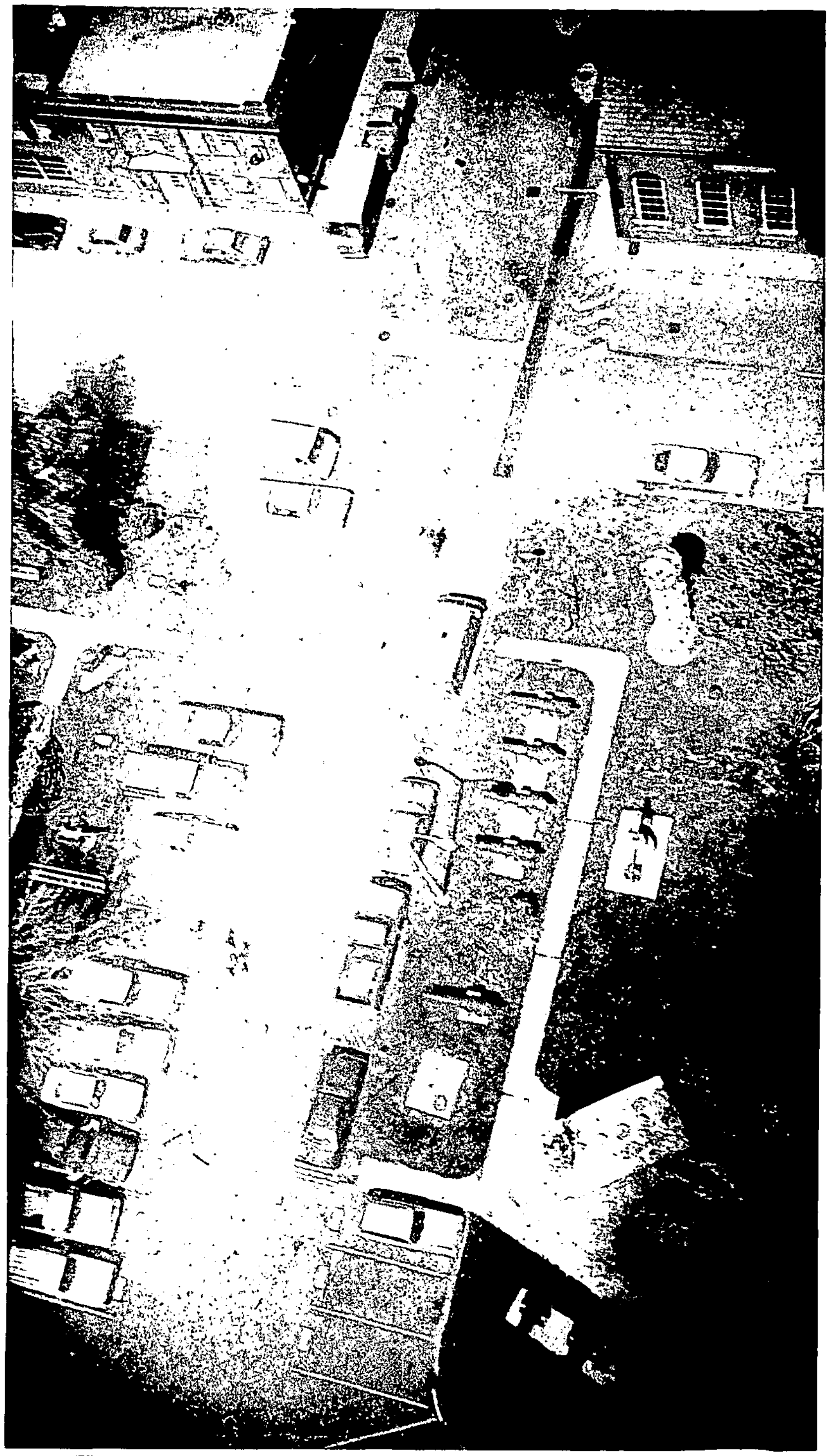

FIGURE A26. Successive Frame Coverage of the Navy Yard Target Display Area (Figure Series A23-A27)

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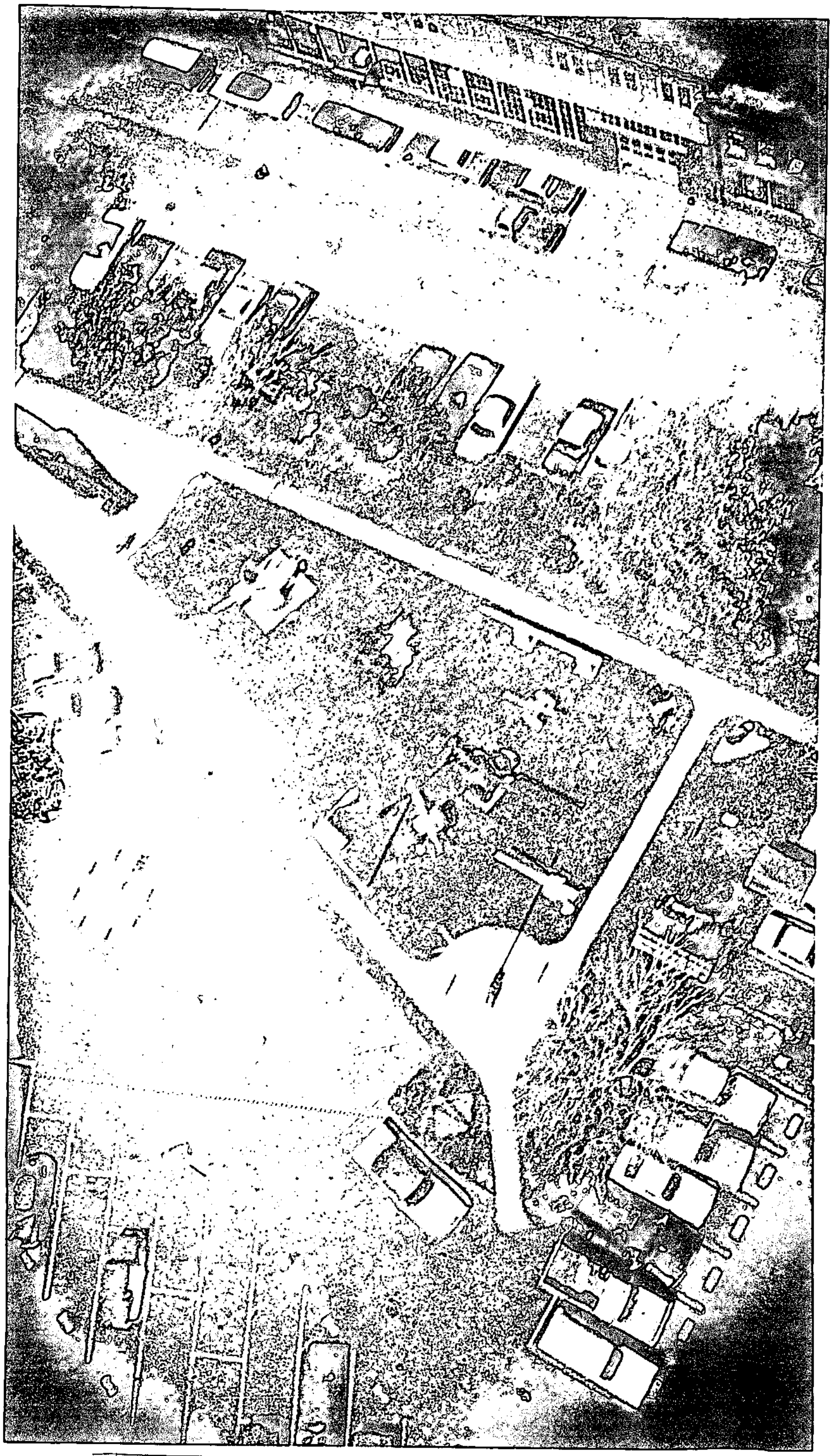

FIGURE A27. Successive Frame Coverage of the
Navy Yard Target Display Area
(Figure Series A23-A27)

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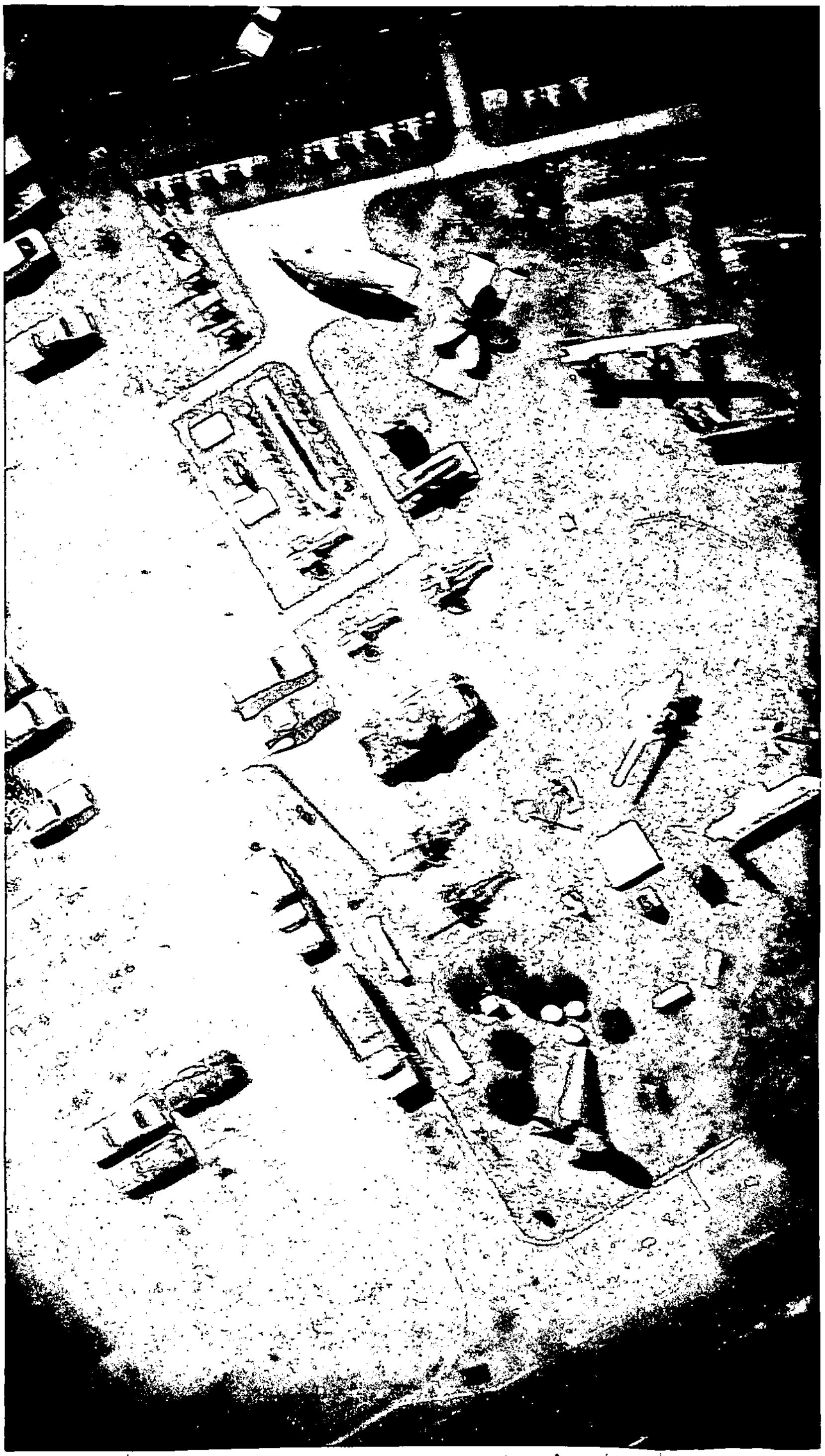

FIGURE A28. Navy Yard Display Area
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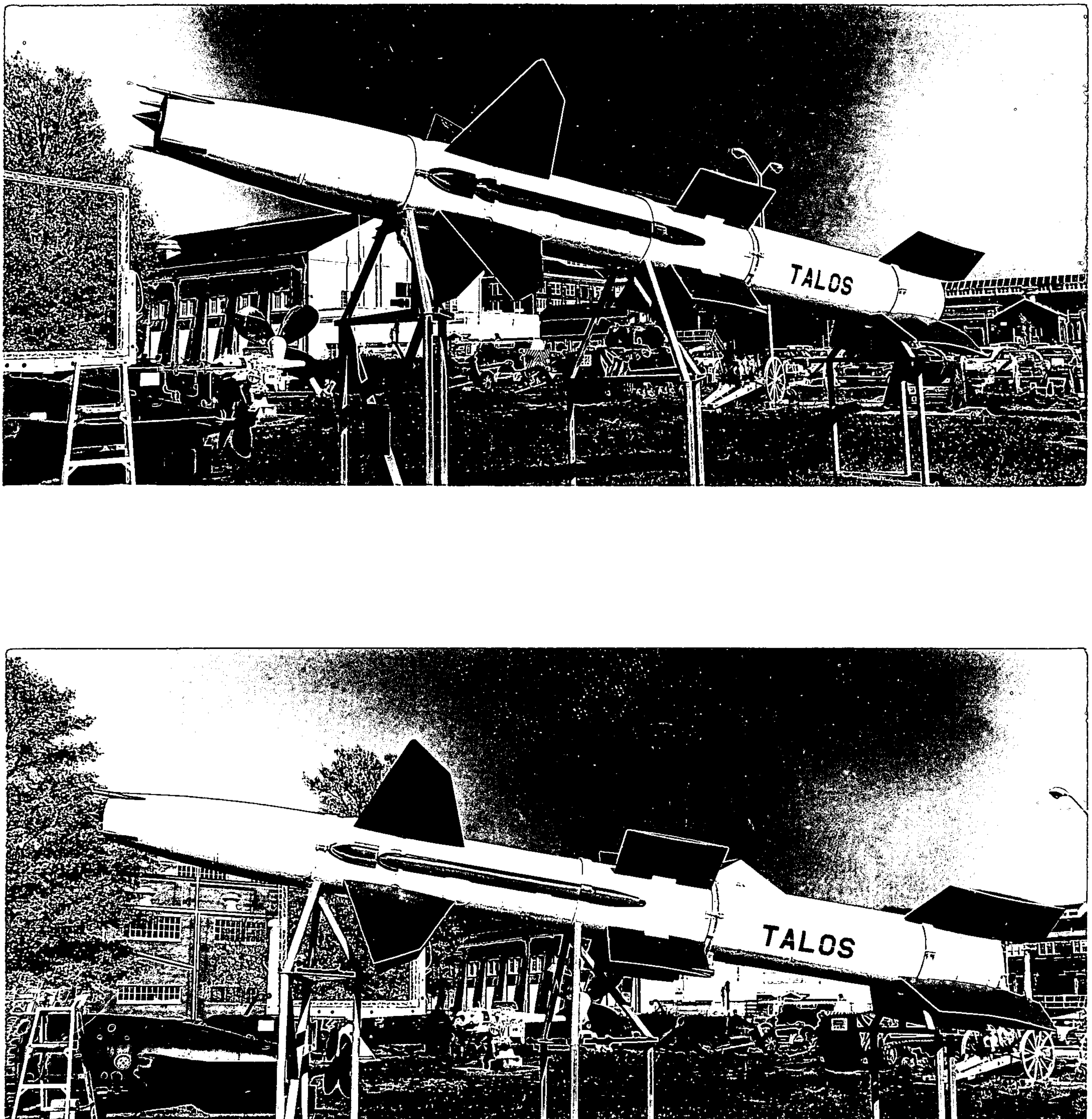

FIGURE A29. Ground Views of Talos Missile at the Washington Navy Yard

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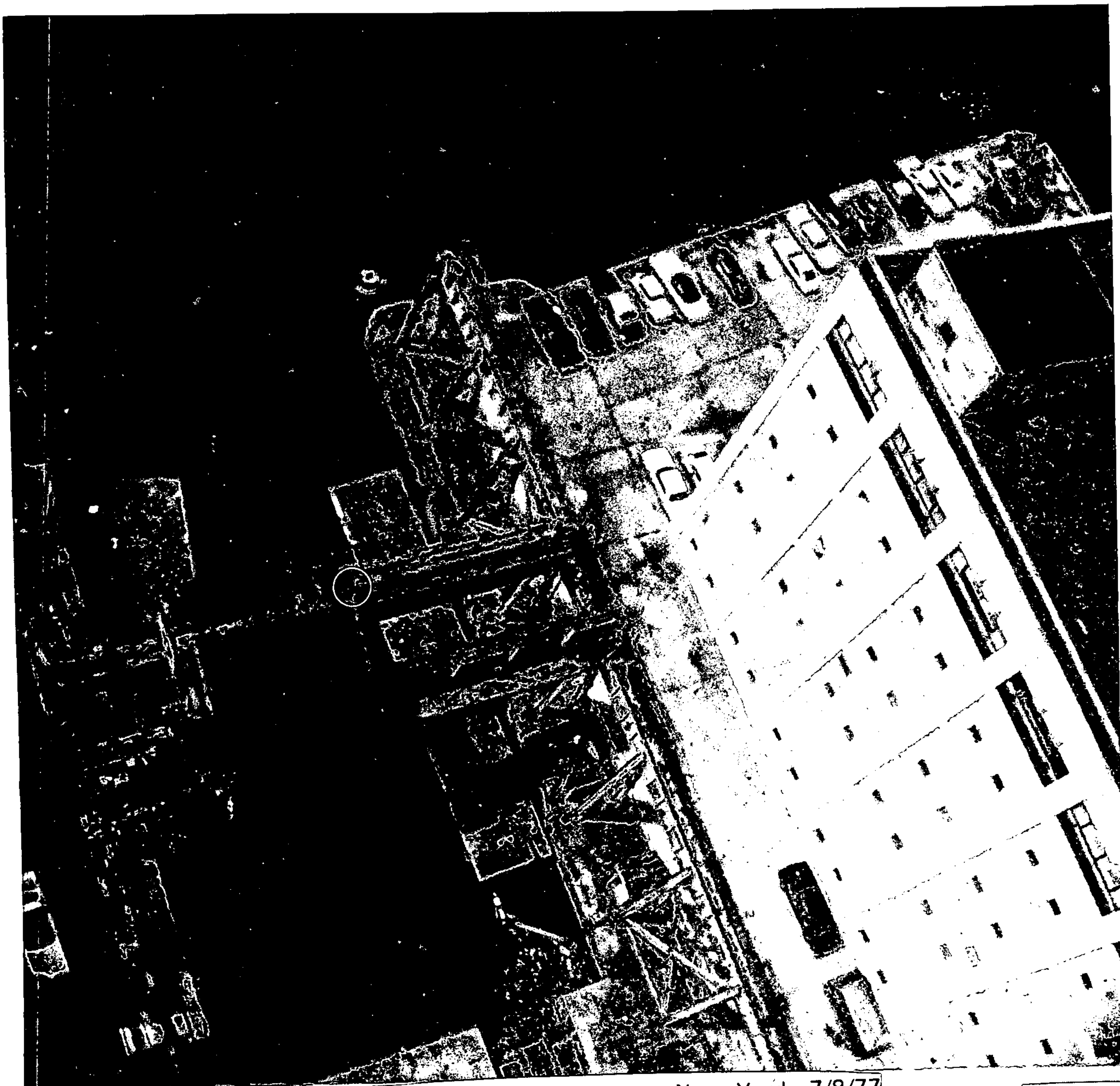

FIGURE A31. The Washington Navy Yard—7/8/77

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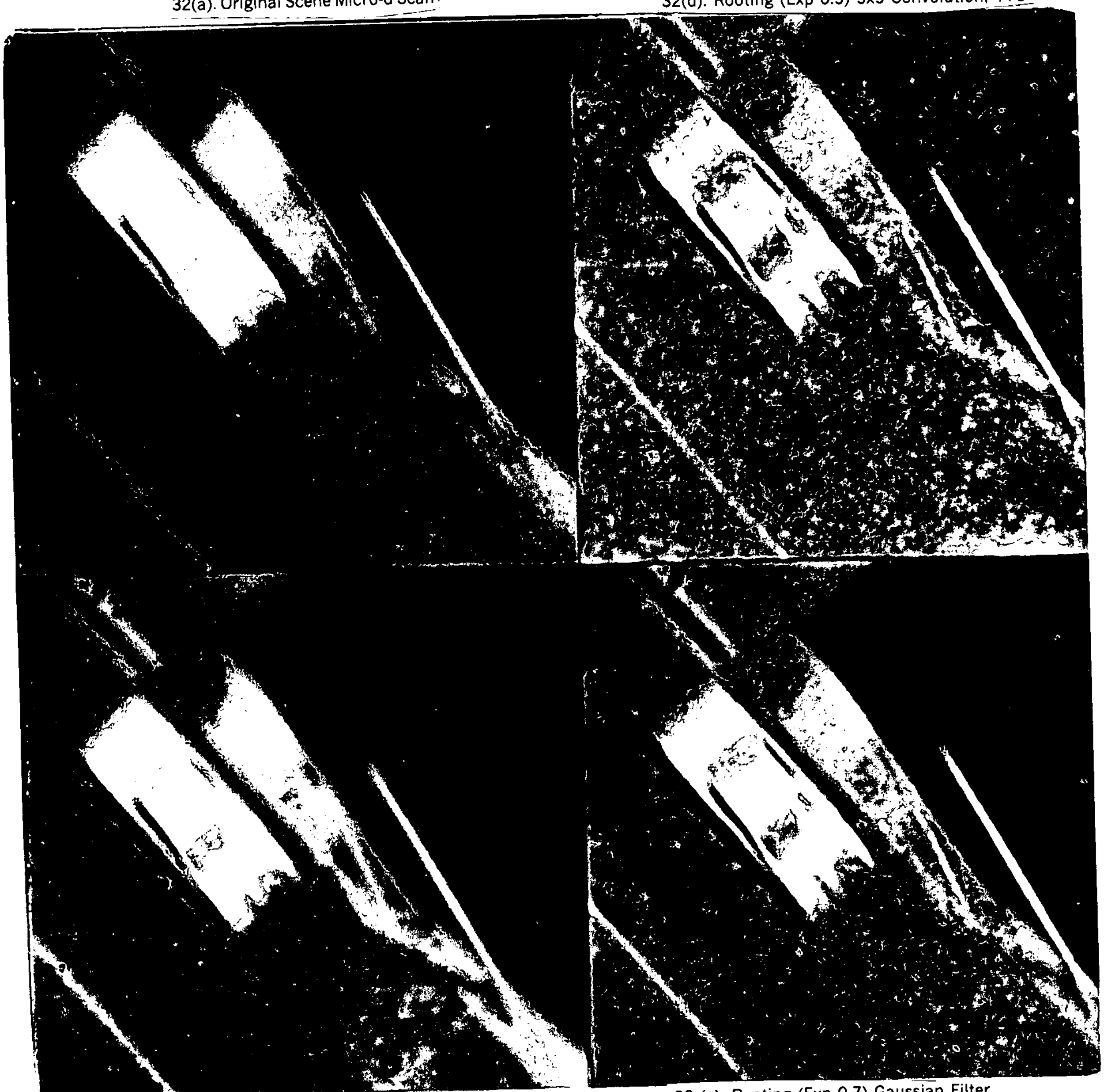
32(a). Original Scene Micro-d Scan

32(d). Rooting (Exp 0.5) 5x5 Convolution, TTC



32(b). Rooting (Exp 0.7) Gaussian Filter

32 (c). Rooting (Exp 0.7) Gaussian Filter Edge Enhancement

FIGURE A32. IDIMS Effect on Smeared Imagery

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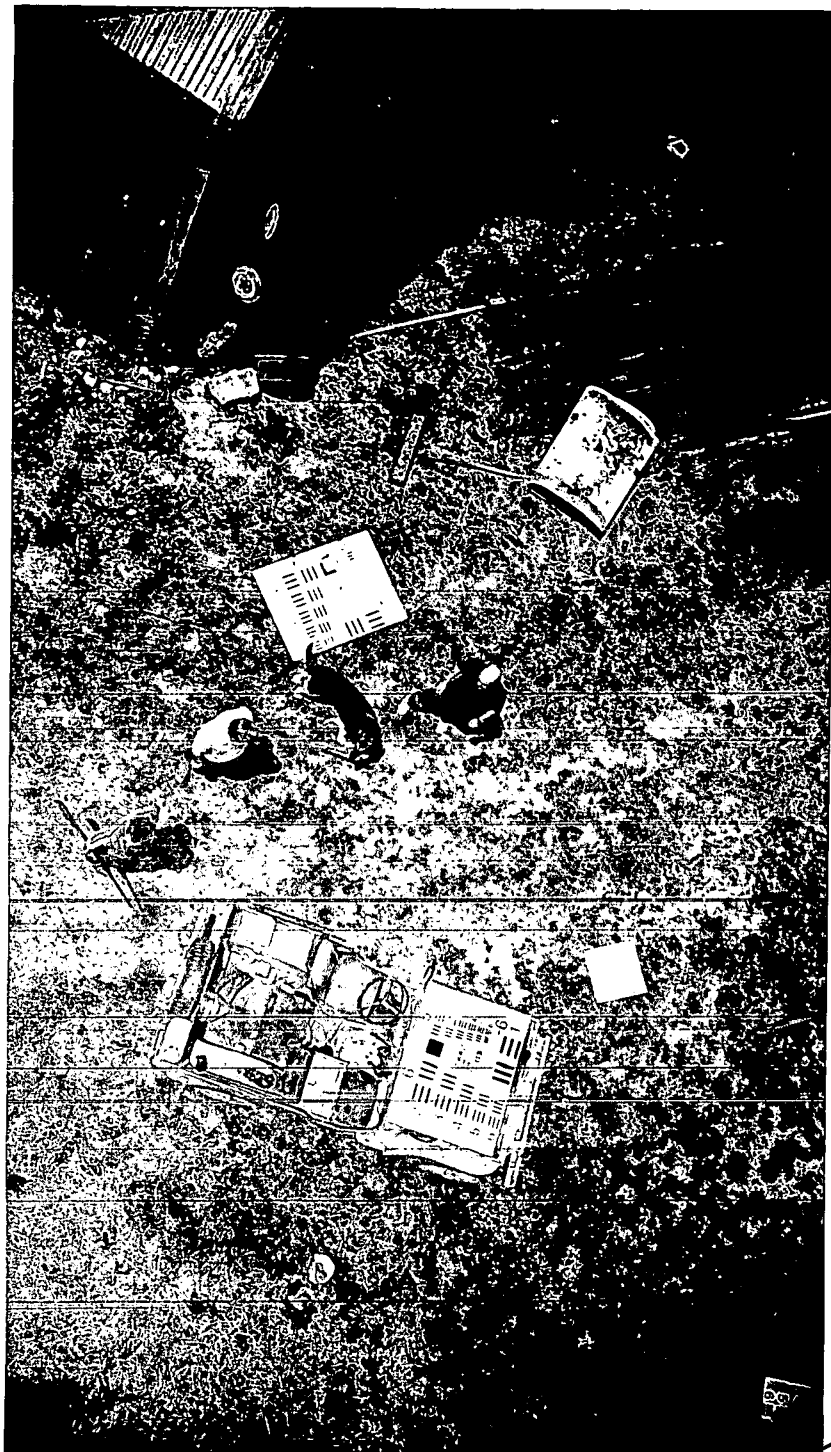

FIGURE A33. Camera/Film Analysis Test Imagery
(From the Balloon Platform)

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ADM-6.1

DD/S&T 3543-64

4 ~~DEC~~ Jan 1965

MEMORANDUM FOR: Director of Logistics

SUBJECT: Follow-on of Project OXYGAS (Dolphins) with [redacted]

1. The Office of Research and Development requests that funds in the amount of $80,000 be transferred to the Office of Naval Research in order that follow-on contract negotiations can be initiated by Navy on Project OXYGAS. Dr. Sidney Galler, Office of Naval Research, is the cognizant Naval official on this project. The use of the [redacted] for the initial contract with [redacted] has proven to be a very effective system.

2. There are no recommended changes in previous security and sterility code arrangements. [redacted] Extension 5155, will continue as Project Officer on this contract and will monitor its execution.

[redacted]

ALBERT D. WHEELON
Deputy Director
for
Science and Technology

Attachments:
Proposal #113064-1d, ORD 2671-64
Requisition ORD 851-65

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LS/ORD/DD/S&T [redacted] 7822 (22 December 1964)

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670
[5055]

EYES ONLY

21 April 1961

MEMORANDUM FOR: DEPUTY DIRECTOR (PLANS)

VIA G: [redacted] A

SUBJECT : "Guided Animal" Studies

REFERENCE : Article entitled [redacted] on page [redacted] of [redacted] Issue of [redacted] (Attached) I

1. This memorandum is for information only, and no action is required. It is forwarded in view of your interest in the program concerned.

2. The article in [redacted] is factually reliable and presents a reasonable picture of some aspects of the field of electrical brain stimulation from the layman's point of view. While the technical aspects of the article are reasonably correct, I must say that I cannot agree with some of the ethical considerations outlined by the author beginning in the right column of page [redacted] I

3. The part played by the Research Branch of TSD under Dr. [redacted] A
A [redacted] in this "scenario" involves both the long-range fundamental
C studies of Drs. [redacted] etc. and the practical studies on [redacted] I
B The latter, of course, is the [redacted] with whose program you are familiar.

4. After our original experiments at the [redacted] had B demonstrated the practical feasibility of electrical brain stimulation as a guidance technique, we transferred the men who were responsible for initiating the program to [redacted], since the B
B [redacted] and the [redacted] did not feel that these studies fitted into their programs. Further development of the technique has taken
B place at [redacted] where we now have a "production" capability.

 [redacted]

5. At the present time we feel that we are close to having debugged a prototype system whereby dogs can be guided along specified courses through land areas out of sight and at some distance from the operator, the purpose being to [redacted] I

6. In addition to its possible practical value in operations, this phenomenon is a very useful research tool in the area of the behavioral sciences. Dr. [redacted] is taking appropriate action to exploit our knowledge of this area and provide adequate background for the development of future Agency applications in the general areas of Influencing Human Behavior, Indirect Assessment and Interrogation Aids.

A

A [redacted]
Chief, DD/P/TSD

Attachment: (1)
[redacted] Issue of [redacted] I

[redacted]

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CENTRAL INTELLIGENCE AGENCY

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Remarks:

A I am so sure (in the absence of hard information) that [redacted] would like your comments on this that I take the liberty of forwarding it to you before showing it to him. If, in fact, you have discussed this subject sufficiently with him that he knows your views well, please just send it back.

A [redacted]

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FORM NO. 237 Replaces Form 30-4 which may be used.
1 APR 55

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CENTRAL INTELLIGENCE AGENCY

OFFICIAL ROUTING SLIP

TO	NAME AND ADDRESS	INITIALS	DATE
1	Mr. [redacted] A		
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Remarks:

Dear [redacted] A

A [redacted] has been extensively briefed on this subject, most recently by me and also earlier by Mr. [redacted] and Dr. [redacted]. Although the article adds a little to what he already knows, I would send it along for his general interest with no comments.

A

[redacted]

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FORM NO. 237 Replaces Form 30-4 which may be used.
1 APR 55

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U.S. GOVERNMENT PRINTING OFFICE : 1955—O-342531

Dave,

Here is the Reiser/Adkins BIRD mess. Basically what's wrong with the ORD approach is that they assume they have proven the feasibility of the BIRD camera approach and that it will have fairly wide-spread application.

If they proved feasibility in last year's efforts with the pigeons, it escaped me. If they proved, it why are we starting ~~it~~ all over again this year? If they proved it, why are we ordering new prototype cameras?

The substitution of staff for contractual personnel for testing and training can only be justified if the program is about to go operational. Any such judgement is premature at best.

The proposed funding is also too rich for my taste. Examples are: $5,000 pigeon lofts in Washington and Alaska, $38,000 of QRC work at [redacted] acquisition of radio DF gear, ~~at a level of~~ 100 hours of ~~playing~~ time, procurement of 30 "operational" cameras, and so forth.

I don't think we should buy into this scheme. Either ORD should retain responsibility for the program until its usefulness has been proven, or OTS should take over the ORD funds and prove or disprove the concept on its own more cheaply.

B.L.
Bruce

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SENSITIVE

6.2(d)

9 SEP 1976

MEMORANDUM FOR: Special Assistant for Strategic Intelligence, Office of the Comptroller

SUBJECT: Leningrad Target for Project TACANA

1. The Office of Scientific Intelligence has searched for potential targets for Project TACANA with the following constraints: a) operation to take place in Leningrad with collector flying a direct path from deployment location back to home base, b) film load to be black and white, with resolution of around one inch to be expected and, c) target to be outdoors, visible, and not time sensitive.

2. We have not been able to identify a specific target of such interest to OSI that it would justify a TACANA operation under the above constraints. If the constraints should change, we would like to reconsider possible targets including, in particular, the Moscow area.

[redacted]

KARL H. WEBER
Director
Scientific Intelligence

cc: ADDS&T
D/ORD
D/OWI
C/OTS/OPS
C/OPS/SE
Chrmn TACANA TCT

E2 IMPDET
CLBY [redacted]

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21 January 64

Chief, Naval Research
T-3 Building
Room 1804
17th & Constitution
Washington, D. C.

ATTENTION: Dr. Sidney Galler

1. The newly organized Office of Research and Development of the Central Intelligence Agency is seriously interested in determining the feasibility of using dolphins and other marine life in specialized operational situations.

2. The use of dolphins in specialized operations seems promising and deserves support. However, we feel that considerable study is required to more accurately define the operational limitations inherent in the use of these animals in close cooperation with other departments having similar interests.

3. Recognizing that the Office of Naval Research has had long and continuing interest in this area, we wish to explore with you ways in which we could augment research; specifically, we would like to undertake active collaboration with appropriate units of the Department of Navy to determine the feasibility of using dolphins in operational situations. Perhaps active collaboration would lead to a more rapid solution of the problems involved with a minimum of duplication. I would welcome your comments on this matter.

Stephen L. Aldrich, M.D.
Deputy Assistant Director
Office of Research and Development

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Remarks:

Mr. Duckett has seen this letter. He will be away for two weeks but Mr. Chapman will talk to him about KECHEL because of the short time situation. You might check with Chapman next week on your return.

Stephen L. Aldrich, MD

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DIRECTOR OF DEFENSE RESEARCH AND ENGINEERING
WASHINGTON, D. C. 20301

3 AUG 1967

Mr. Carl E. Duckett
Central Intelligence Agency
Washington, D. C.

Dear Carl:

I have recently been informed by Mr. Cesaro of ARPA that Project KECHEL is being terminated due to the lack of operational requirements at this time. My staff and I have seen this system demonstrated and were impressed by the potential it may have for a variety of purposes by components of DOD. If operational considerations permit, I would like to maintain this R&D program in operation under the technical guidance of the Office of Research and Development with financial support and guidance from ARPA in order to ascertain the potential applications of systems like this to DOD problems and to make use of the technology developed under this program. If this arrangement is agreeable to you, I would like to have Mr. Cesaro meet with representatives of ORD at the earliest opportunity to work out suitable arrangements.

Sincerely,

Signed
Finn Larsen
for
John S. Foster, Jr.

TS 196659
Copy 2

TOP SECRET - SENSITIVE
EYES ONLY

DRAFT:SLAldrich:pjk/2652
29 December 1967

The Honorable John S. Foster
Deputy Director of Research and Engineering
Department of Defense

Dear John:

As you may recall, I recently sent you a letter indicating that the Agency was unable to continue support of certain animal programs due to lack of definitive requirements and budgetary restrictions. This did not include the marine animal (dolphin) program.

Recently the Director indicated his continuing interest in the marine animal program. This stimulated a series of meetings with representatives of ARPA and the Department of Navy which resulted in a proposed DOD/CIA program including joint funding of the marine animal program and ARPA funding of the guard dog program. ARPA requested that technical management of these programs be undertaken by the Agency and the Director agreed to this.

My previous letter may have been misinterpreted with respect to the Agency's judgment as to the usefulness of animals. From a technical viewpoint, there is a high probability that animals will be able to carry out a number of useful, if not unique, tasks of interest to the Department of Defense and to CIA. We very much hope that these animal systems investigations will be carried to a further stage of development.

There has been an extremely close and fruitful exchange of information, support and facilities involving the Agency, ARPA, and the Department of Navy. We very much hope that this relationship will continue to exist and that we may both share in the benefits.

Carl E. Duckett
Deputy Director
of
Science and Technology

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ORD-6563-67

The Honorable John S. Foster
Deputy Director of Research and Engineering
Department of Defense

Dear John:

You are aware that our Office of Research and Development has undertaken projects to determine the feasibility of using animals and birds for certain intelligence activities. Some of this work has been jointly funded by ARPA. The Agency has recently reviewed these programs and has decided to discontinue them. This decision was based on the lack of firm operational requirements. It should be noted, however, that technically these programs have progressed exceptionally well.

We are prepared to undertake an orderly transfer of these programs to ARPA should you decide you wish to continue them on your own. Some funds are available in FY 1968 to assist in an orderly transfer. We will not, however, be able to provide any funds in fiscal year 1969 for the continuation of these programs. This decision does not include the DOLPHIN project which will be reviewed by the Agency within the next few months.

Yours truly,

Carl E. Duckett
Deputy Director
for
Science and Technology

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ORD 1964-65
14 July 1965

MEMORANDUM FOR: Deputy Chief/Technical Services Division

SUBJECT: Life Sciences Programs of Possible Interest to Technical Services Division

1. To follow up on our discussion of a few weeks ago, I have the impression that TSD is cutting back on some of its activities in the life sciences although there continues to be substantial requirements within DD/P for techniques stemming from the Life Sciences when and if they become operationally useful. This also seemed to be the flavor of Mr. Helms' memorandum to the DD/S&T dated 26 December 1963.

2. Life Sciences activities in ORD include four major programs: Stress, Human Behavior, Animal Studies, and Weapons Detection and Development. Certain projects within these programs appear to have potential value to DD/P but would certainly require careful review and further development in order to meet specific operational requirements. Examples which come to mind include the use of animals and birds for the emplacement of sensors or transponders, the use of chemicals or other techniques for the manipulation of individuals or small groups, techniques for remote detection of weapons systems or their components, and methods for remotely assessing the response or reactions of individuals.

3. Research and development in some of these areas is "high risk" in the sense that the chances for success are relatively small, although the payoff could be of immense value to DD/P as well as other directorates. Success in these programs depends not only on careful selection of research and development but on clearly identified requirements specific enough in nature to permit us to focus on those of highest priority with greatest likelihood of success. It is also important that we avoid duplicating projects currently under way under TSD's auspices. Duplication was avoided, for example, in the case of the missile fuel detection problem by an exchange of information last winter.

4. I do not feel that I have an adequate appreciation of the specific research in certain areas which I understand are

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being pursued by TSD. These include current projects on BW/CW collection, manipulation of behavior (chemically or other means), and remote physiological and psychological assessment. This information gap can be filled relatively easily. Some mechanism should be found to keep each other fully aware of relevant programs. I can assure you that you will have our complete cooperation in this regard.

5. TSD could provide substantial assistance to ORD by identifying intermediate and long range requirements in certain of the Life Sciences areas. You may recall we requested your assistance in determining whether there are requirements for our dolphin and bird projects within DD/P. Perhaps there are other projects in our program of potential interest to DD/P. In this regard, we have recently completed a survey which emphasized a number of behavioral areas including drugs which we will send to you for your information and comments. This study was not done in response to a DD/P requirement but was a background study for our own use. It occurs to us, however, that there may be some specific areas covered by this survey which you may wish to have studied in more detail.

6. I would appreciate any comments you may have on ways in which we can provide realistic support to DD/P components and in turn assure ourselves of adequate feedback.

STEPHEN L. ALDRICH, M. D.
Deputy Assistant Director
Office of Research & Development

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 6.2(d)

3 OCT 1968

DD/S&T 3804-68

MEMORANDUM FOR: Deputy Director for Plans

SUBJECT : Maintenance of Trained Animal Capability

REFERENCE : DD/P Memorandum 8-3731 dated 18 September 1968, Same Subject

1. I have been informed that ORD is in the process of making arrangements to continue the bird and cat capabilities for one additional year. They will be receiving guidance from TSD as to an appropriate scenario in order to test the operational feasibility of these systems.

2. There was an apparent misunderstanding regarding the cost of maintaining this program. However, ORD has agreed to reprogram some funds for this end. We understand from Dr. Gottlieb that these funds will be augmented by TSD.

3. Recent demonstrations given to representatives of the Clandestine Services were quite encouraging. Efforts this year will concentrate on the operational usefulness of these systems. No effort will be made to further the state-of-the-art or carry out research and development to improve the capabilities of these animals.

Carl E. Duckett
Deputy Director
for
Science and Technology

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1- RECHEL
1- AXIOLITE

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3.3(h)(2)
6.2(d)

ORD 7611-67

19 December 1967

MEMORANDUM FOR THE RECORD

SUBJECT: Meeting with ARPA Representatives Regarding the Animal Programs

1. [redacted] Mr. Reiser and I met with Dr. Niedenfuhr and Mr. Cesaro of ARPA to discuss a combined Agency/ARPA animal studies program. We presented the attached proposed program, and they indicated they were prepared to live with this agreement. They estimated that their FY 1969 funding would be somewhere around 500 K and probably 300-400 K in FY 1968. This will include a 10% administrative item to cover travel and consultation. Inherent in this agreement is a commitment that the Agency, [redacted] in particular, will be the technical monitor of the programs.

2. We also discussed suitable candidates for contract program management. After due consideration, we concluded that [redacted] have the greatest capability. We will arrange to set up a meeting sometime in January to brief both companies in detail on the requirements for the system and give them a thirty-day bid time. ARPA will participate in the briefing. We will explicitly exclude them from hardware development. The time frame will be approximately twelve months from initiation of contract. The contractor will be provided with all reports pertinent to these programs resulting from previous R&D.

3. Prior to initiating this joint program we should

a. Arrive at a suitable understanding with management about our monitoring these programs, and

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SUBJECT: Meeting with ARPA Representatives Regarding the Animal Programs

b. Arrive at an understanding that the Agency will consider funding parts of the OXYGAS program in FY 1969 should feasibility be demonstrated to their satisfaction.

Stephen L. Aldrich, M. D.
Deputy Director
of
Research and Development

Attachment
As stated

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ORD:SLAldrich:pjk/2652 (19 December 1967)

 6.2(d)

ORD-6496-67

27 October 1967

MEMORANDUM FOR THE RECORD

SUBJECT: Meeting with the Executive Director on the Animal Projects

1. A meeting was held on 26 October 1967 to discuss the future plans for the bird and cat programs, AXIOLITE, KECHEL, and OLITORY. Attending the meeting were the Executive Director, [redacted] and Mr. Cantwell from OPPB, Mr. Duckett, Mr. Karamessines, Mr. Whitten and myself. The purpose of the meeting was to report on the DDP review of these projects by Mr. Whitten and [redacted] and to survey the operational requirements. Both Mr. Karamessines and Mr. Whitten indicated that the technical achievements which were demonstrated were of the highest order and represented truly exceptional achievements. Nevertheless, they felt the opportunities for operating such systems were minimal and, as a result, could not justify the expenditure of substantial funds for further development of these programs. There was considerable discussion about a working relationship with ARPA and the possibility of having ARPA continue the total support of these programs with or without our management. Mr. Duckett felt that this would be in conflict with the DCI's instructions and that the question was not so much one of money, but whether the Agency had a need for these systems. I reminded the group that ARPA has already contributed half the funds in the animal program but does not have the technical monitoring capability as Dr. Foster pointed out in his memorandum to the Director regarding KECHEL.

SUBJECT: Meeting with the Executive Director on the Animal Projects

2. After considerable discussion, it was decided to terminate these projects in an orderly way during FY 1968. Mr. Karamessines will send us a memorandum summarizing their findings, and, we will, in turn, notify ARPA and/or the DDR&E that we intend to phase out of these projects during the fiscal year and offer to work out suitable phasing with them if they wish to continue the programs. The above discussions and decisions do not involve OXYGAS, which will be reviewed subsequent to the demonstrations this year. ORD is specifically authorized to spend FY 1968 funds to assist this phase out. A decision as to whether we will undertake the monitoring of these projects, if totally funded by ARPA, will be discussed with the Director.

Stephen L. Aldrich, M. D.
Deputy Director
of
Research and Development

31 August 1967

MEMORANDUM FOR: Director of Research and Development

THROUGH : Acting Deputy Director for Science and Technology

Bob:

This will confirm our conversation today. I have spoken with Tom Karamessines and the Director about continuing Project KECHEL with ARPA financing. I emphasized to you that this must be major financing.

I have also agreed to review with Carl Duckett and Tom Karamessines at an early date the earlier decisions made with regard to the following projects:

OXYGAS
AXIOLITE
KECHEL and its related OLITRAY

L. K. White

cc: DD/S&T
DD/P
D/PPB

TS 188966
Copy 1 of 6

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ORD-0397-76

25 March 1976

MEMORANDUM FOR: Director of Research and Development

THROUGH: Chief, Operations Technology Division, ORD

SUBJECT: NPIC Support in Bird Camera Program

1. A Technical Collection Team (TACANA/TCT Task #1) has been formed to demonstrate the operational utility of an AVIAN asset. As a part of this effort, a new bird camera has been designed which weighs less than the old one and which uses a 16mm film with motion compensation instead of the 9mm size. Testing of this camera will continue through June of this year at which time the final demonstration is scheduled.

2. Initial tests by ORD with this camera surfaced four problem areas:

a. Reliable slicing of 70mm film (3400 and 3414) to the required 16mm format was difficult. Though the OTS slicing machine was used, the personnel involved were not familiar with its use.

b. Effects of humidity on the 3414 film and possibly improper developing of the film.

c. A lack of facility for obtaining good-quality enlargements of the negatives.

d. A lack of familiarity with available films which can provide good resolution at low light levels.

[redacted] DD/NPIC, recently briefed the DD/S&T and suggested that his people at NPIC could advise us on these problem areas. At subsequent meetings with [redacted] (NPIC), it was determined that NPIC could obtain a variety of film types directly from Kodak on the 16mm format and the required 2 1/2 mil thickness base. [redacted] further advised that there were special processing techniques and film types which should be investigated to best provide high resolution,

E2 IMPDET CL BY [redacted]

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SUBJECT: NPIC Support in Bird Camera Program

low light level capability similar to those now being used on the mini-camera program. Discussions were also held with [redacted] (PSB/ISD/PSG), and his people have been most helpful in developing several rolls of film and providing several good-quality photo enlargements which have been extremely beneficial in evaluating the capability of this system.

3. To help in this program area, it is requested that NPIC provide the following support on a noninterfering basis:

a. Provide a minimum of 500 feet of 16mm film (2 1/2 mil base) of each of the following types: 3400, 3414, 5069, SO242, SO410, and any other types recommended by NPIC for this program.

b. Develop two to three rolls of this film per week as taken by the system. Make recommendations as to what kinds of film should be used and any precautions concerning handling requirements necessary for use in the field.

c. Provide enlargement photographs of selected negatives and give advice on the probable resolution potential of this camera system.

4. The chairman of the TACANA/TCT is [redacted] OTS/OPS/SDB.

Charles N. Adkins
Operations Technology, ORD

cc [redacted]

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ORD 244-64
4 February 64

MEMORANDUM FOR: Special Operations Division

ATTENTION: [redacted]

SUBJECT: Operational Evaluation of the Dolphin Proposal from [redacted]

1. Attached is a proposal from The [redacted] [redacted] of [redacted] to investigate the feasibility of using dolphins in support of covert marine operations. The principal investigator is [redacted], and the project officer is [redacted] The cost for the nine-month study is approximately ninety seven thousand dollars.

2. This proposal, as you know, reflects to a considerable degree the ideas which you and I discussed with the contractor on two previous occasions. I would appreciate your review of Parts I and II from the operational point of view. In particular, I would like to know whether the demonstration of feasibility as outlined in the proposal would be of continuing operational interest to your office. In addition, I would like to be certain that your group would act as the operational monitor of the project if it is approved. It would be our intention to monitor the scientific, technical, and management phases of the project. Operational monitoring of this project would involve close and continuing contact with the project investigators both here and in the field as well as responsibility for redirection of the program to enhance its operational usefulness.

3. This project will also receive continuing review from Dr. Galler's office in ONR as appropriate. We would appreciate it if you would forward your views with regard to the project by 17 February so that we can initiate action as quickly as possible.

STEPHEN L. ALDRICH, M. D.
Deputy Assistant Director
LS/ORD/DD/S&T

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OPERATOR'S MANUAL

AVIAN DELIVERY SYSTEM

The system described in this manual offers a method for delivery and retrieval of small objects to normally inaccessible locations on buildings or other structures. The system utilizes a trained raven as the delivery vehicle.

The purpose of this manual is to provide guidance to trained bird handlers in the maintenance of the carriers and utilization of the system. It is not intended as a substitute for on-the-job practical training of a handler and cannot be expected to serve as a training manual for utilization of the system by unskilled individuals.

INDEX

I. Introduction - Description of the System

The package delivery system has been developed as a means of placing a small device upon a window sill or other ledge of a building, and also of recovering the package. The transport vehicle is a trained raven.

The bird has been taught to take the package in his beak and to fly with it to the proper target surface, place it on the target surface and return to the cage from which he made his outflight. Similarly, the bird may be released to recover the package. The maximum package weight that the bird can reasonably be expected to carry weighs about 40 grams (10% of birds body weight). Package dimensions can vary considerably but are limited to a size which the bird can readily grasp in its beak. Packages used in routine training measure 3 x 1 x 3/4 inches.

Training has been principally directed to conditioning the birds to making outflights from a cage located just inside a window. Birds have also been launched from a cage in the back of a station wagon and camper. The target must be within line of sight from the launch point. Maximum ranges of 300 feet under ideal conditions have been achieved.

To guide the bird, the red beam of a helium-neon laser is projected to mark the target surface. Typically a projected spot is aimed at a point an inch or two below the target surface. A motor driven shutter interrupts the laser beam at a frequency of approximately two cycles per second. The bird has been trained to fly to the flashing red spot which appears upon the target building. The laser beam need be projected only during the outflight.

The return flight is guided by the presence of a small high-intensity table lamp which is turned on at the instant the bird properly places a package or picks up a previously placed package. The table lamp serves two purposes. Turning on the lamp signals the bird that he has performed properly and that he will receive a food reward upon return to the launch cage. The lamp is also a "beacon" reminding the bird of the location of the launch cage.

The small, low power lasers used in the system emit about one milliwatt of light energy. The reflection of the projected red spot is not visible in broad daylight. Missions, therefore, are generally limited to dawn or dusk conditions, although successful demonstration missions have been conducted at night in lighted city streets. It has not been possible to record precise data concerning the range of acceptable ambient light conditions because of the wide variations of reflectance of common building materials. As a rule of thumb it can be stated that, if both the target landing surface and the projected spot can be clearly seen by a human observer at the launch site, ambient light is satisfactory for a mission flight.

The on-site portion of an actual operation might be conducted as follows: On a table inside the selected launch window are placed the launch cage and the table lamp. These objects are located approximately one to six feet from the window opening. The cage is equipped with a swinging latched door at each end. One of the doors faces the window. The laser is located at any convenient spot so that it may be aimed at the target point. The bird is transferred from a carrying container to the launch cage. The laser is aimed, by means of simple open sights, at the target. Window curtains, if any, are drawn aside and the window is opened. The laser is switched on permitting the beam to mark the target. The front door of the launch cage is opened and, as the bird emerges, the package is held so that the bird grasps it. (Photos 1 & 2) The bird flies to the target surface and, when he lands, the laser is turned off. At the instant the package is seen to be properly placed, the recall lamp is turned on. The bird flies into the cage, receives his food through an opening in the side of the cage, (Photo 3) and the front door is closed. To recover the package, the procedure is repeated except, of course, that the bird flies out carrying no load. The laser spot guides him to the package location. At the instant the bird is seen to have picked up the package, the recall lamp is turned on. As the bird re-enters the cage, he drops the package to take his food reward. If the launch cage is placed a considerable distance back from the launch site window (up to 6 feet) the cage itself may not be in line of sight with the target. In such a case, the bird may not be able to see the laser spot until he reaches the sill of the launch site window. Such out-of-line-of-sight placement of the launch cage has been demonstrated as feasible. The recall lamp, however, must be in line of sight from the target so that the returning bird will be properly guided. The launch cage and recall lamp, obviously, cannot always be positioned in the same location in the launch site room. A returning bird will home in to the recall lamp, set some distance inside the window and may be fed near it. Once the launch site window is closed, the bird has been essentially secured and can be returned to his cage as soon as is convenient.

A window from which a bird is launched should, where possible, be curtained except for the actual open portion to eliminate the risk of a returning bird crashing into a transparent window pane.

II. The Carrier

A. General Treatment and Handling

The carrier, crow or raven, has been tamed and associates food and his general well being with humans. The bird must never be handled roughly or punished in any way, except by the properly controlled withholding of food during training and exercising. Proper housing, food, and exercise must be provided to keep the birds in top physical and mental conditions.

It is frequently necessary to pick up or carry a bird as when transferring him from one cage to another or weighing him, or perhaps when recovering a sated bird at the end of an exercise session. A bird can be grasped in the hand by gripping one leg between the thumb and forefinger allowing the bird, in turn, to rest the other leg on the wrist. The foot of the grasped leg should be permitted to hold to the second or third finger. (Photo 4) Movements toward a bird to be picked up may be fairly rapid, but should not be abrupt or jerky as sudden movements may startle the bird.

As a bird is held, the grip should be firm but flexible. One should "give" with the bird's movement if he turns or attempts to fly. Birds' legs are fragile, thus a rigid grip risks danger of a damaged leg joint or broken bone. Some birds do not permit a handler to grasp a leg or do not readily perch on the handler's arm or hand. Such birds are more easily grasped by two hands gently encircling the body.

Birds perched on the arm can often be held in place by holding the bird's identification band. The looseness of the band permits the bird to turn with minimum danger of leg injury.

B. Housing and Transport

The principal problems in transporting, storing, and maintaining the system concern the birds.

Good feather condition is essential to the usefulness of a bird. Wire mesh cages or pens should not be used as they tend to cause severe damage to tail feathers. Necessary cage openings can best be covered by round vertical bars spaced about one inch apart. However, ventilation slots located high on the walls or in the tops of cages may be covered with mesh if they are well above the head level of the bird as he perches in the cage.

To prevent feather damage, shipping-living cages should be as large as reasonably possible. Cages measuring 27" wide, 26" front to back and 21 1/2" high have proved to be satisfactory. Cages should be equipped with dropping trays in which litter, e.g., "Kitty Litter", can be placed. A wooden dowel about 3/4" in diameter placed above the tray provides a perch for the birds. For shipping, a cup for food and another for water should be attached inside each cage. Cages of this type and size are satisfactory as living cages in which birds may be housed for long periods of time. When such a cage is used as a living cage it is best to attach feed and water cups outside the cage just below an opening through which the bird can reach. External cups are easy to clean and allow more free space inside.

Plywood is a satisfactory material for cage construction. However, if a cage is to be occupied for other than short periods of time, plywood walls should be lined with a hard surface material like Formica. Formica surfaces are easy to keep clean and cannot be splintered by a bird's powerful beak.

For transport over long distances birds are best moved by air to shorten time in transit. For travel time, not to exceed about five hours, and where space is limited as in a small foreign car, cages with interior dimensions of about the size of an 18" cube can be used. Small cages should be used as little as possible to avoid feather damage. Food and water cups can be omitted from small cages provided birds are given water immediately before and after travel, again not to exceed five hours.

Caution: Birds should not be left in closed cars exposed to summer sunlight as temperatures considerably above 100 degrees F. may develop which could seriously harm or even kill the birds. During transport periods greater than about 24 hours, birds should be fed as nearly as possible in accordance with normal feeding procedures.

It has been found that all equipment needed for a mission can be packed in ordinary suitcases, except for the large cages. Larger shipping-living cages are particularly bulky. For transport in a small car, a folding living cage has been developed. Unfolded and assembled, it forms a cage satisfactory for long-time housing.

C. Diet and Care

Because the birds work for food rewards, each bird's food intake and body weight must be carefully monitored. Birds in training are weighed almost daily, principally to avoid over-deprivation, but also because an unexpected weight loss may be a warning of illness.

The basic item of diet is a mixture called "crow salad". The recipe is on the following page.

Ingredients	Approx. % by Weight	Recommended Mixture
fatty beef	82	900 grams
beef or pork liver	2	25 grams
canned corn	2	25 grams
fresh or canned tomatoes	2	25 grams
lettuce	2	25 grams
fresh carrots	2	25 grams
raw egg with shell	2	1 egg
cottage cheese	2	25 grams
whole wheat bread	2	25 grams
bone meal	2	25 grams
Vitamycin*	2	2 teaspoons

*Vitamycin is a vitamin and mineral preparation produced by the Dow Chemical Company, Indinapolis.

With a conventional hand operated kitchen food grinder grind: liver, corn, carrots, egg shell, bread, lettuce, tomato. Add these to the beef, egg, bone meal, and Vitamycin. Mix thoroughly. The mixture must, of course, be refrigerated. This amount will feed two ravens for about a week.

The exact proportions are not critical. In scaling down our standard training farm quantities, for example, we did not suggest a fraction of an egg!

On the average, each bird needs about 50 grams of crow salad per day.

Crow salad has been prepared in freeze-dry form. The dry material is mixed with water in approximately one-to-one proportion by weight. After thorough mixing the product is of a watery consistency, but it thickens after being allowed to stand for several hours. Experiments with several birds indicate that the freeze-dry mixture can be fed at the same rate as fresh crow salad to maintain constant body weight. The freeze-dry product is not as effectively utilized as the fresh product. Do not use freeze-dry food except under conditions where it is not practical to supply the food in fresh form.

Drinking water should be available to a bird at all times in his living or shipping cage, with the exception that, for convenience in short time travel, water may be omitted from the shipping cage.

Although the feeding of a fully trained bird may differ somewhat from that of a bird in training, a knowledge of the trainer's feeding procedures should be useful to those charged with the care of a mission trained bird.

Experience with each bird reveals the maximum weight at which the bird will work reliably. Greater weight results in reduced hunger drive and reluctance to work for food rewards. Significantly lower weights present unnecessary risk of weakness and poor resistance to disease. A tolerance of plus or minus 20 grams is ordinarily acceptable.

During the training period, which in some cases has extended for years, the optimum working weight may change, particularly with changing seasons. Warm weather commonly requires a reduction in weight, cold weather permits it to be increased.

To insure adherence to the maximum permissible weight policy, feeding programs are purposely directed slightly toward over-feeding. If performance of a healthy bird becomes sluggish or unreliable, a bird's food intake is limited until a good working weight is again reached.

A bird typically receives about 50 grams of crow salad per day. On working days much of this food is received as reward for performance. The remainder is fed at the end of the day. Birds are weighed daily except on weekends and records of weight and performance are kept. Adjustments for off-optimum weight are usually made by fairly small changes in the daily food allotment. Abrupt drastic weight losses are avoided as much as possible. Weight reduction, when required, is limited to a rate of about 10 grams per day. For example, an overweight sluggish bird may be dropped to a 40-gram daily intake, then, if necessary, to 30 or even 20 grams until the bird is again performing well. The diet of an underweight bird is increased in similar increments.

For convenience in rationing crow salad, a bird's allotment is weighed out at the beginning of the day and placed in an individual container assigned to that bird.

On non-working days, usually Saturdays and Sundays, a bird is daily hand fed all that he will eat in one session. The remainder of his allotment, if any, is placed in the feed cup for consumption when the bird is hungry again.

Commonly, weekend feeding of a bird results in some weight gain as the bird is idle and thus burning less fuel. As a result performance on Monday, particularly in the morning, is often poor. Birds are usually not pressed for top performance on Monday. By Tuesday, and during the remainder of the week's working days, weight and the related hunger drive is adjusted to a satisfactory level.

Not unusually a bird will actually gain weight during the working days of the week. If such a gain is significant, 20 grams or more, the weekend ration may be reduced.

Because weight is an indication of a bird's health, birds should be weighed frequently on accurate scales and weight records kept. Inexpensive scales of the type known as "dietetic" scales are easily obtained and are easy to pack for shipping. Unfortunately they are often inaccurate and, worse, their readings tend to drift. If such scales are used, a set of standard weights should be provided and frequent calibration checks made.

In normal training, maintenance of high drive levels is avoided. Nevertheless, such drive levels do temporarily increase the probability of good performance and should be employed when "the chips are down".

To attain a temporary high drive level without serious risk to health, the following procedure should be followed: This procedure has proved satisfactory prior to important demonstrations involving mock missions. If a bird is at or near optimum weight he is fed a normal days' ration 48 hours in advance of the anticipated demonstration time.

No more food is given except for the little that may be earned in a very few test flights. There is some evidence that it is best not to exercise the bird at all during approximately the last 16 hours preceding the demonstration. At the end of the 48 hour period it can be expected that the bird will be eager to work and will be, because of rather extreme hunger, motivated to risk flight in an unfamiliar location that might otherwise present stimuli disturbing to him at only moderate drive levels.

Obviously, one cannot always anticipate need for a bird's services at precisely 48 hours in advance. Fortunately there is considerable tolerance. A bird in good health can withstand 24 to 30 hours of deprivation starting at almost any time even though the start of such deprivation may coincide with a slightly underweight condition. If a postponement delays a scheduled flight, for a day, somewhat scanty feeding (typically about 30 grams), but with actual amounts determined by bird weight will keep the bird "at the ready" 24 hours before the newly scheduled flight.

In premission periods, slight weight losses are acceptable. Gains are not. Some additional day's delay may be possible by similar 24 hours advance feeding, but a long-term delay, four consecutive days, for example, might result in weight loss that cannot safely be allowed to continue.

In recent training, it has been found that birds can safely fly while tethered to a lightweight line. Tethering has greatly reduced fly-away losses that previously occurred with some birds in their early outdoor training sessions. Other losses occurred even with advanced birds under low hunger drive levels.

The line is 10 pound test monofilament fishing line paid out from a conventional closed-face spinning reel (Zebco model 800 for example). (Photo 5) A small fish-bait snap swivel is permanently attached to a leg band. (Photo 6) A similar snap swivel is tied to the free end of the line, thus the line can easily and quickly be attached to the bird's leg before the bird is released for flight. A bird straying from his proper flight path can be gently brought to earth by careful braking of the line as it pays out.

It is inherent in the design of a spinning reel that the line is subjected to twisting. To reduce the resulting curling or kinking of the line, it is frequently unreeled by hand and pulled out to its full length. The stretched out line is held taut by its outer swivel which allows the line to untwist. The straightened line held taut is reeled in again, ready for use.

Birds in advanced outdoor training must, of course, make many untethered flights. Because birds in training cannot be constantly at the high degree of hunger that would be imposed for an actual mission, there is a higher risk of loss. If there is reason to believe that a bird may not be fully motivated to stay on course, tehtered flights are made at the start of a training session so that the bird's behavior can be judged. Only if the bird appears to be working well are untethered flights then permitted.

Periodically stimulating a bird to preen helps him to maintain good feather condition. Once or twice a week the bird should be wet down with water from a spray bottle to induce preening.

D. Exercise and Maintenance of Trained Behavior

To keep fully trained birds "in storage" involves, ideally, a program similar to the training schedule already described.

It is desirable that a bird be given as much exercise as possible. Not only does exercise help maintain flight strength, it also assures a fair approximation of the ideal food consumption. Most of the bird's food is that which he is willing to work for, thus regulation of the diet is determined automatically to a considerable extent.

It is understood that, in "storage" locations in foreign countries, security requirements may make it impossible to find ideal exercise areas. Outdoor exercise at mission ranges is preferable to either indoor or short range exercise, but exercise can be given indoors at short range if there are no alternatives. Outdoor untethered flights should be few in number and made only with a bird that seems eager to work.

Package placement and retrieval in exercise not only keeps a bird in flying trim but also maintains load carrying ability.

For indoor exercise the target platform can be a table at one end of a hallway and a launch cage and recall lamp at the other. Even in a moderate sized room some valuable exercise can be given. Exercise areas and target locations should be varied as much as possible. Exercise sessions are conducted like miniature missions except that more strict requirements are enforced in terms of package placement. For example, in a real mission run, a placement at the end of a sill opposite the end marked by a laser spot might be acceptable. In an exercise run it should not be rewarded.

If a bird should go astray in a mission flight it might be necessary to recall him to the launch cage. During exercise flights the recall lamp should not be used following any improper response unless it is absolutely necessary as it might be in outdoor exercises. If the bird does not return without recall, it is best to return the bird by hand. The recall signal has, in training, been associated with food reward given upon return, thus the recall signal alone has some rewarding effect. To use the recall signal following an improper response tends to strengthen that improper response. A sated bird will not perform well at any range. Exercise of a bird showing signs of satiation should be halted.

An audible recall signal, the click of a toy "cricket", was also used in training the birds. This signal should be used only when necessary to recall a bird that is not responding well to the recall lamp.

Crow salad is used for food rewards. A pinch of food, about 1/4 to 1/2 gram, is presented to a bird when it returns to its launch cage following correct performance and recall. The timing of a reward is critical. Reward begins with recall. The recall lamp should be lighted instantly when a bird places a package properly, or, on retrieval, when a bird has picked up the package.

Food given as reward is, of course, a part of the bird's diet.

In spite of the advantages of frequent exercising it is not an absolute essential. If a day or two of regularly scheduled exercise is omitted the bird may simply be fed, preferably at the time of day an operation is likely to take place. The bird should be fed the amount that he would normally eat if he were being exercised, or slightly less. If the experienced handler must be absent on an exercise day it is best to omit the exercise program and to leave only feeding to less experienced caretakers. <u>Exercise sessions are in effect miniature missions, so improper rewarding can adversely affect the behavior required for real missions.</u>

E. Illness and Treatment in the Field

In most instances, the raven is a hardy bird. All but the most extreme temperatures have little effect. High temperatures may cause a little sluggishness and slightly lessened endurance while low temperatures seem to heighten activity and sharpen the bird's appetite. However, it is wise to provide the bird shelter from direct exposure to sun, wind, and weather extremes.

It is recommended that the diet of crow salad be adhered to when practical, especially when placing the bird on a drive prior to a mission. The majority of the health problems of ravens in training for a mission stem from inadequate nutrition. While it is important that the bird be hungry enough to work well, it is imperative that the health of the bird be maintained by adequate food. Adhere closely to the feeding instructions included in this manual.

An unexpected weight loss of, for example, 20 to 30 grams, such as one not due to an imposed deprivation, or a failure to gain weight quickly following a necessary deprivation, may be an indication of a stress condition. Cessation of exercise plus full feeding (all the bird can eat twice a day) is called for until weight is regained. Freedom to fly about in a closed room may also help. (Stress has been an occasional cause of death among crows, in training. Post-mortem examinations have commonly revealed enlarged adrenals, accompanied by no other indications of illness. The incidence of stress conditions has been lower with ravens, and when it occurred recovery has usually been rapid.)

Like humans, the raven faces many types of environmental hazards and diseases. Fortunately, these hazards and diseases are seldom encountered; not so fortunately there will be little you can do in the field to effect a cure or even diagnose the disease.

In the case of the more serious illnesses, the first indications will be a loss of appetite followed by a paling or blanching of the normally bright pink inside lining of the bird's mouth and a loss of gloss or sheen of plumage.

Sometimes sneezing or coughing will occur. The bird feces may become very runny and almost clear rather than the normal white and olive or brown excreta of a pasty consistency. Occasionally, however, the course of the infection runs fast and the only thing you may notice is the bird will not eat or is reluctant to eat. Do not wait more than a day to begin treatment if the bird goes off its feed or exhibits any of the above described symptoms. Place the bird on a full feed ration. Emphasize the foods you know the bird prefers. Live food, such as minnows or worms, may help stimulate the appetite. Administer Sulmet* in drinking water (two tablespoons, or one fluid ounce, to one gallon of water) for a period of five days. Discontinue treatment for three days, then administer again for three more days. To assure that the bird drinks the medicated water make it available to him for only about six hours per day, preferably in the morning. Letting the bird go without water for the

*Sulmet is a commercial sulfa preparation made by the American Cyanamid Company.

remainder of the time will build up a strong thirst drive. Sulmet medication is about the only treatment practical in the field.

Occasionally skin growths similar in appearance to warts may appear on the legs and around the bill. Unless the growths become extensive in number or very large, they do no real harm. If a mission is imminent, ignore them. If you will have the bird in your possession for some time and no mission is planned, you may burn off the growth by carefully applying silver nitrate solution with a swab. As needed, peel off the dead tissue and reapply silver nitrate.

All in all, it is best to prevent illness rather than treat it. Be sure the feeding schedules are adhered to. Be sure to use crow salad, or, if this is not available, supplement the diet with vitamins. Do not unnecessarily expose the birds to weather extremes but do supply adequate ventilation.

Of perhaps greater danger to the raven under field conditions is traumatic injury or the ingestion of dangerous substances. If the bird receives a broken wing or broken neck there is little one can do to correct the injury. A broken leg may or may not incapacitate the bird depending on the site and extent of the break. A clean break between the leg joint and the foot may be splinted with any lightweight material--match sticks, a length of straightened paper clip wire, etc., secured over the break with tape. A break at the joint is very difficult to set and the injury would probably keep the bird from performing. Immediately after the break is set, the bird might perform all right, but it is not recommended that this be tried unless absolutely required. Regardless of the nature or location of the break, the bird should be given as much time as practical to rest and recover from the injury. When an operation is imminent try a dry run with the bird under secure conditions. It is conceivable that a bird with a severely broken leg or other extensive injury might still be able to perform satisfactorily.

Birds in general, and ravens, in particular, will ingest just about anything they can get into their mouths. Avoid keeping loose objects or harmful substance near the birds.

If the raven does swallow something harmful, first aid treatment is difficult if not impractical. Often the bird will regurgitate the material spontaneously. Here again, prevention is more effective than treatment.

Feather damage (broken or ruffled feathers) is best avoided but occasionally occurs in spite of the operator's best efforts. Broken or frayed body or tail feathers should be left alone. They will regenerate soon enough and the bird can perform satisfactorily with some damaged body and tail feathers. The wing feathers are a different matter. Loss or damage of wing feathers degrades severely the bird's flight capability. If wing feather damage is noted just prior to a mission, fly the bird to determine if the bird is still capable of flight. Be sure to test the bird weighted with the load it will be carrying during the mission. If the bird seems to fly sufficiently well do not disturb any feathers. If the bird seems to have difficulty flying, set the bird aside, maintaining working weight and exercise sessions if possible. Serious feather damage requires that a bird be dropped from mission ready status.

III. Hardware

A. Cages

Two types of folding cages are used in transport, housing, and operational use of the bird. These are (1) the large plywood shipping-living cage and (2) the operational aluminum launching cage, which doubles for a short distance shipping cage.

The dimensions of the shipping-living cage, assembled, are 27" wide, 26" front to back, and 21-1/2" high. Folded, the cage requires packing space only 9 1/2" high with other dimensions unchanged. It weighs 37 lbs. A pull-out dropping tray may be filled with sand, shavings, or other absorbent material for cleanliness and odor control. A pair of cups for feed and water clamps to the vertical bars of the door. These cups may be fastened outside when the cage is no longer in transit. Openings in the door grill permit a bird to reach through to the outside cups. The external placement of the cups allows them to be filled and cleaned easily, and eliminates from the interior of the cage a possible hazard to the bird's feathers. (Photos 7 & 8)

An aluminum launching cage has been constructed. The walls of this cage fold flat against the top permitting top and sides to be placed inside the tray which forms its bottom. Assembled, the cage measures 21 1/2" wide, 23" front to back, and 17" high. Folded, it measures 20 1/2" by 22 1/2" by 2 1/2". The compromise dimensions of the cage offer the possibility of use for three purposes: as a shipping cage, a living cage, and as a launch cage. Doors at each end and a wooden insert to raise the floor level to the bottom of the front door provide the requirements for a launch cage. Packed with its floor insert, the folded cage measures 4 3/4" high. With the floor it weighs 28 lbs. (Photos 9 & 10)

B. Black Box Bird Carrier

The black box bird carrier, 18" x 7 1/2" x 13 1/2" is ventilated by baffled, light-tight openings (Photo 11). Because of complete darkness in the box, a bird carried in it makes little or no noise. This box should only be used when absolutely necessary, such as when carrying a bird into a building. Birds should not be left in the box for longer than 15 minutes.

C. Weight Scales

Accurate scales are desirable for weighing the birds. Unfortunately, good laboratory scales are bulky and delicate. A substitute is the small, simple type of spring scales known as "dietetic". The readings of such scales often tends to drift, so it is advisable to use a set of calibrating weights to permit checking and adjustments of the scales.

D. Laser and Accessories

A flashing red spot produced by a helium-neon laser is used to guide the bird to the delivery or pick-up point. The laser, Spectra Physics Model 132, is mounted on a pivoting stand and equipped with a motor driven chopper and simple open sights for aiming. (Photo 12) A spec sheet is included in the appendix.

As an aid to aiming the guidance laser, a telescopic sight has been mounted on a Spectra-Physic model 132 laser. Properly adjusted, the scope provides a line of sight parallel with the laser beam and 2 1/4" above the beam. The laser may be aimed with the scope crosshairs appearing 2 1/4" above the point at which the laser spot is to appear. (Photo 13 shows the scope-equipped laser mounted on a camera tripod.)

A laser requires the nominal 115 Volt 60 Cycle alternating current (ordinary U.S. house current). Where only 240 Volt house current is available, a step down transformer may be used.

For use where neither 120 nor 240 Volt AC power is available at the launch site it is possible to use an inverter to convert 12 Volt battery power to 120 Volts, 60 Hz power. A Honda motorcycle battery, model 12N9-3A, and a Terado inverter, model 50-170, is suitable for this purpose. (Photo 14) (Specs in appendix) It is reasonable to expect that a 12 Volt motorcycle battery of 10 ampere hour rating will operate the laser via the inverter for at least one hour continuously.

E. Recall Lamp

This is a conventional "high-intensity" miniature lamp. Ordinarily such lamps employ a 12 Volt bulb and are equipped with a built-in transformer for 120 Volt AC operation. Because timing of the recall is critical, the lamp is equipped with an easy working external foot operated switch. If 115 Volt 60 Cycle alternating current is not available the recall lamp can be used with a step down transformer or with the inverter mentioned in section D, above.

It has been found that the high intensity lamp, used as a recall signalling device, is overly bright if directed outward toward the returning bird under dark twilight conditions. The light may be directed downward to avoid blinding the bird. If the launch cage is visible to the returning bird, the lamp may be placed on top of the cage aimed so that it illuminates the interior of the cage through an opening in the cage top. (Photo 15)

IV. Hypothetical Example of System in Use

It may be helpful in understanding the procedures of care and working of the birds to consider them in terms of an imaginary mission program. Following is a description of a hypothetical mission. The principal emphasis of the description is on care and handling of the birds.

An overseas mission is planned requiring the placement of a device at approximately a certain date. Following initial placement, the device is to be retrieved and replaced at intervals ranging from two to four weeks. Actual mission flights are planned for either dawn or dusk as opportunity arises.

A team of two birds is to be flown overseas. Information concerning working weight and any idiosyncracies is known by the handler. Air travel time, including stop-overs, will total 36 hours. Arrangements have been made to store the birds and equipment at a secure "base station" in the general area of the mission site. Air travel is to be by aircraft over which mission personnel has control, that is, not by commercial air line.

Birds are to travel in shipping-living cages approximately the dimensions of a two foot cube. These cages can, when necessary, be taken apart and the parts folded. The equipment and supplies check list is carefully gone over (section VI) and all items are packed for shipping.

Ten days before the first planned mission the birds, supplies, and equipment are loaded aboard a plane for the first leg of the journey. During travel the birds are hand fed crow salad three times a day because eating tends to reduce possible traumatic effects of travel experience. Feeding times are separated in time as much as reasonably possible, four or five hours apart, for example. At each feeding, a bird is given all the food he will quickly consume. If the bird does not consume his alloted daily ration at the end of the third hand feeding session, the remainder of the food is placed in the feed cup.

The trip to an overseas air field requires three days, including one stop-over enroute, during which the normal feeding schedule is maintained. From the air field the birds are to be taken by a small car to a secure base station at a distance requiring about three hours of driving. The shipping cages are too large to fit into the car, so the birds are transferred to the smaller cages. The shipping cages are folded so that they may be carried in the trunk of the car. Other equipment, packed in suitcases, is also carried in the car.

Upon arrival at the base station the birds are transferred again to the larger cages.

The fourth day is the first at the base station. The birds are weighed and found not to have lost weight in transit. Two attempts, spaced about eight hours apart, are made to work the birds at short range indoors. They perform poorly at the first session, better at the second as appetite returns. At the end of the day the birds are hand fed, each from his allotment of 50 grams of crow salad, part of which has been earned in the exercise sessions. One bird stops eating before he has consumed all of the allotment and is fed no more for the day.

On the fifth day both birds are more active and are each given several exercise sessions in the course of the day. These sessions are held indoors, some at the maximum possible ranges down a hallway. A laser is used in guidance. Each bird works sufficiently to have received about 50 grams of crow salad as rewards and neither is given additional food at the end of the day.

On the sixth day each bird again works well indoors and, in the course of the exercise sessions conducted periodically throughout the day, earns the allotment of 50 grams.

On the seventh day it is found possible to arrange for outdoor "simulated mission" flights at dawn and at dusk. The birds are tried in the morning session first tethered at short range because their handler does not wish to risk danger of even temporary straying of a bird. The birds do not seem eager to work, probably because of fairly low drive, and so range is not extended and the outdoor practice session is ended. The birds are given only a few indoor exercise sessions in the course of the day, so as to allow drive to increase. At a dusk session outdoors the birds are more eager to fly. Following a few short range tethered flights, range is extended to mission distance and a few successful untethered flights are made. Only four longer range flights (two correct placements and two retrievals) are permitted because, again, of fear of straying by a partially sated bird. Evening weighing of the birds indicates a weight loss of about 15 grams for each bird. The loss is not considered alarming, and the birds are fed only the remainder of their allotment.

An actual mission flight has now been scheduled for a site a few hours drive from the base station. Placement of a package on a target ledge is planned for 6:00 pm of the tenth day. Launch is to be from the window of an apartment located about 100 feet from a target ledge. Only one bird is to be taken to the apartment a few hours before the attempt is made.

On the eighth day the handler decides to make a choice between the two birds at an evening outdoor test session. The birds are kept idle through the day, not exercised because he wishes to build up drive for the evening test. At dusk, both birds are tested at mission range. Both perform properly, but one shows less hesitation in placing a package on a target ledge, setting it down without showing any tendency to pick up again and responding quickly to the recall lamp signal. This bird is first choice for the mission, but both will be made ready.

It is now approximately 48 hours from the scheduled mission flight time. Past feeding has maintained the birds at near optimum weight. Each is now found to be only about 10 grams under the recommended optimum holding and training weight. Each is then fed the remainder of his day's 50 gram ration. All litter and any other substances that a hungry bird might ingest are removed from the cages. Only drinking water remains.

Twenty four hours later (T minus 24) each bird is given a short indoor working session, but allowed to earn no more than 10 grams of food.

At opportune times, necessary equipment, e.g., laser, recall lamp, etc., is moved in suitcases to the launch apartment. Late evening, after dark, is deemed the most secure time to move the chosen bird to the apartment. The bird is transferred to one of the launch cages. His living cage is folded and, because it is too large to fit a suitcase, is wrapped as a package. Bird, cage package, and a "black box" cage are taken in a small car for the trip to the launch site. Shortly before arrival the bird is transferred to the "black box". This box, 18" x 7 1/2" x 13 1/2" is ventilated by baffled, light-tight openings. Because of complete darkness in the box, a bird carried in it makes a little or no noise. The launch cage is folded and placed in a suitcase.

Bird, suitcase, and wrapped living cage are carried into the apartment. The cages are unwrapped, assembled, and the bird is transferred to the living cage.

As time T approaches, equipment is set up. It is found convenient to place the laser at one window and the launch cage and recall lamp at another. As dusk begins to fall the bird is moved from the living cage to the launch cage. Unfortunately, a heavy rainfall commences and lasts through the dusk period. A light rain or mist might have reduced the risk of detection and yet permitted the flight to have been attempted, but it now must be postponed.

It is decided to "hold" until dawn at which time another attempt at delivery may be possible. This will mean a delay of 12 hours. The handler estimates that at the "holding" rate of feeding of 30 grams per 24 hours, he should feed the bird 15 grams of crow salad. Lacking a scale he guesses the amount accurately enough. He has left word at the base station to feed the reserve bird at the same rate.

At the first signs of morning light, equipment is again placed and checked and the bird is again transferred to the launch cage. As soon as the target becomes clearly visible the windows are opened and the laser is sighted at the ledge and turned on very briefly to check the aim.

Rather than risk a package on the first flight, the handler signals for the laser to be turned on and releases the bird but does not present him with the package. The bird flies to the target, the laser is switched off, the recall lamp is turned on and immediately extinguished as the bird enters the cage. The bird is rewarded at the same time. (Had the bird seemed "spooky" of the target ledge, one or two more no-load runs might have been made if it seemed safe to allow them.)

For the final flight, the package is held at the cage opening as the door is opened. The bird grasps it, flies to the target ledge, and is recalled as soon as the package is put down. Reward follows the return, and if package placement is considered acceptable the mission is "wrapped up". (If the positioning of the package is critical and it is not acceptably placed, it may be necessary to send the bird out to recover it and then to try again. If the bird cannot be faulted for an improper placement, for example, if he accidentally moves it with his foot on take-off to return to the cage, there is no question but that he should be rewarded. If placement is faulty because of failure to make the placement in accordance with previous training, it may still be necessary to use the recall signal, which is rewarding in itself, even though this is poor training procedure. In an actual mission avoiding temporary loss of the bird is more important than slight possible deterioration of behavior.)

The bird has successfully accomplished a placement and it is expected that the package will remain in its place for some time. Both birds have lost weight because of food deprivation in preparation for the flight. The mission bird is hand fed immediately as much as he will accept. A message to the base station informs the station that the back-up bird is to be similarly fed.

The mission bird is returned to the base station as soon as it is practical to do so. A two day rest and "feed-up" restores both birds to normal weight.

At the base station, the regular feeding and exercise program is restored. Although it is hoped that recovery and replacement of the package can be programmed as a regular operation for every three weeks, it is realized that emergencies may arise requiring, on short notice, a retrieval of a package. It is not possible to keep a bird constantly ready to go, but the handler arranges a schedule which feeds each bird lightly on a different alternate day. For example, one bird is allowed only 35 grams, the other given 65 grams on a particular day. The next day the feed allotment is reversed. Thus there is always one bird kept at a fairly high drive.

If an emergency should arise, both birds are immediately deprived of food. As one bird is already on a mild deprivation schedule, he should be ready to go to work in 24 to 30 hours following the last feeding.

In an emergency, the readiness of a bird must be judged at the time by the handler. He has deprived both birds but even though one may theoretically be more hungry than the other, he must make his choice of the birds in terms of apparent eagerness to work and upon his knowledge of their past records. In an emergency situation in which bird eagerness cannot readily be judged, it is more likely that a "doubtful" bird will make a retrieval rather than a placement. Placement is the more difficult behavior.

V. Check List of Information Needed from Field for Operational Planning

A. Photograph and description of target

1. Height of target from ground
2. Distance of target from launch point
3. Horizontal angle of target from launch point
4. Knowledge of depth of target ledge
5. Scale of photograph
6. Any peculiarities of target

B. Description of launch point

1. Height of launch point from ground
2. Available power
3. Indoor or outdoor release
4. Size and configuration of launch opening, i.e., window, back of truck, etc.
5. Any peculiarities of the launch point such as drapes over windows, grill work, etc.

C. Operational site environment

1. Climate
2. Urban or rural

3. Obstacles between launch point and target, i. e., trees, window grills, window shutters, phone and electric wires
4. Time of day for operation
5. Any local wind peculiarities in area covered by bird
6. Dawn or dusk
7. Noise level and peculiar noises
8. Any possible disturbing influences - human activity - dogs, cats, other birds, etc.

D. Type and length of travel required

E. Legal restrictions or obstacles in international transport of birds

F. Overseas storage and maintenance

G. Facilities available

1. Indoor exercise
2. Outdoor exercise
3. Local availability of food items, litter, etc., for birds

VI. Equipment and Supplies Check List

1. Trained birds - 2 each
2. Folding living-shipping cages - 2 each
3. Folding launch cages - 2 each
4. Laser with open or telescopic sights - 2 each
5. Laser mount with chopper and base - 1 each
6. Power Supply containing Terado inverter, storage battery, and battery charger, - 1 each
7. Step-down transformer (230 v. to 115 v.) - 1 each
8. Recall lamp with foot switch - 1 each
9. Map case (black box) - 1 each
10. Scale with calibration weights - 1 each
11. Fresh crow salad in thermos jug
12. Freeze-dry crow salad
13. Sulmet or other sulfa drug
14. Silver nitrate
15. Vitamycin
16. Bone meal
17. Dummy training packages
18. Food grinder - 1 each

19. Emergency recall signal, audible - 2 each

20. Cage litter (commercial Kitty litter)

21. Spray bottle for water - 1 each

22. Binoculars or other visual aids

23. Tethering equipment

    reel with line

    snap swivels

    leg bands

24. Spare parts

    Laser fuse (Buss MDL 1/2 amp, Fusetron fuse) Terado

    Inverter fuse (Buss AGC-25 or Littelfuse 3AG-25)

    Bulbs, recall lamp (size 93-12 volt)

    10' extension cord with 3-way outlet

    3 wire adapter for laser

    Small Phillips screwdriver

    Long-nose pliers

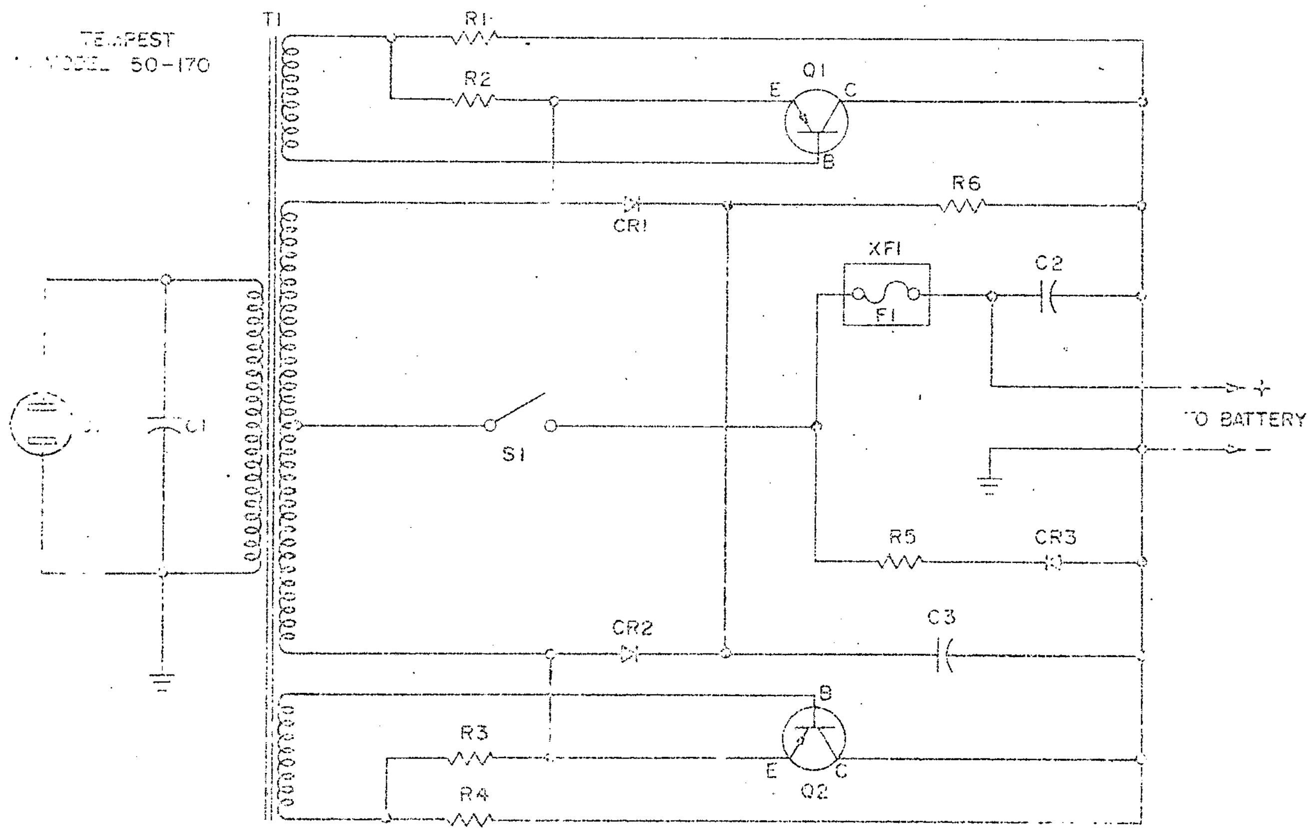
    Roll electrician's tape

INVERTER

SPECIFICATIONS

TEMPEST MODEL 50-1..

OPERATING INSTRUCTIONS



OPERATING INSTRUCTIONS
MODEL 50-170 TEMPEST

Terado CORPORATION

INPUT VOLTAGE - 12 VOLTS D.C. CAR VOLTAGE REGULATOR MUST BE SET NO HIGHER THAN 13.8 VOLTS WHEN ENGINE IS WARM

OUTPUT VOLTAGE - 117 V.A.C.

CAPACITY - 125 WATTS CONTINUOUS
150 WATTS INTERMITTENT

1. CAUTION: MAINTAIN AT ALL TIMES, AT LEAST A 30 TO 40 WATT LOAD ON THIS INVERTER. WITHOUT THIS LOAD THE PEAK COLLECTOR TO EMITTER VOLTAGE WILL RISE AND CAUSE TRANSISTOR FAILURE. THIS INVERTER IS NOT DESIGNED FOR CONTINUOUS OPERATION. A PERIOD OF FIVE (5) HOURS USAGE SHOULD NEVER BE EXCEEDED IN ANY CASE. COOLING OF THE POWER TRANSISTORS IS VERY CRITICAL AFTER THIS TIME IS REACHED.
2. FUSING - USE ONLY 25 AMPERE FUSES. RECOMMENDED TYPES: BUSSMAN AGC25 & LITTLEFUSE 3AG-25. NEVER SLUG FUSES. THIS COULD CAUSE COMPLETE BURN-OUT OF POWER TRANSISTORS AND TRANSFORMERS.
3. FOR FACTORY SERVICE - ADVISE OUR FACTORY SERVICE DEPARTMENT THAT THE UNIT IS BEING RETURNED, ALONG WITH AN EXPLANATION OF PROBLEMS. FLOAT PACK OR CAREFULLY CUSHION UNIT TO AVOID DAMAGE. ALSO EXAMINE WHEN RECEIVED AND MAKE CLAIM IF NEEDED.
4. SHIPPING - VIA PREPAID EXPRESS OR TRUCK - DO NOT SHIP PARCELPOST - WARRANTY WILL BE VOID IN ALL CASES IF THESE INSTRUCTIONS ARE NOT FOLLOWED.
5. CAUTION - YOU ARE RESPONSIBLE FOR DAMAGE TO YOUR UNIT IF RETURNED IMPROPERLY PACKED ****SAVE PACKING MATERIAL UNIT IS RECEIVED IN****
6. WARRANTY - THE TEMPEST INVERTER IS GUARANTEED AGAINST DEFECTIVE WORKMANSHIP AND MATERIAL FOR A PERIOD OF 90 DAYS. WE RESERVE THE RIGHT TO REVOKE THIS GUARANTEE IF IN OUR OPINION THE CONDITIONS AND INSTRUCTIONS HAVE NOT BEEN FOLLOWED. A NOMINAL SERVICE CHARGE FOR PARTS AND LABOR WILL BE MADE ON ALL UNITS OUT OF WARRANTY.

INSTALLATION OF INVERTER

1. CAUTION: DO NOT INSTALL INVERTER IN MOTOR COMPARTMENT AS EXCESS HEAT CAN CAUSE TRANSISTORS TO FAIL. ALSO THE WEATHERPROOFING UNDER THE HOOD OF VEHICLE IS INSUFFICIENT. UNIT SHOULD BE INSTALLED IN DRY AREA.
2. KEEP RADIOS AWAY FROM INVERTER AND ITS WIRING, TO REDUCE NOISE PICK-UP. REVERSE AC PLUG IF NOISE IS HEARD WHEN OPERATING RADIOS. THIS INVERTER NOT RECOMMENDED FOR TAPE RECORDERS.
3. CAUTION: THE INVERTER INPUT LEADS MUST BE CONNECTED TO THE PROPER POLARITY TERMINALS TO INSURE PROPER OPERATION. THIS UNIT IS EQUIPPED WITH A POLARITY SENSING DEVICE THAT WILL BURN OUT IF BATTERY CABLES ARE CONNECTED UP IN REVERSE OF ABOVE. SERIOUS DAMAGE TO TRANSISTORS CAN ALSO RESULT IN THE CASE OF REVERSE POLARITY.
4. INVERTER IS DESIGNED FOR NEGATIVE GROUND VEHICLES. CABLES SHOULD BE CONNECTED RED TO POSITIVE - BLACK TO NEGATIVE. CAUTION - IF THE VEHICLE A POSITIVE GROUNDED SYSTEM, COMPLETE INVERTER WILL HAVE TO BE INSULATED FROM VEHICLE BODY.
DO NOT OPERATE REFRIGERATORS OR COMPRESSORS. STARTING CURRENT WILL IMMEDIATELY DESTROY TRANSISTORS. WARRANTY VOID

OPERATION OF INVERTER

1. THIS IS A TRANSISTORIZED POWER INVERTER USING 2 TRANSISTORS ON MODEL 50-170. IT IS DESIGNED TO GIVE PEAK EFFICIENCY INVERTING 12 VOLTS DIRECT CURRENT TO 110 VOLTS AC - 60 CYCLES.
2. THIS INVERTER DOES NOT HAVE EXACT 60 CYCLE CONTROL FEATURE BUILT IN. THE FREQUENCY OF UNIT IS DEPENDENT ON THE INPUT VOLTAGE AND THE LOAD ON THE 110 VOLT SIDE.
3. THIS INVERTER WILL OPERATE MANY 110 VOLT APPLIANCES. THESE INVERTERS ARE NOT RECOMMENDED FOR FREQUENCY SENSITIVE EQUIPMENT.
4. CAUTION: OPERATION OF FLUORESCENT LIGHTS - FIXTURE MUST BE POWER CORRECTED. DISREGARD WATT RATING OF TUBE OR TUBES, STARTING CURRENT MUST NOT EXCEED 75% CAPACITY OF INVERTER. MEASURE STARTING CURRENT WITH A WATT METER BEFORE ATTEMPTING TO USE WITH INVERTER.
5. CAUTION: DO NOT OVERLOAD INVERTER WITH APPLIANCES SUCH AS TOASTERS, ELECTRIC FRYING PANS, ELECTRIC COFFEE MAKERS, LARGE MOTORS, HEAVY POWER TOOLS. ALWAYS INSPECT NAMEPLATE ON APPLIANCE FOR WATTAGE BEFORE USING, OR MEASURE WITH A WATT METER. LOADS IN EXCESS OF RATINGS ON INVERTER WILL ACT AS A SHORT CIRCUIT AND CAUSE TRANSISTOR FAILURE.

PARTS LIST FOR MODEL 50-170

SYMBOL	PART NAME	PART NO.
C-1	CONDENSER .1 MFD - 400 VOLT PAPER	1025
C-2	CONDENSER 4000 MFD - 50 VOLT ELECT.	1365
C-3	CONDENSER 500 MFD - 50 VOLT ELECT.	1031
CR-1	RECTIFIER 1.0 AMP - 50 PIV	1204
CR-2	RECTIFIER 1.0 AMP - 50 PIV	1204
CR-3	RECTIFIER 1.0 AMP - 50 PIV	1204
F-1	FUSE - 25 AMPERE	1040
XF-1	FUSEHOLDER, HKP	1039
J-1	RECEPTACLE, ROUND 2 WIRE TYPE	1159
Q-1	TRANSISTOR, POWER - TYPE 2N2152	1352
Q-2	TRANSISTOR, POWER - TYPE 2N2152	1352
	(NOTE: THE ABOVE TRANSISTORS ARE SELECTED UNITS AT THE FACTORY - THE ABOVE TYPES MAY BE SUBSTITUTED IN CASE OF EMERGENCY)	
R-1	RESISTOR, 100 OHM - 5 WATT	1328
R-2	RESISTOR, 1.5 OHM - 5 WATT	1327
R-3	RESISTOR, 1.5 OHM - 5 WATT	1327
R-4	RESISTOR, 100 OHM - 5 WATT	1328
R-5	RESISTOR, .47 OHM - 2 WATT	1227
R-6	RESISTOR, 150 OHM - 5 WATT	1329
S-1	SWITCH, SPST	1135
T-1	TRANSFORMER, POWER	1019-3
	RED LEAD BATTERY CABLE, #14 WIRE - 6 FT.	1186
	BLACK LEAD BATTERY CABLE #14 WIRE - 6 FT.	1187

Terado CORPORATION
1068 Raymond Ave. -:- Phone 646-2668
St. Paul, Minnesota 55108

LASER

SPECIFICATIONS

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1.0 Model 132 Specifications

Output

Power:	1.0 milliwatt minimum
Wavelength:	632.8 nm (visible red)
Transverse Mode:	TEMoo
Longitudinal Mode Spacing:	550 MHz
Beam Diameter:	Approximately 0.8 mm at $1/e^2$ points
Beam Divergence:	Approximately 1.0 milliradian at $1/e^2$ points
Polarization, 132:	Unpolarized
Polarization, 132-01:	Vertically Polarized (cross component less than 3%)

Stability

Intermode Amplitude Noise (1-100 kHz):	Less than 0.3% rms.
Amplitude Ripple (120 Hz over voltage range 105 vac to 125 vac)	Less than 0.5%
Warmup Time:	Greater than 0.7 mw at turnon. Greater than 1 mw three minutes after turnon.

Environmental

Operating Temperature:	0 to 40°C
Storage Temperature:	-20°C to 65°C
Altitude:	10,000 feet maximum

Power

Voltage:	105V-125V rms
Frequency:	60-400 Hz
Volt-amps:	35 volt-amps, max
Cable Length:	6 feet

Mechanical

Weight:	7.5 lbs, (3.4 Kg)
Dimensions:	15.5 x 5.6 x 3.9 inches
High Voltage Protection:	An interlock is provided on the bottom coverplate to disable the high voltage supply whenever the plate is removed. 1"-32 thread is provided to connect accessory telescopes.

Options

01	Linear Polarization (cross component less than 3%)
02	190-250V rms 50-400 Hz 35 volt-amps, max 6 feet of power cord

2.0 Introduction

The Spectra-Physics Model 132 CW Gas Laser provides the high level of performance and reliability associated with Spectra-Physics leadership in the gas laser field. Quality workmanship and performance features such as conservative operating specifications, guaranteed stability, and self-starting are standard. A compact, light-weight package and simplicity of operation make the 132 Lablite a pleasure to use.

Heart of the Model 132 is a new internal mirror plasma tube with long-life cold cathode. Spectra-Physics technical leadership in HeNe plasma tube physics has been fully incorporated into the 132 tube. Improvements in cathode design, plasma tube sealing, and dielectric coatings result in extended lifetime and improved amplitude stability.

The output of the Model 132 behaves as unpolarized light in most experiments. However each axial mode of the 132 internal mirror plasma tube is actually polarized perpendicular to adjacent modes. For applications requiring a polarized light, Option 01 provides a cross component that is less than 3%. This degree of polarization is sufficient to provide the benefits of polarized light in most applications.

3.0 Operation

WARNING

IF THIS UNIT IS DROPPED OR OTHERWISE DAMAGED, IT SHOULD BE CHECKED BY A QUALIFIED TECHNICIAN BEFORE CONNECTING TO A POWER SOURCE.

1. If the laser is a European model, ("220-240" on serial tag) check that power is disconnected. Then remove six screws to release bottom panel, and adjust transformer input tap for the closest available line voltage. The transformer is wired for 240v operation between transformer taps 1 and 3 at the factory. Taps 1 and 2 connect the laser for 220v operation.

   Note

   It is important that the transformer be connected for the correct input voltage. If low voltage is connected to the 240v tap the laser may not start. Connection of high voltage to the 220v tap may result in decreased plasma tube life. BE SURE TO REPLACE BOTTOM COVER BEFORE APPLYING POWER.

2. Plug into appropriate power source: 117 volt, 60 Hz to 400 Hz for U.S. models; 220 Volt or 240 Volt, 50 Hz to 400 Hz for European model.
3. Place the power switch (next to line cord) at "on".
4. The laser should lase within 30 seconds. If not, refer to Section 4.0 for troubleshooting information.

WARNING

THIS UNIT HAS HIGH VOLTAGE CIRCUITS THAT ARE EXPOSED WITH THE COVERS REMOVED.

4.0 Troubleshooting

If there is no laser output when power is applied, the following checks will aid in locating the malfunction:

WARNING

MAINTENANCE TO THE HIGH VOLTAGE CIRCUITS IN THIS UNIT SHOULD ONLY BE ATTEMPTED BY TECHNICIANS EXPERIENCED IN HIGH VOLTAGE AND HIGH CURRENT CIRCUITS.

1. Look at the laser exit aperture (DO NOT LOOK DIRECTLY INTO THE LASER SINCE THE MODEL 132 LASER OUTPUT MAY BE HAZARDOUS TO THE EYES). Look for an indication of plasma exitation. If the plasma is lit, there will be an orange light reflecting inside the case. If the plasma is lit but there is no laser output, it can be assumed that the tube is defective. See Section 5.0 for tube-replacement instructions.

2. If there is no indication of plasma excitation in step 1, disconnect line power. Wait two minutes for high-voltage capacitors to discharge, and then remove four screws to release the top cover. Make a visual inspection of the plasma tube for breakage. Then check the fuse which is located at the rear of the upper deck.

3. If there is no evidence of malfunction on the upper deck, a defect may exist in the high-voltage supply. Remove six screws to release the lower cover. A line voltage interlock prevents application of line power to the high-voltage circuit. THIS PRECAUTION IS TAKEN BECAUSE OF THE EXTREMELY HAZARDOUS VOLTAGES AND CURRENTS IN THE HIGH-VOLTAGE CIRCUIT.

4. With line power disconnected, wait two minutes to let the high-voltage capacitors discharge, and then short out any residual capacitor charge with a well-insulated lead. Short between the "+" connection (shown in in Figure 5-1) and the "Cath" connection on the printed side of the circuit board.

5. Proceed with high-voltage circuit troubleshooting. The schematic is shown at the rear of the manual.

4.1 High Voltage Circuit

The high voltage circuit supplys the plasma tube dc excitation voltage (approximately 1300 volts). AC is transformed in T101 to 1300 RMS and the doubler circuit of diode CR 101, CR 102, and associated capacitors supply dc high voltage of 3400 volts. Ballast resistors R111 through R114 limit plasma tube current to 6 ±2 milliamperes.

Start multiplier section, CR 103, CR 104, CR 105 and C111, C112, C113 provide increased high voltage (more than 8000 volts) under a no-load condition (tube plasma not lit). This circuit becomes ineffective and high voltage drops to approximately 3400 volts as soon as the tube ignites and draws current.

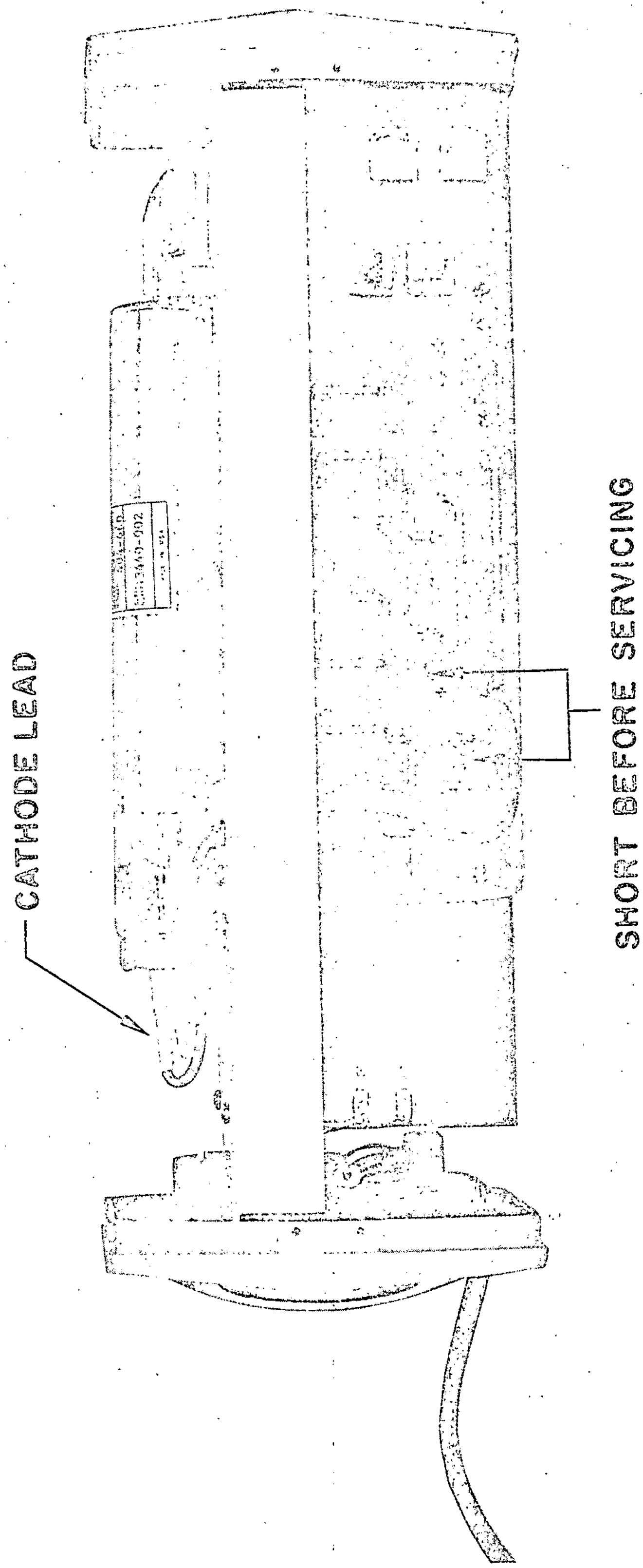


Figure 4-1 Cathode Lead

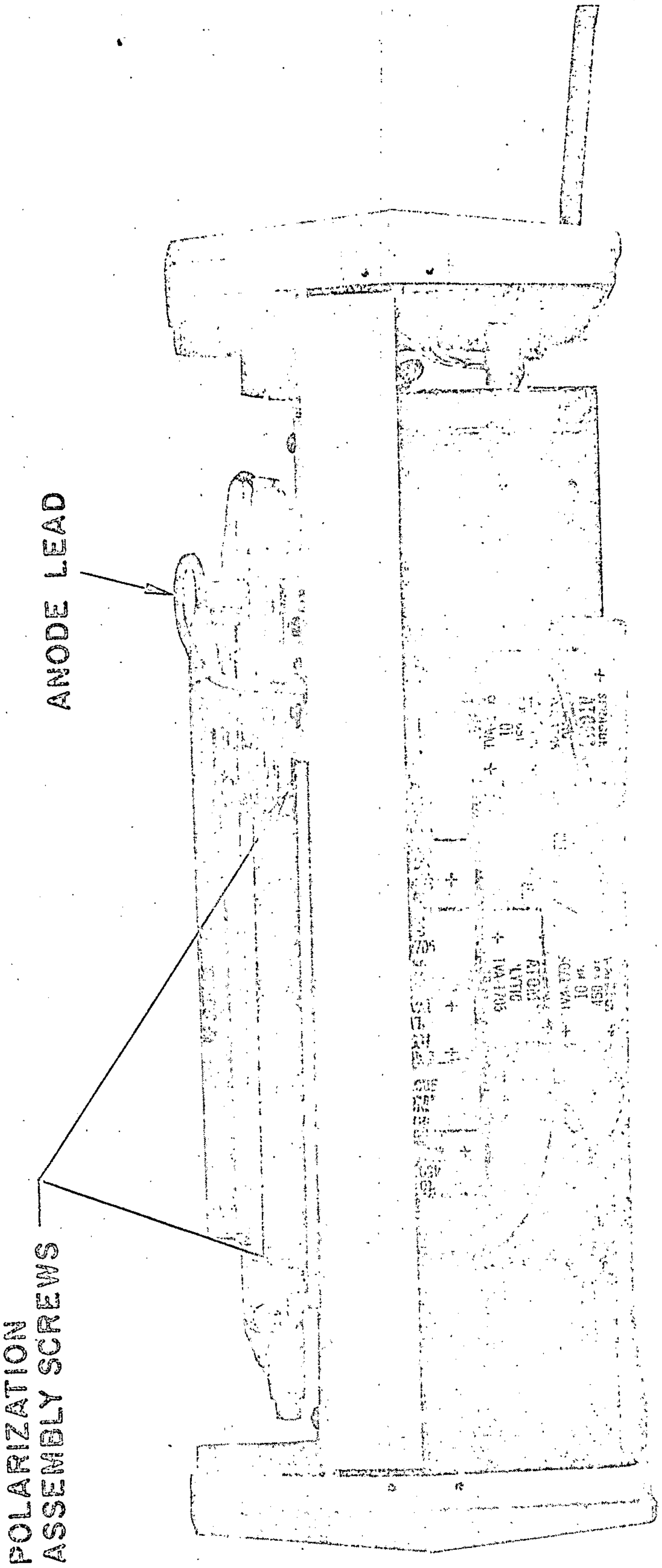


Figure 4-2 Anode Lead and Polarization Assembly

5.0 Tube Change

5.1 Tube Removal

1. Disconnect from line power. Wait at least two minutes to allow internal capacitors to discharge.
2. Remove four screws to release top cover.
3. Remove two screws to release polarization magnet (shown in Figure 4-2). Slide this assembly clear.
4. Remove six screws to release the bottom cover. SEE WARNING BELOW BEFORE PROCEEDING.

WARNING

WITH THE BOTTOM COVER REMOVED, THE H.V. CAPACITORS SHOULD BE SHORTED OUT TO ELIMINATE THE DANGER OF A RESIDUAL H.V. CHARGE. FIRST CHECK THAT LINE POWER IS DISCONNECTED AND THEN USING A WELL-INSULATED WIRE, SHORT THE "+" CONNECTION SHOWN IN FIGURE 4-1 TO THE "CATH" CONNECTION ON THE PRINTED SIDE OF THE BOARD.

5. Unsolder the plasma-tube anode and cathode leads from the H.V. circuit board. See Figures 4-1 and 4-2 to identify the leads. Pull the leads through the top deck.
6. Use a 3/32 allen wrench to remove two plasma tube mounting screws at each end of the plasma tube. Then lift the plasma tube clear.

5.2 Tube Replacement

Replace the plasma tube and polarizing magnet in the reverse order (of Section 5.1) taking the following precautions:

1. Determine tube position by laying the polarizing magnet in place with the mounting holes lined up and positioning the plasma tube for no mechanical interference.

Note

After the tube mounting screws are tightened, do not place any bending or rotating pressures on the plasma tube.

2. Refer to Figures 4-1 and 4-2 for correct anode and cathode connections. BEAR IN MIND THAT IF THE HIGH-VOLTAGE CONNECTIONS ARE REVERSED, THE PLASMA TUBE WILL BURN OUT ALMOST IMMEDIATELY.
3. When replacing the polarizing magnet, use the slotted mounting holes to position this assembly with 1/16-inch clearance from the plasma-tube cathode.

4. When replacing the bottom cover, note the interlock plug located at the rear of the bottom cover. When replacing this cover, guide the interlock plug into place and press firmly to engage it before fastening the bottom cover.

6.0 Field Installation of Polarization Magnet Assembly

1. Turn off line power and wait at least two minutes to allow internal capacitors to discharge.
2. Remove four screws to release top cover.
3. Lay the polarization magnet assembly in place as shown in Figure 4-2. Check that there is clearance to the tube with mounting-holes lined up. If not, loosen the tube mounting brackets to re-position the tube. Then tighten the tube in this position.
4. Using the two screws provided, fasten the polarization magnet using the slotted mounting lugs to position this assembly with 1/16-inch clearance from the cathode.

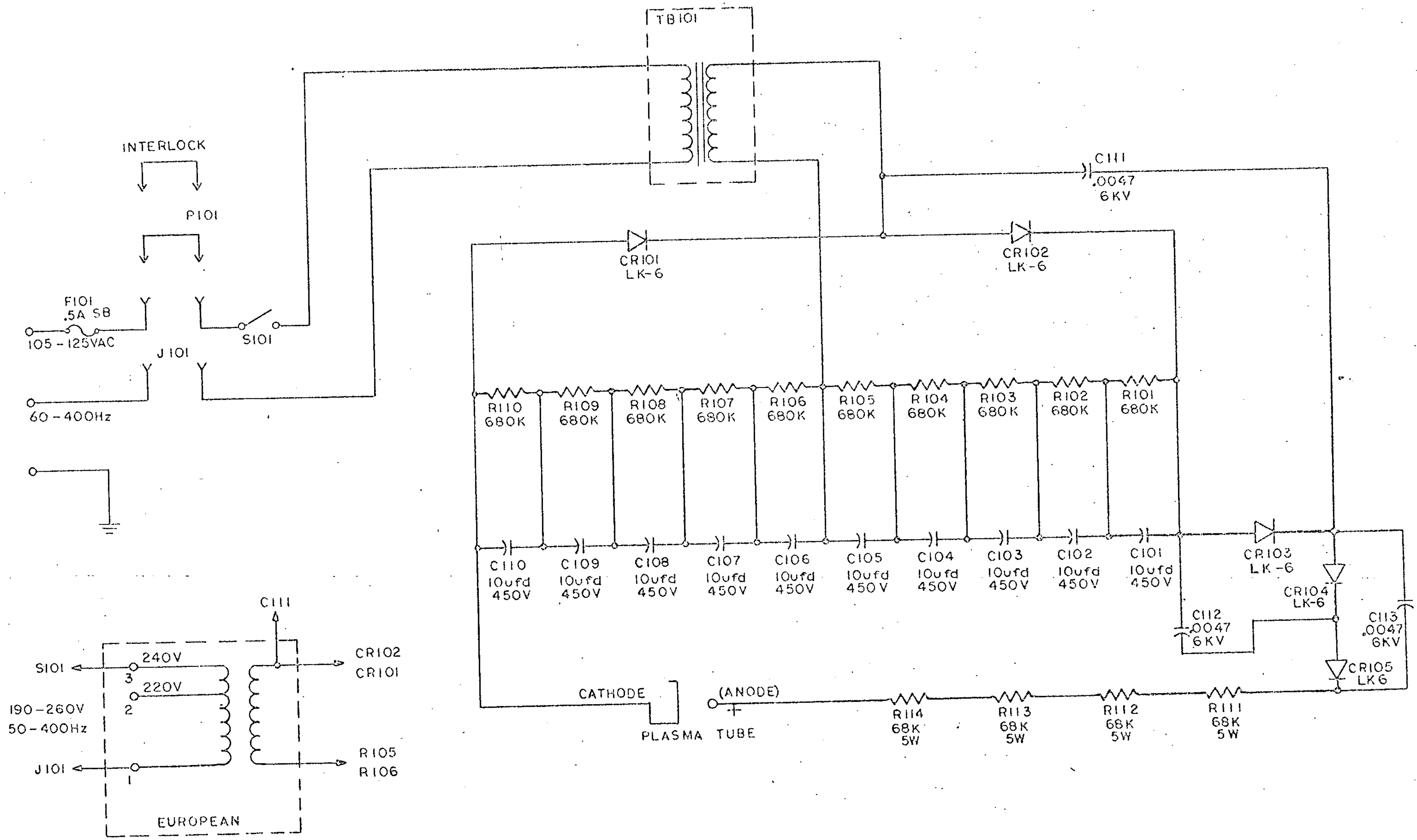
> Note
>
> A small decline in total power output (less than 20%) may be noted with the installation of the polarization assembly.

WARRANTY

All mechanical, electronic, and optical parts or assemblies, including the plasma tube are unconditionally guaranteed to be free from defects in materials or workmanship for one year after date of shipment. The simplicity and reliability of the Model 132 are such that any repairs that may be required can readily be accomplished at the users facility.

In the event that a replacement part or plasma tube is required, simply contact the nearest SPECTRA PHYSICS field office or service center, and the part will be forwarded to you in exchange for the defective item.

Units that are returned to the factory, or service center for repair will require that a $25.00 service charge and all transportation charges be paid by sender.



MODEL 132 LABLITE HELIUM-NEON GAS LASER SCHEMATIC DIAGRAM

PRINT NO. C404-678

Approved for Release: 2019/07/30 C06527437

NOTE
Grip on leg; finger and wrist perch

Photo 4
Correct Way to Hold Bird

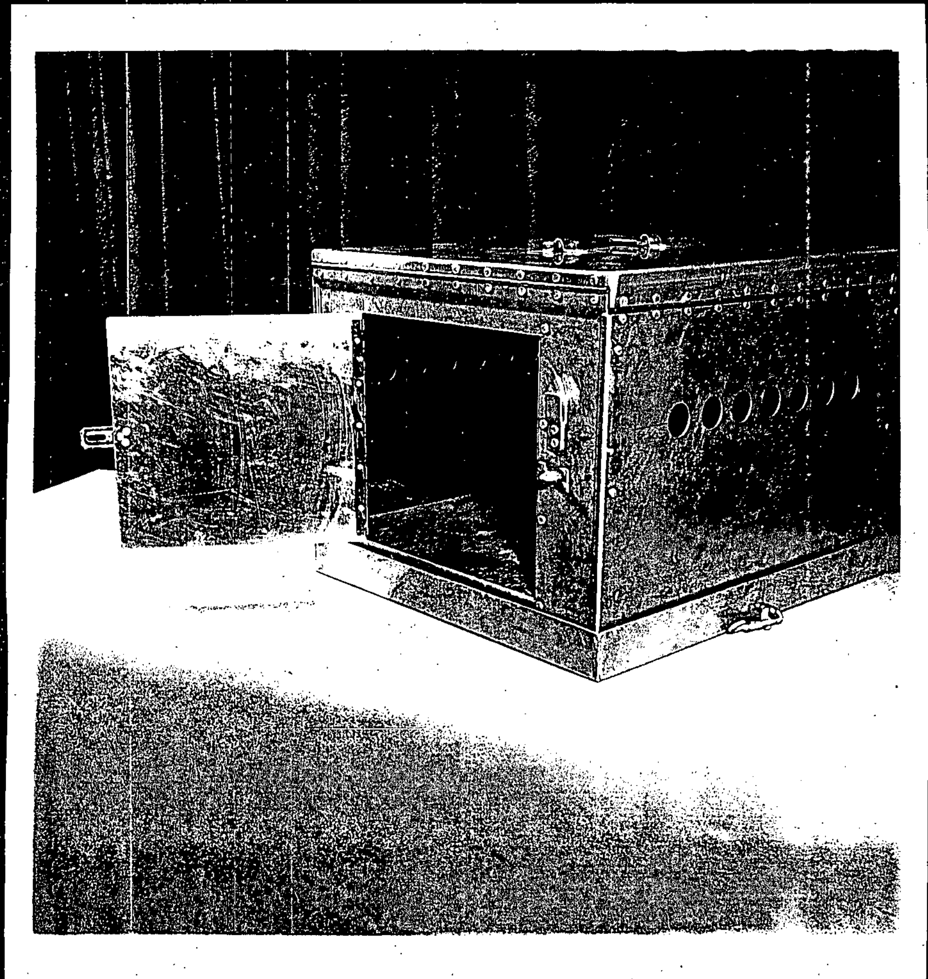


Photo 9

Launching Cage (inside)

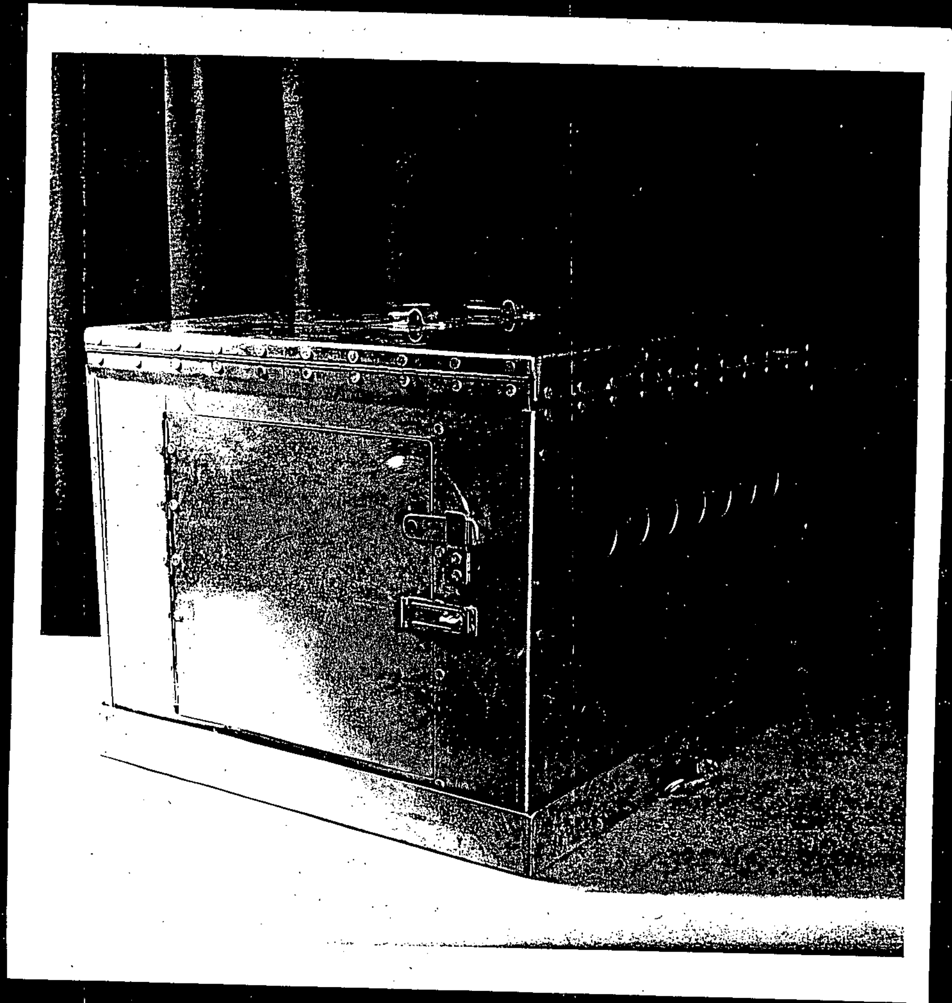


Photo 10

Launching Cage (outside)

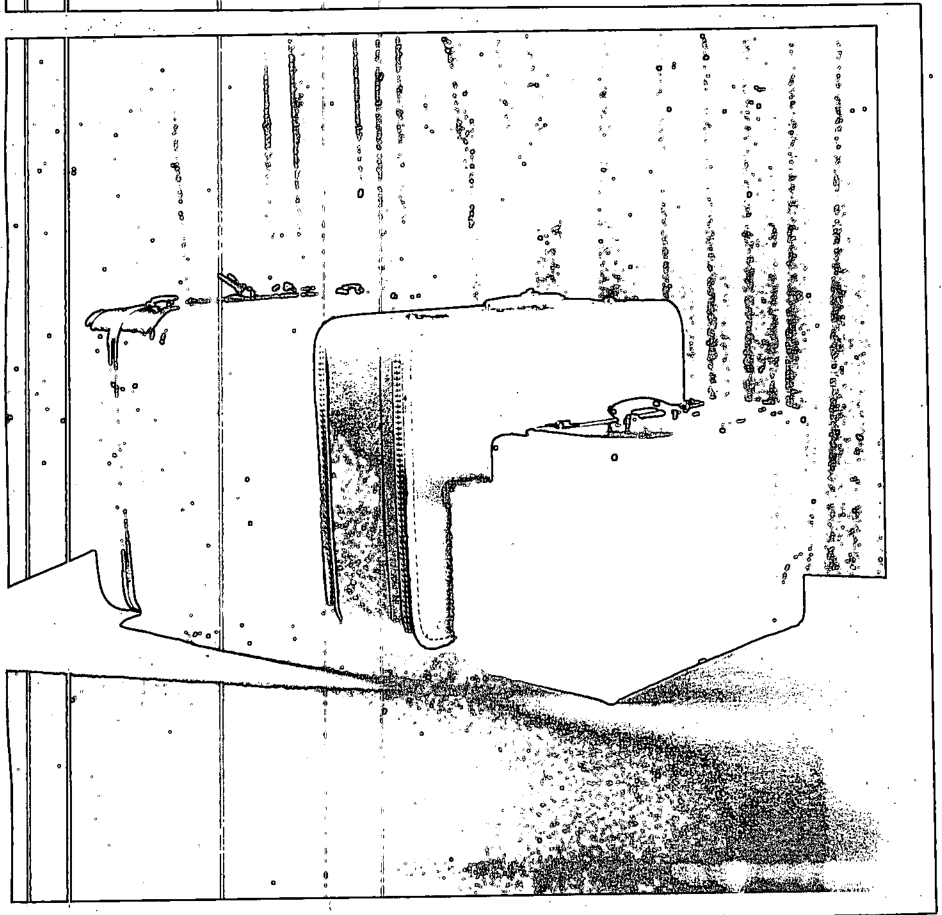


Photo 11

Rt. Black Box   Lf. Carrying Cases

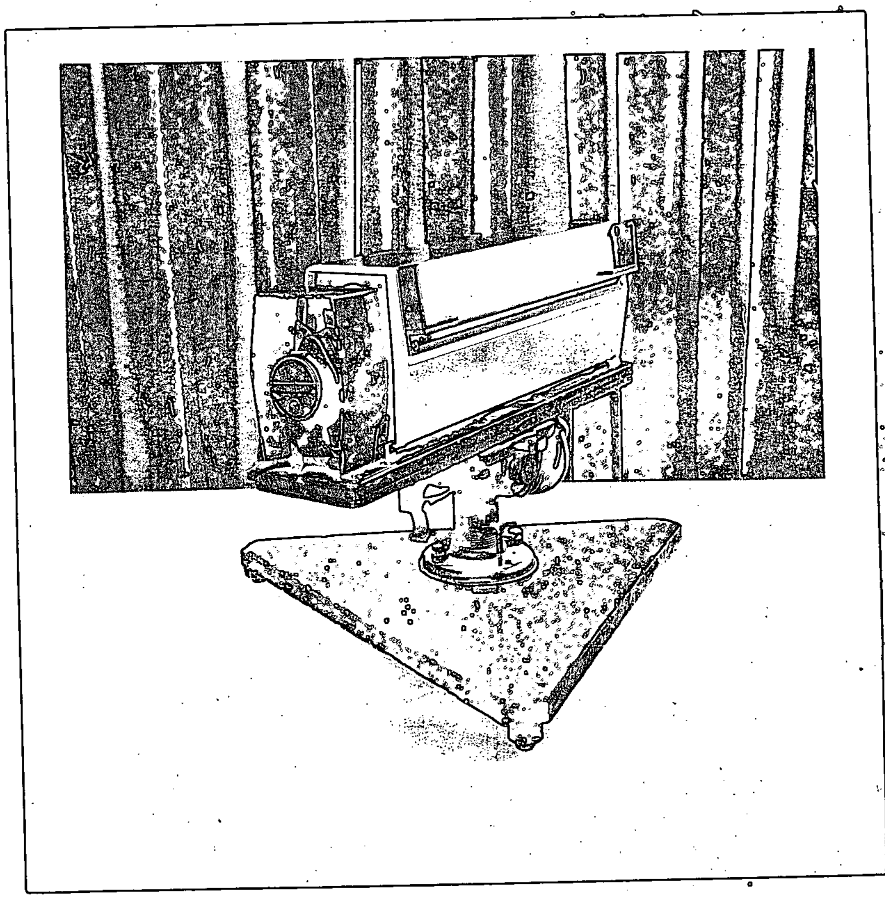


Photo 12
Laser Mounted on Pivot
and Chopper Stand

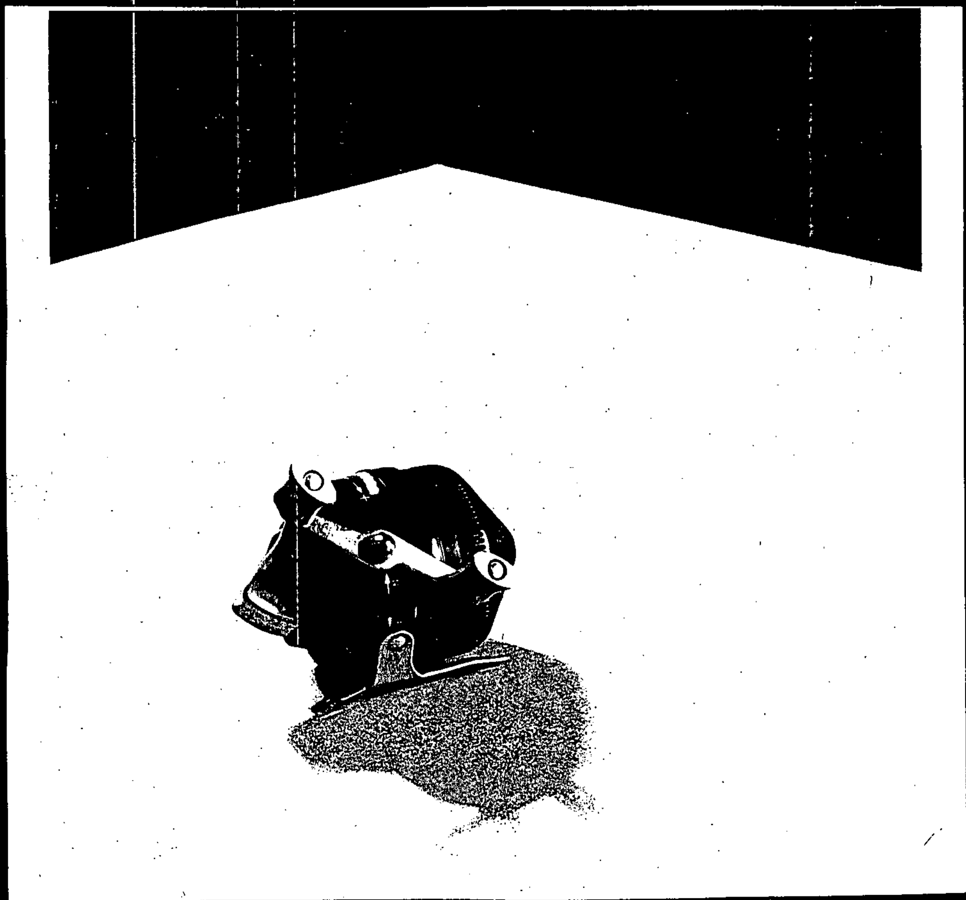


Photo 5
Spinning Reel

Photo 6
Snap Swivel Fastener

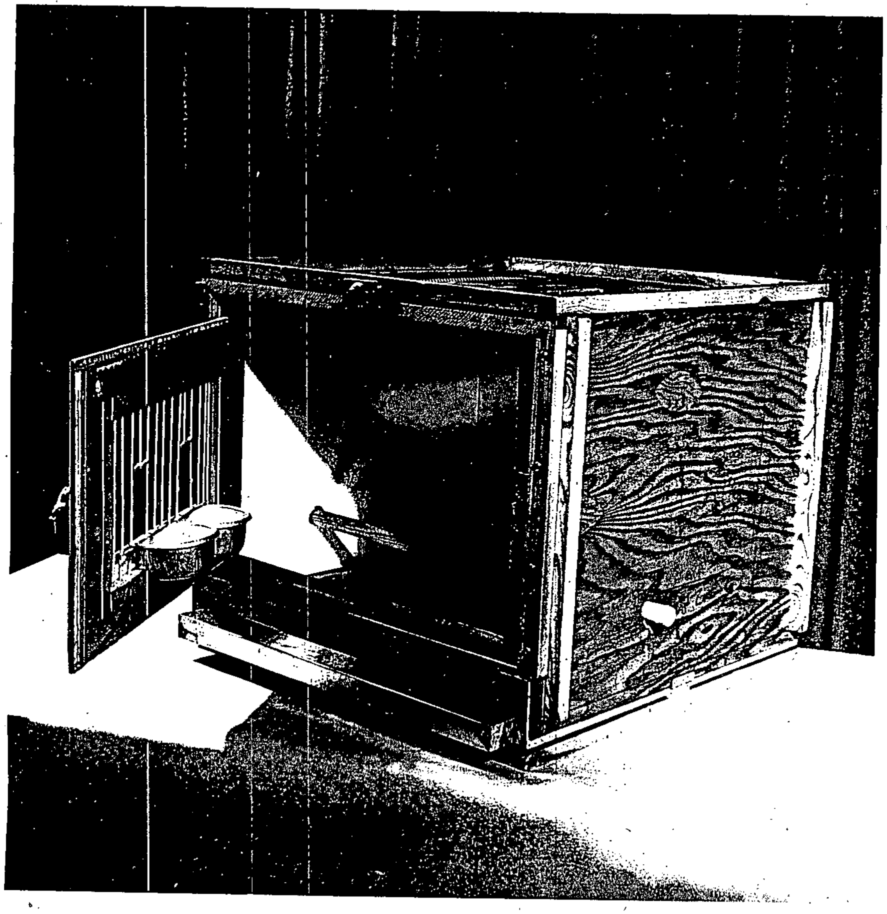


Photo 7
Shipping-living Cage (inside)

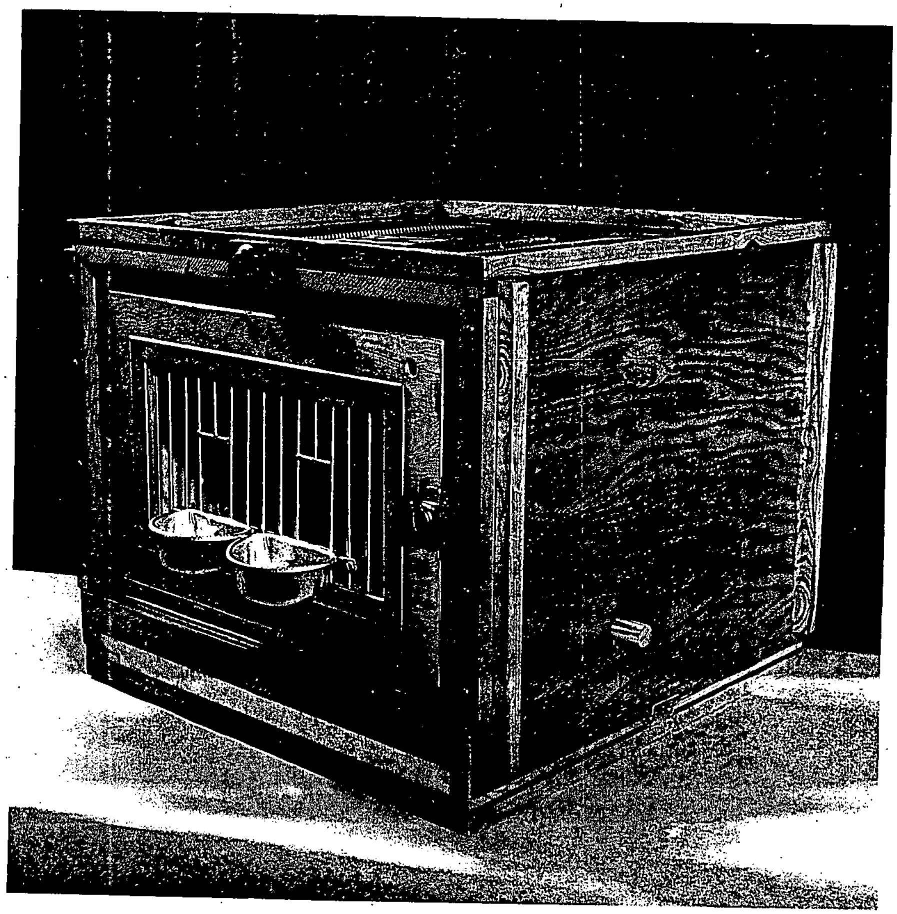


Photo 8
Shipping-Living Cage (outside)

Photo 13
Laser with Telescopic Sight on Tripod

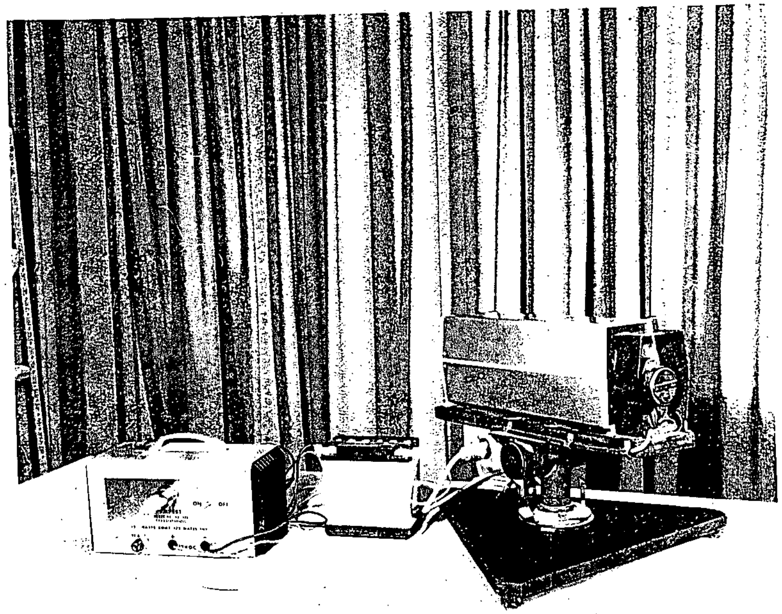


Photo 14
Laser Connected to Inverter and Battery

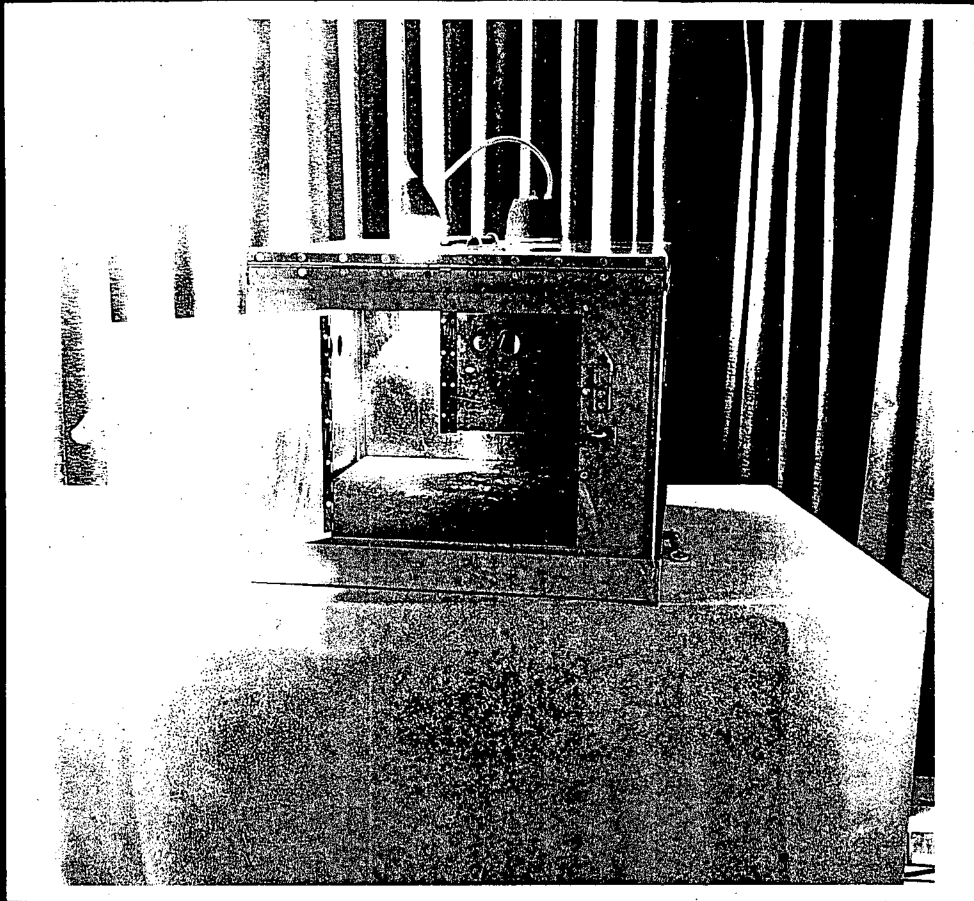
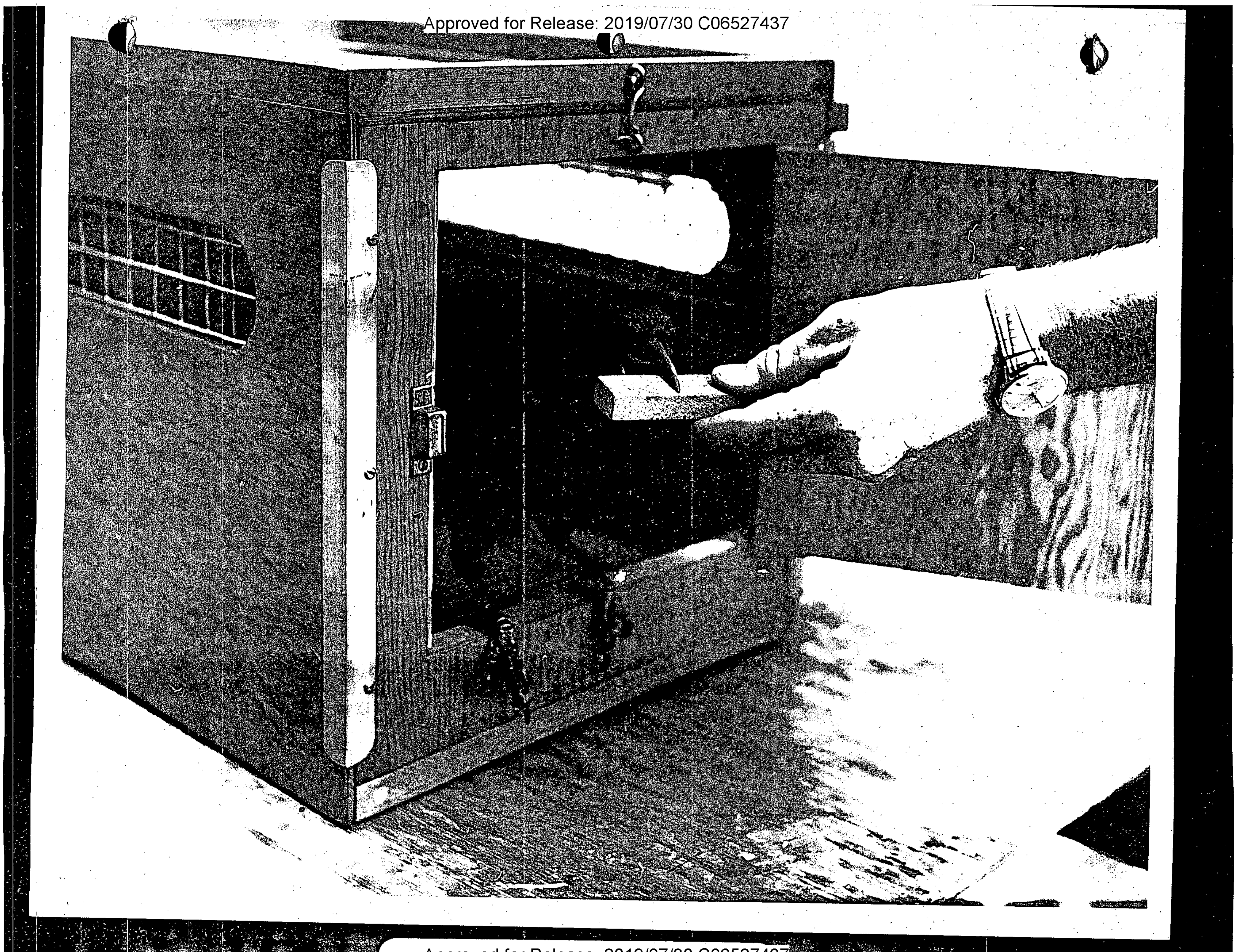


Photo 15

Recall Lamp - Light Diverted into Cage



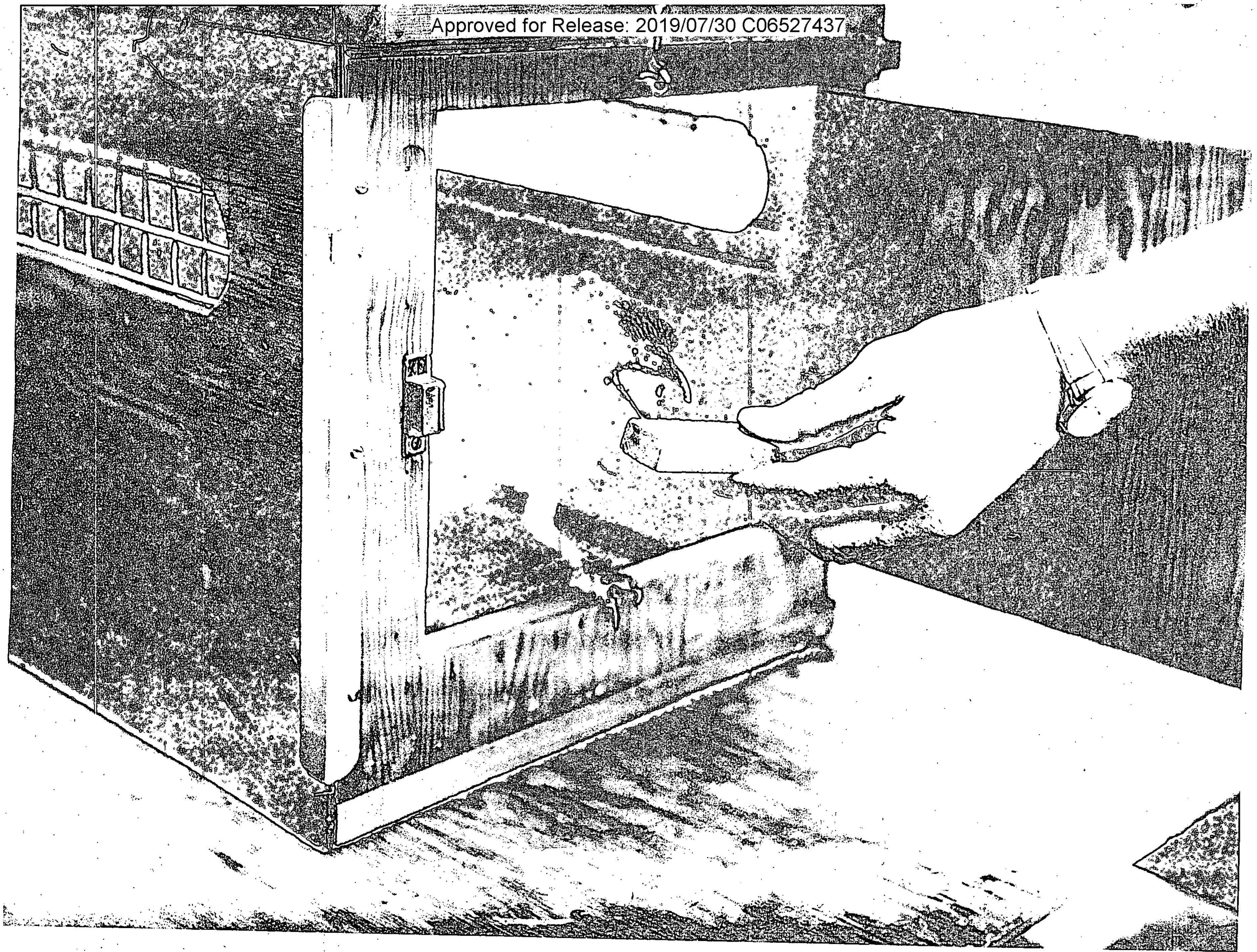
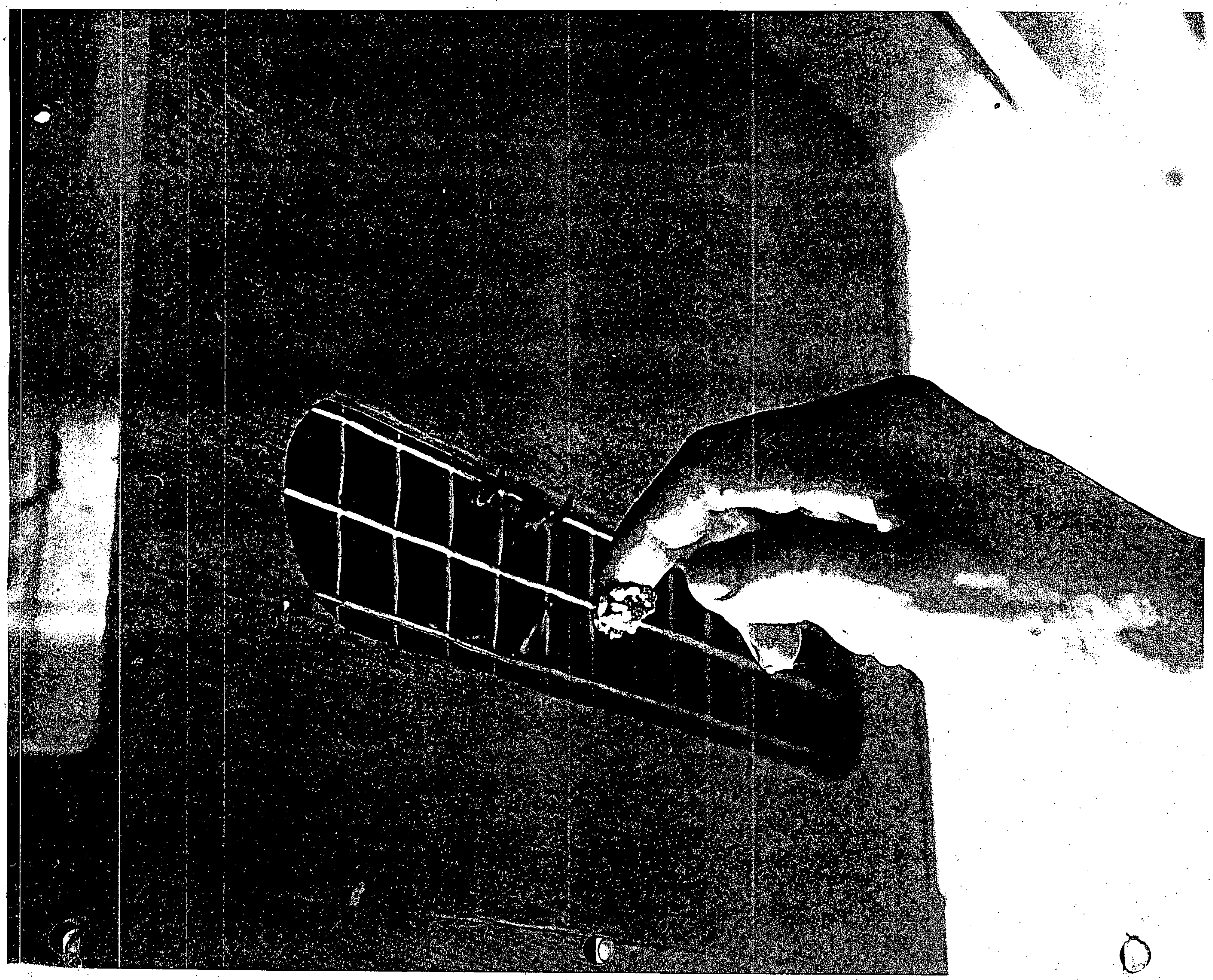


Photo 1
Taking the Package



Approved for Release: 2019/07/30 C06527437

20 December 1973

MEMORANDUM FOR: THE RECORD

SUBJECT : ORD Bird Programs

1. On 13 December 1973, ORD/LSD personnel briefed EA/CH/OS personnel on their avian sensor and training programs. In attendance were [redacted] and [redacted] EA/CH/OS, [redacted] and [redacted] ORD/LSD, and Mr. Dan Hogan and the undersigned from OTS. The major purpose of the meeting was to make EA/CH/OS personnel aware of the programs and to determine their level of interest in the programs.

2. The avian sensor program involves the use of untrained migratory birds as environmental sample collectors for chemical warfare agents. This is a statistical study on the probability of capturing, in undenied areas, birds whose migration and nesting patterns would place them in or near suspected Soviet CW sites. Chemical analyses of the tissues of such birds would provide information on the types of CW agents being investigated. This is a basic study requiring no DDO input at this time.

3. The avian training program involves the use of trained birds to perform some act, e.g. photography, package emplacement, of operational significance in areas inaccessible to human agents. ORD personnel are working toward the development of an avian/photographic system applicable to a specific target. They are interested in conducting a basic study to determine the limits of usefulness of various avian species and are interested in obtaining requirements and possible operational scenarios to work against.

4. EA/CH/OS personnel stated that they could not identify any requirements, but suggested some possible scenarios. These are: a) Photograph of a specific room interior, b) Aerial photograph of targets located 20 miles or more from a suitable launch point, and c) Emplacement of a line between buildings over a distance of fifty feet or more.

E2 IMPDET CL BY [redacted]

SUBJECT: ORD Bird Programs

5. [redacted] had attended a previous briefing on the capability. He stated that he had presented the program to the EA Division branch chiefs and emphasized that EA did not have a requirement for the capability.

M. David Boston
C/OTS/CB

3.3(h)(2)

6.2(d)

~~CONFIDENTIAL~~

OTS/CB Memo #76-11
15 January 1976

MEMORANDUM FOR: DC/OTS/DED

SUBJECT : ORD Report Card - Status of the LSR/ORD Avian Program

1. On 13 January 1976 at the request of [redacted] DC/OTS/CB, I visited [redacted] C/LSR, Project Engineer of the Avian Program, in order to determine the status of the program. Unfortunately, [redacted] had only recently inherited the Avian Program from [redacted] who is going on full time training, and therefore, [redacted] was not totally familiar with the intracacies of the program. Based on the Avian Demonstration and the above briefing, the following is my interpretation of the status of the program.

2. Many years ago, the DDO was interested in a certain potential scenario. Consequently, the DDO levied upon LSR/ORD the requirement of obtaining a bird that would take pictures of certain objects. Apparently, this particular scenario never came to fruition.

3. A few years later the DDO levied another requirement on the LSR to train a bird to place a sensor on a window ledge. This was carried out to completion. Unfortunately, the bird was in the process of molting when the emplacement was needed and, to make matters worse, when the bird was finally able to fly, it placed the sensor on the wrong window ledge.

4. Until recently the Avian Program has been shelved due to the lack of hard requirements. During the past year or so, ORD has apparently decided to determine once and for all the value and applicability of the program. This determination culminated in the "Avian Demonstration" held at [redacted] on October 7-9, 1975. At that demonstration the bird capabilities were demonstrated. Although the general consensus at that time was that the bird capabilities were interesting, it appeared there were preciousfew scenarios in which a bird would be the only possible vehicle to complete the mission.

E2 IMPDET CL BY [redacted]

~~CONFIDENTIAL~~

5. Since that meeting, it has been discovered that four possible scenarios have materialized in which birds could be used. They are as follows:

a) A bird climbing up and down a rope.
b) A bird taking pictures in a denied area.
c) A bird placing a microphone on a window sill.
d) A bird collecting a water sample.

What was dismissed, a few months ago, as an improbable, exotic, humorous idea has suddenly become a serious undertaking. In fact, it is presently being handled by the TCT. [redacted] SDB/OPS, is acting as chairman. [redacted] DC/SE/USSR, as vice-chairman and [redacted] as secretary of the effort. As it stands to date, LSR has the following plans for the bird program. It has a contract with [redacted] in California to conduct a feasibility test of a specific operational scenario. The scenario is to have a kit of pigeons equipped with cameras fly from one location (launching site) to another location 3 miles away, take pictures of a certain object and fly to a different location (home).

6. The experiment will involve 3 kits. The first kit will act as a control group and will be trained to fly from home to the target and back to home. The second kit will be trained to fly from a launching point to the target to a new home 25 miles away. The third kit will be trained in California to fly from a launching point to the target and to a new home. This kit will then be moved to Oklahoma and will be carefully observed to determine the affects long distance displacement has on their performance.

7. Finally, the second kit in California will be moved with the kit in Oklahoma to Washington, D.C. It has been determined that at this time a live demonstration might be held for interested offices. Specifically, the kits will individually fly from a launch point to [redacted] to East Building. The above project has been already funded at $90,000 and should take 6-7 months to complete. If all goes as planned, the feasibility of bird scenarios will have been proven by ORD/LSR.

8. For your further edification, ORD/LSR has made a 27 minute 16mm film of the Avian Demonstration held at [redacted] It shows the performance of the birds in real life situations. LSR also has a 10 minute film clip of an impromptu demonstration of a raven collecting a water sample.

9. At this point in time, [redacted] is not being funded whatsoever. It is my impression that they are not employed at this time because of the less "spectacular" performance of [redacted] birds as compared to [redacted] birds [redacted]. This is unfortunate because [redacted] approached the problem from a scientific posture, examining cause and effect, whereas [redacted] took a more pragmatic approach to get the job done. Both approaches, I feel, are equally valid in this case.

10. It should be noted that the bird scenario presently being investigated in California by [redacted] is not an OTS requirement, but was generated directly by the DDO staff. No firm requirements have yet been placed upon OTS by the DDO.

11. I would like to reiterate my opinion which is reflected in OTS/CB Memo for the Record #75-127, "Avian Demonstration [redacted]
"It appears as if justification of spending approximately $100,000 per year for the maintenance of a stable of birds for an occasional deployment would be difficult to rationalize. The undersigned received the impression that given the present avian capabilities and the known possible missions, there was little interest in maintaining the capability at this time. In fact, there was only one DDO Division (SE) that indicated an immediate interest in the present avian application.

Through discussions with both contractors, the undersigned believes that if the contracts were allowed to expire, [redacted] would close down this type of operation completely. However, [redacted] has a continuing interest in this basic type of training since he trains animals [redacted] and would most likely stay in the field. Given a lead time of 3 to 4 months, and $20,000 to $30,000, [redacted] would be able to obtain and train 3 to 4 birds for a particular scenario which has been previously demonstrated. Compared to yearly maintenance of a stable of trained birds, this would be the most economical route provided that operational plans for using a trained bird are developed far enough in advance of the requirement."

~~CONFIDENTIAL~~

12. In closing I would like to state that based on the limited knowledge I have gained to date, it is my opinion that the Avian Program should be terminated by ORD upon completion of its present contract with [redacted] I feel it should then be turned over to OTS and retained at not cost for R&D until a requirement is levied on OTS. At that time, [redacted] could train a particular bird within 3 to 4 months to perform a scenario similar to those already demonstrated in the past by ORD, at a cost of $20K to $30K.

3.3(h)(2)

ORD #2388-74

5 May 1974

PROGRESS REPORT No. 1
AVIAN TRAINING PROGRAM
[redacted]
(Feb.-March 1974)

Program Director:

Dear Sir:

Enclosed is a copy of the pathology report relating to the 2 falcons. This concerns only 1 falcon but the other, performed by another lab.,is essentially the same. You may note that the report states "etiology unknown."

In retrospect, we believe the root cause is linked to a condition referred to in the falconer's vernacular as "bumble foot." In simple terms it means an infection in the bird's feet of the streptococus variety.

The reason this infection attacks birds of prey (in captivity) has never been clearly understood. Some opinions reflect the idea that it is caused by a diet deficiency. We reject this because other birds, of the same type, on the same diet, are not effected.

It seems to us that the original abrasions were caused by keeping the birds on a cement floor at San Clemente Island and that finally their expirations came as a result of treating the feet by soaking in hot water. We did this on the advise of one veterinarian and according to the opinion of another one this treatment caused the infection to spread into the bird's organs resulting in termination.

AVIAN TRAINING PROGRAM.....

In any case, our new birds show no signs of the bumble foot condition and they are being kept in individual cages equipped with padded perches.

In the field they are doing very well in the initial training, still on land. They should be working over water in a matter of a couple of weeks.

Included with this report is an account of the boat accident and damage. It is not as severe as the report would seem to indicate. All of the cosmetic features, except for the radar,have been restored.

Respectfully,

[redacted]

[redacted]

TISSUE REPORT

OWNER'S NAME [redacted] PET'S NAME NOT STATED
AGE [illegible] MALE ______ FEMALE ______ CAT ______ DOG ______ OTHER [illegible] Falcon
SPECIMEN Necropsy SPECIMEN # [illegible]
CLINICAL IMPRESSION ______
DOCTOR [redacted] DATE 3-21-74

GROSS DESCRIPTION:

The specimen consists of a piece each of liver, kidney, lung, heart and gizzard which in aggregate measure 2.6 x 2.9 x 1.3 cms. All the specimens are grossly unremarkable. Multiple representative portions of each tissue are submitted for sectioning.

MICROSCOPIC DESCRIPTION:

Sections are of liver, kidney, heart and gizzare. Principal lesions are present in the liver and kidney. The hepatic lesions consist of cloudy swelling of the hepatocytes, congestion, accumulation of hemosiderin in the kupffer cells and variable neutrophilic exudate. The renal pathology is characterized by granular swelling, pyknosis and necrosis of the tubular epithelium, congestion and glomerular atrophy. The gizzard exhibits congestion of the submucosa, muscularis and serosa. The myocardium shows only minimal changes consisting of slight congestion.

No etiologic agent is identified in any of the organs.

DIAGNOSIS: HEPATORENAL SYNDROME (ETIOLOGY UNKNOWN)

Note: The above is consistent with concomitant damage of liver and kidney commonly seen in infections, toxemia and shock. The syndrome is known to run a fulminant rapid course due to progressive renal failure and liver injury.

[redacted]

[illegible]

Accident Report

On 25 March 1974 the Formula boat (j24), stationed at San Clemente and used on the Avian Training Program, was involved in an accident which occured at the N.O.T.S. pier area on the east side of the Island.

The condition of the power systems prior to the accident were as follows: function of the port engine and outdrive system was normal. The linkage connecting the controls with the starboard outdrive was inoperative due to a sheared bolt at the shift lever. The gears could be operated manually from the engine compartment. Repairs to the linkage were hampered by accessibility problems which would have put the boat out of action for several days at a critical time.

On approaching the pier the starboard engine was shut down because of the lack of shift function. As the boat came alongside the pier the port outdrive linkage failed, leaving the gears in forward. The port engine was then shut down. Attempts were made to secure the boat to the pier to no avail. The first swell put the boat on the rocks. The boat then came broadside to the swells and was moved along the rocks and under the pier. The radar scanning unit and the deck struck under structure of the pier. A line was then secured to the pier and the boat was pulled free.

The hull suffered no serious damage and has been repaired. Both propellers was damaged and they too have been replaced. The deck has also been restored. The scanning unit was bent out of alignment and the antenna dome damaged.

ACCIDENT REPORT.....

All repairs have now been completed except for the radar unit.

ORD #2389-74

8 May 1974

PROGRESS REPORT No. 2
AVIAN TRAINING PROGRAM
[redacted]
(March - April 1974)

Program Director:

Dear Sir:

As the following daily reports will show, 3 of the birds listed have just started to work free. 2 of these are the Canadian falcons which have undergone fairly extensive preliminary training before they started to work free. We also list the cockatoo and this one is included as a feasibility test. We are completely in the dark as to what the possibilities are in regard to this critter. We have not been able to dig up any information as regards to its distance possibilities or the visual potential. We do know that this particular bird is a clever flyer but seems if it may be too slow to avoid gull attacks.

DAILY TRAINING SCHEDULE

Monday Aril 22, 1974

Do Da (Raven)
3 miles from shore to boat. ½ mile from boat to target. Response and strength good. Wind 5 m.p.h. N.W.

Dink (Prairie Falcon)
1&½ mile from boat to the target. Refused to come to boat. Fed and worked on boat. Wind, 10 m.p.h. N.W.

This bird is an extremely good prospect. It has shown willingness to work over the water, a big question mark in the beginning. As of the date indicated here this bird was working under a severe handicap since the primary feathers on one wing have been broken half way up since we first got him. These will be replaced later in the year as the bird molts.

Cockatoo
50 yards to the boat. Three flights. Response and strength good. 10 m.p.h. wind N.W.

Falcon (female)
I mile to target on land. Started work on lure in building. Strength and response good.

Terciel (male falcon)
Started work on lure in building. Heavy wind 30-40 m.p.h. N.W.

Tuesday April 23

Do Da
3 miles to boat. 3/4 mile from boat to target. Response and strength good.

Dink
100 yards to boat. Refused second attempt. 1&½ miles from boat to target. Heavy gull pressure. Strength questionable.

Cockatoo
100 yards to boat. 3 flights, strength and response good.

Terciel
Start work to boat. 50 yards to boat. 50 yards from boat to target. Carried package with response and strength good.

Brandy & G.B. (Hawks)
5 miles to target. Very good altitude, response and strength good.

AVIAN TRAINING PROGRAM.....

Wed. April 24

Do Da
3 miles to boat. 1 mile from boat to target. Wind 5 m.p.h. S.

Dink
Short flight to boat. 1 mile to the target. Made stop before coming in. Response fair but strength questionable.

Cockatoo
¼ mile to boat. Wind 5 m.p.h. with response and strength good.

Falcon
3/4 mile to the lure. 3/4 mile to target. Response and strength gppd.

Terciel
100 yards to boat & 100 yards return to target. Lure used on target. Response and strength gppd with 10 m.p.h. wind.

Thursday April 25

Heavy winds all day, 20-40 m.p.h. to N.E. All birds flown inside.

Friday April 26

Heavy winds again 30 m.p.h. All birds flown inside.

Week end

Monday April 29

Do Da
3&½ mile flight to boat. 3/4 mile return flight from boat to land. Response and strength good.

Dink
3/4 mile flight from boat to target. Again, response good but flying capacity questionable because of impaired wing.

Cockatoo
¼ mile to the boat. Two flights with response and strength good.

Terciel
100 yards to boat. 100 yards from boat to target. Response and strength good.

Falcon
Start work on the boat. Fed and carried on moving boat.

AVAIN TRAINING PROGRAM.....

Tuesday April 30

Do Da
Attempted 2&3/4 mile flight to boat but bird refused because of high winds but did come from 1&½ miles. Returned from 1 mile.

Dink
½ mile from boat to target. Flight capacity questionable.

Terciel
200 yards to boat. 3 flights with strength and response good.

Falcon
Close work on boat. Response good with heavy winds.

Although not indicated here the hawks worked several times in the time frame of this report when other bird work was finished early enough.

In following the work of the prairie falcon one will note the bird's limitations due to impaired wing but it can also be noted this one has excellent potential. At the first signs of molt we expect to put this bird up and feed him heavily in order to shorten the molt period and again have him working at full capacity.

Respectfully,

 3.3(h)(2)

ORD #2340-74

15 May 1974

PROGRESS REPORT No. 3
AVIAN TRAINING PROGRAM

(April-May 1974)

Program Director:

Dear Sir:

At long last our boat is fully repaired. One of engines has had a cracked head replaced with new valves and other parts. The outdrive for the other engine has been replaced and, in toto, the boat is operating to its full potential. (except for radar)

Needless to say, limited function of the boat has hampered our training schedule to some extent and we look forward to getting back to normal.

One of our birds recently generated a considerable amount of excitement by making a 5 mile flight from land to the boat. This exceeds by 1 mile the longest prior distance flown over water.

We were happy to see the bird seemed to be in fine shape when he arrived at the boat, seeming not in the least tired nor exhausted.

During the flight there was a great deal of apprehension on our part since the bird was out of visual contact for most of the flight.

Until we are able to get some kind of satisfactory tracking beacon for the bird we are most anxious to acquire a chase boat which, we believe, is available in a short time.

We are aware we have played down the potential of the raven and, in fact, we have been surprised by the performance of this bird. It is true that this particular bird is our show bird [redacted] and has had some 3 or 4 years of training. It is also true he was the pick of the litter, so to speak, of some 50 birds.

We have already acquired several nestling ravens this year and when they are ready they too will join the program.

Starting from scratch our terciel falcon has come on very strong and, in our opinion, will soon be performing as well as the raven.

The small prairie falcon, as described earlier, has also shown great promise. At the present we have set him up, on full feed, hoping to get through the molt as soon as possible.

The female falcon has been a slight problem up to this point. She flys well but seems to tire easily and does not have the strength to complete long flights. Her stamina has increased steadily but not dramatically. She too has entered into a heavy molt and because of this will be delayed in her further training.

Regarding the flights over land, the hawks are doing a fine job, making flights of several miles at any time the elements are at all favorable.

We are enclosing more daily training reports along with some cost reports on medical care for the falcons

AVIAN TRAINING PROGRAM....

to demonstrate we left no stone unturned in our concern for them.

Respectfully,

DAILY TRAINING SCHEDULE

Wed. May 1, 1974

Do Da
2&½ mile flight to boat. 1&½ mile flight from boat to beach. Light N. wind. Response and strength good.

Dink
1 mile flight from boat to target. Strength fair, response good.

Cockatoo
¼ mile flight to boat. Gull pressure, driven into the water. Strength questionable, response good.

Terciel
300 yards to boat. 4 flights. Response and strength good.

Falcon 50 yards to boat. 3 flights. Response and strength good

Hawk flights on land from 5 to 8 miles.

Thur. May 2

Do Da
3 mile flight to boat. 1&½ flight from boat to beach. Light N.W. wind.

Dink
Down for the moult

Tercial
¼ mile to boat. 3 flights. Response and strength good.

Falcon
200 yards to boat. 3 flights. Response and strength good.

Brandy (hawk)
5 mile flight to target/ Response and strength good. Light N.W. wind.

Friday may 3

Do Da
3 mile flight to boat. Strength and response good.

Took boat out of water for early flight back to L.B.

AVIAN TRAINING PROGRAM.....

VETERINARIAN EXPENSES ON FALCONS

Aug. 26, 1973.....	$132.50
Oct. 6, 1973	179.00
Oct. 18, 1973	243.50
Aug. 2, 1973	23.00
Dec. 15, 1973	22.00
Dec. 29, "	140.00
Jan. 1, 1974	64.00
Jan. 16, 1974	56.00
March 9, 1974	7.00
April 6, 1974	261.00
April 8, 1974	205.15

The above figures only in support of report on falcons.

 3.3(h)(2)

ORD 2424-64
2 November 1964

MEMORANDUM FOR: Chief, Maritime Branch/Special Operations Division

SUBJECT : Project OXYGAS

1. Attached is a progress report on Project OXYGAS which will, no doubt, be of interest to you. As you recall, ORD undertook this project with you for the purpose of demonstrating the technical feasibility of using dolphins for a variety of operational purposes. From the technical point of view, we were interested in determining the dolphin's reliability in placing an appropriate object on a [redacted] We also recognized that there would be a serious question of the range of the dolphin but felt that an initial achievement of [redacted] range with a payload would be most encouraging. The first technical objective has been achieved more rapidly than anticipated. The second technical objective is now under investigation, and we are hoping that we will be able to achieve a reasonable range, although not necessarily a useful operational range, by the completion of the contract period in January 1965.

2. Quite frankly this project has progressed more rapidly than we anticipated, although unbridled enthusiasm is not justified at this time. I wish to emphasize that there are many difficult technical problems which face us which include the operational range of the animal, communication problems between the animal and its handlers, design of an appropriate payload shape, improved handler training techniques, and others. Nevertheless, there is the very real possibility that technical feasibility will be demonstrated by January. Dr. Galler of ONR, who takes a more optimistic point of view, feels that technical feasibility has been established already. The possibility of success requires that we begin to explore where we go from here. My tentative thoughts on this are outlined below.

3. ORD could continue to support OXYGAS at its present location for another few months with profit, although we are rapidly approaching the stage where security dictates that we move the operation to a more suitable location. You are aware of the possibility of joining the Navy in using an operational testing site for this project. The decision to demonstrate operational feasibility will require greater participation, both administratively and operationally, by SOD. As the project becomes more operational, it is my view that ORD should gradually withdraw its participation

~~SECRET~~

except to the extent that technical problems arise. It might be advisable for your activity to survey other DD/P units to see whether they have requirements which dolphins might perform. We should consider a similar survey in the DD/S&T as well.

4. I think we can assume that the cost of maintaining an operational dolphin capability would be considerably higher on an annual basis than the current contract of approximately $100,000. The exact cost would depend, to some extent, on the availability of Navy facilities, the number of dolphin, the operational requirements, and the like. I suspect that considerable support could be obtained from Navy on a "no cost" basis because of their intense interest in this project. The extent of collaboration with the Navy would, of course, depend upon your own security and operational requirements.

5. In summary, the OXYGAS project appears to be running ahead of schedule. I think the chances are quite good that we will demonstrate a reasonable technical feasibility this year. I am suggesting that we begin planning for follow-on phases, although I think it is premature to make final decisions on follow-on until technical feasibility has been demonstrated. It may not be premature to alert appropriate senior officials in the DD/P of the project. We would be most happy to provide suitable technical information and/or briefings at the appropriate time.

STEPHEN L. ALDRICH, M. D.
Deputy Assistant Director
Office of Research & Development

HOLD
OXYGAS

3.3(h)(2)

6.2(d)

ORD-446-65
16 February 1965

MEMORANDUM FOR: Deputy Chief/Maritime Branch/SOD/DD/P

SUBJECT : Project OXYGAS

TITLE: Study of Feasibility of Training Dolphins for Operational Uses

CONTRACTOR: [redacted]

DATES AND FUNDING: 7 May 1964 - 14 January 1965 - $97,870
15 January 1965 - 15 July 1965 - $80,000

1. Storms and physical relocation of this project have delayed the technical feasibility demonstration which is now scheduled for 29 March 1965.

2. Two dolphins are now routinely delivering simulated [redacted]

3. Tasks to be undertaken in the follow-on period of 15 January 1965 to 15 July 1965 include the following:

a. Obtain two or more new "wild" animals for training by the latest most direct training methods.
b. Extend the [redacted]
c. Conduct further studies on reinforcement limitations, i.e., time vs. distance vs. reinforcement modality (e.g., bridging stimuli, etc.).
d. Fabricate and test optimized payload configuration.
e. Carry out a system design study (paper exercise) for fixing of mission parameters and limitations.

SUBJECT: Project OXYGAS

4. In addition to the work being accomplished by [redacted] we are negotiating with ONR to undertake a program designed to answer some of our critical questions [redacted] at a funding level of $80,000. Problems being considered in this negotiation are:

a. Reinforcement limitations including bridging techniques.
b. Communication links
c. Optimal training techniques
d. Harness systems
e. Physiology - including anesthesiology, pharmacology, respiratory gas exchange as related to decompression, and dolphin health problems.

5. The ONR and [redacted] programs are not redundant and are designed to compliment one another.

[redacted]
LS/ORD/DD/S&T

CONCURRENCE:

[redacted]
Technical Manager
LS/ORD/DD/S&T

(Date)

Distribution:
Original & 1 - Addressee
1 - BDF
1 - TM/LS/ORD/DD/S&T
1 - Project File - OXYGAS
1 - LS Chrono
1 - ORD Chrono
1 - JNP Reading File

LS/ORD/DD/S&T: [redacted]/hn:5155(15 February 1965)

SECRET

6.2(d)

ORD # 3571-67

6 JUN 1967

MEMORANDUM FOR: Director of Research and Development, DDS&T

SUBJECT : Project OXYGAS

1. We are grateful for the report which Drs. [redacted] and Stephen Aldrich made to the Technical Requirements Board (TRB) on 16 May 1967, on the status of Project OXYGAS. The guidance of the TRB was requested by them as to whether or not there was operational justification for continuing the program and, if so, as to new tasks for which animal training and systems design should be initiated.

2. It is the view of the Board that Project OXYGAS should be oriented toward developing intelligence collection systems rather than maritime sabotage systems. It is our impression that Drs. [redacted] and Aldrich understand and concur in this. We have reflected at length on the more significant question, namely, what we reasonably can expect the future usefulness of trained dolphins to be. The Board has been forced to conclude that it requires more specific information than has been available to date before it can arrive at a firm position in this respect. The information most needed relates to our capability to guide dolphins over a range of at least twelve miles in unfamiliar waters. Also, the Board would like assurance that dolphins can be trained to seek out and retrieve a "black box" submerged in shallow water or floating near the shore, the dolphins having entered the water from twelve miles out.

3. The results of the short-term feasibility tasks, which BSD/ORD plans to undertake with dolphins prior to 31 October 1967 will be of high interest to the TRB and,

to a considerable extent, should reveal the potential value of training and maintaining dolphins for operational tasks. Meanwhile, the TRB feels that any longer range commitments should be held in abeyance.

[redacted]

Chairman
Technical Requirements Board

3.3(h)(2)

6.2(d)

21 December 1964

MEMORANDUM FOR: DAD/LS/ORD

SUBJECT: Project OXYGAS

REFERENCE: ORD 2690-64 dated 3 December 1964

1. We have reviewed the referenced memorandum and our response to the various questions will be covered in succeeding paragraphs. It should be noted that we agree in general with the program and your plans for supporting it through FY-65.

2. Maritime Branch will be interested in the program providing the contractor successfully completes the current technical feasibility study. Maritime Branch will take the lead in determining operational feasibility once technical feasibility has been demonstrated.

3. We concur in the program submitted by the contractor. We have no additional tasks to add. The system design study appears satisfactory; however, we would like to include sea launch and recovery and air transportation of the animals. Maritime Branch will arrange for the necessary support to carry out these evolutions. We only ask that we be kept apprised of all developments in order that the necessary arrangements for transportation may be made on a timely basis.

4. We welcome the opportunity for active participation by Maritime Branch personnel in this study. We will be happy to have a member of our staff survey [redacted] at a time to be mutually agreed upon by both of our offices.

5. We expect to be in a position to provide funds to assist in the study. Your reluctance to invest in specialized maritime equipment is understood and where such items may be required, we will plan to provide.

6. Our participation with your office in this project has in our opinion been a more than satisfactory arrangement. It is understood that as the project attains a more operational than technical complexion your office's input will diminish and ours will increase. I feel there will be need for continuing conferences between our offices as this transition takes place in order that properly balanced participation can be achieved.

[redacted]

Chief, Maritime Branch
Special Operations Division

~~SECRET~~

GROUP 1
Excluded from automatic downgrading and declassification

3.3(h)(2)
6.2(d)

~~TOP SECRET~~

2 November 1964

MEMORANDUM FOR: Chief, Special Operations Division

SUBJECT: Project OXYGAS

1. This report is submitted for information only. Per attachments 1 and 2, the nature of the Project and its progress to date are such that broad spectrum attention to it may be indicated at a later date.

2. Project OXYGAS was conceived for the purpose of exploring feasibility of utilizing the bottle-nose dolphin (Tursiops truncatus) in underwater attacks against enemy shipping. SOD/ME and ORD/LS (DDS&T) are co-sponsoring OXYGAS with ORD/LS having contracted ($97,870) through [redacted] for the exploration plus providing technical guidance and SOD/ME providing the necessary operational input.

3. At the outset, the OXYGAS concept and the modest investment were considered more than justifiable providing feasibility could be demonstrated to deliver a simulated weapons package over an open sea distance to a propeller of a moored PT boat. Obviously, if the PT boat attack system can be developed, many spill-over areas of interest will then appear feasible such as: attacks on varieties of ship types; harbor and coastal reconnaissance through photographic means; specialized ELINT functions; certain types of resupply operations; placement of sonar, acoustic, and seismic buoys; placement of rocket detection units, and RF, UV, BW, CW sensors and trace element collectors.

4. As is known, the Agency and the Navy have spent considerable time and money developing swimmer delivery systems to accomplish these same purposes with the end-product being of marginal effectiveness at best.

5. As a matter of interest, it is estimated that the combined Agency/Navy annual costs in maintaining marginally effective swimmer attack systems run in excess of five million dollars for the swimmers and specialized equipment alone. This estimate does not include support shipping or outfitting costs. Not an inconsiderable factor in a manned system is the physical danger to the man in exposing himself to an unnatural environment with or without the additional hazard of enemy action.

192245 - Series B

~~TOP SECRET~~

Copy 2 of 4

GROUP 1
Excluded from automatic downgrading and declassification

~~TOP SECRET~~

6. Progress to date with OXYGAS has been so encouraging that it is now deemed appropriate to invite high level attention to the project. If, as expected by both ORD/LS and SOD/MB, feasibility of the use of dolphins in this fashion can be demonstrated, guidance and support of moderate magnitude will be required if the concept is to be transformed from a technical feasibility stage to an operational system.

7. Assuming feasibility is demonstrated, SOD/MB feels the OXYGAS concept should be developed into an operational system. In this context it should be understood that the dolphin cannot be expected to completely replace the man in the water. The dolphin should, however, be expected to obviate the need for a major portion of our man-effort with a resultant considerable short and long-range dollar saving and many other advantages.

[redacted]

Chief, Maritime Branch
Special Operations Division

Attachments:
1. Memo
2. Book

Distribution:
1-3 - C/SOD
4&5 - MB/SOD

182245
3 of 5

~~TOP SECRET~~

3.3(h)(2)

3.5(c)

ORD - 3764-74
PROP - 082374/3

PROPOSAL FOR AVIAN OPERATIONAL SUPPORT

Submitted by

[redacted]

12 August 1974

~~SECRET~~

INTRODUCTION

Dear Sirs:

Enclosed is a proposal for the Avian Operational Support project based on a 12 month period and starting September 13, 1974 through September 12, 1975. Although not indicated in the body of this proposal, a paramount consideration is the expansion, or acceleration, level of effort.

At the present time the personnel at the San Diego location are working a 7 day week so it is not a question of increasing the work load but rather a question of adding more people. As more subjects are available, and they will be a considerable number in the coming weeks, we hope to add 2 more trainers.

This will give us 4 people, or two teams, at the Point Loma location and at least 1 person in the [redacted] area at all times.

We were fortunate in acquiring the services of a young man training to be a veterinarian. Coincidently, he is an experienced falconer and probably has more medical knowledge concerning falcons than anyone in this part of the country. It is the opinion of this contractor this young man will be a welcome asset to the project.

It is not expected that these additional trainers will increase the level of funding to any extent. In certain areas the costs will be cut but in others it will slightly increase. A case in point would be maintenance of the living quarters in San Diego and the new [redacted] facility.

Since this proposal was completed there have been small changes in the bird procurement department. There is now a definite commitment for 3 falcons from the B.C. source. A gyr falcon has been contracted and paid for and will be delivered in November. Another prairie falcon, paid for previously, is now in our possession but presently at the veterinarian's for treatment on feet. This is the picture:

Falcons	on hand	contracted for
	4	4

The total of 8 should be ample for our needs since 3 of the ones we now have are proven birds as is one of the B.C. birds already mature and of good disposition.

Please advise us of any additional information you may need to round out this proposal. Funding requirements will follow in a day or so but it will in are already discussed.

Regards,

[redacted]

12 August 1974

[redacted]
Chief/ Life Sciences Research Division

SUBJECT: Avian Operational Support

GOAL: The essential purpose of this project will be to provide reliable trained avian vehicles for emplacement, transport and/or recovery of reconnaissance-surveillance sensors to meet operational requirements as defined by the Sponsor. Additionally, Package orientation and sample matching will be initiated to amplify and augment the scope of possibilities. The accomplishment of this goal requires: bird procurement, (reduced basis) domestication, health maintenance, transport and housing facilities approved by government regulatory agencies, minimal 7' x 10' facility for each trained bird, task training, package and harness and release mechanisms, integration of vehicle and system test and evaluation. Besides these requirements the Contractor will be responsible for the support and housing of personnel at the San Diego location. It will be vital to maintain other trained birds at the [redacted] facility when they are not actively working on the top priority task. The details and effort necessary for meeting each of the sub-requirements vary with the nature of the operational scenario defined by the Sponsor.

PRESENT STATUS: The lines of specialization appear to have formed more clearly during the past months as work and training continue with a varied stable of birds. Included among these raptors are GOLDEN EAGLES, PEALE'S FALCONS, HARRIS HAWKS, PRAIRIE FALCONS, RED TAIL HAWKS, HORNED OWL and RAVENS. The latter is not a raptor but is considered to be in the bird of prey category.

While personnel on this project have worked with birds of this kind for many years it has only been during the last months when they have come to realize what great potential they offer.

It is a considered opinion that many of them are capable of performing certain tasks and behaviors, in many instances with a high degree of reliability, not considered possible only a wear or so ago. Certainly, advocates of the ancient sport of falconry would not have entertained such a notion. The present research indicates these birds do have special attributes which might be utilized to perform a wide variety of tasks.

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Avian Operational Support....

To support these beliefs a number of reasonably good samples of documentation are available.

One might well ask why this information is just coming to light. Why has no one discovered such great potential before this? We can only speculate. Before the current effort no one has ever really tried to combine sophisticated behaviors with the birds in question. The falconer has always been interested in the use of his birds in pursuit of his sport which allows the birds to excercise its natural instincts with man as his partner. On the other hand, the animal behaviorist's work, for the most part, has been confined to the laboratory where experimental work is usually conducted with rabbits, rats, chickens and pigeons, perhaps because they are more available.

The final report covers the activities more fully over the last months but a few highlights may be worth presenting at this time. Since not all the species are committed to the same scenario they will be listed seperately.

HAWKS: 6 of these birds have been carefully selected from a total of approximately 30 which have been tediously hand fed and trained over the last 2 years. They represent a tremendous investment in man-hours, training, patience and just plain hard work. Are they worth it? It would certainly seem so. They are capable of performing tasks which are uniquely different in concept and in some cases could not, perhaps, be done in any other way. Each of them will fly up to several miles, in a strange area, and locate to objects or specific features to which they have been previously trained. They can perform certain behaviors such as emplacement of packages or objects and of removing them from harness' they might be wearing. Wearing a small camera on their legs, they can fly over a sensitive area and photograph it without causing undue suscicion. In fact, they have the capability of almost any behavior requiring beak or talon combined with a fairly high level of intelligence. Reliability and determination are their strong points. They become so heavily reenforced that, once committed to a course, they are not easily diverted. Even though not strong flyers some of them are able to carry a 13 ounce package for more than 1 mile when weather conditions are favorable.

GOLDEN EAGLES: Eagles respond in much the same manner as hawks, although not as adaptable because of their greater size. In training they have been able to carry a 3 lb weight for a distance of 1 mile. They could be used for such a special purpose when weather conditions are right.

Avian Operational Support....

RAVENS: Unfortunately, only one raven was available for work this past season. He was a member of the troop for a number of years and an actor, both in front of the camera and on stage, for most of that time. Among his other talents, he was an excellent flyer so it was decided to try him on the project. From the very beginning he was a great success. In a mere matter of weeks he was flying 6 miles over water to a boat not visible to the human eye. It was a sad event when he was lost as the result of an attack by wild ravens. In an earlier report an account of this misfortune is covered in detail.

Hopefully, this will never happen again. We now have a telemetry system made particularly for this kind of work. Reliable sources inform us that reception is good from 10 to 20 miles when the bird is airborne and from ½ to 1 mile on ground or in water. This should afford enough protection to prevent another disaster. The system consists of a small beacon weighing approximately 30 gms which is attached to the bird's leg. The receiver is a 3 lb unit with a directional antenna capable of tracking a bird in flight. It has been used successfully by the National Fish and Wildlife Service.

The arrival of this kind of help is timely. It is a reminder that the indicated flight for the TACANA Operation is very substantial. A round trip of 12 nautical miles translates into a flight of about 30 land miles. If ravens are capable of this task this project will be prepared. 8 excellent specimens were taken in the spring, hand fed and imprinted to humans. Experience has shown that juvenile ravens must not be subjected to deprivation until they are at least 5 months old. They are ready to start. There are high hopes they will be as good as the former bird.

HORNED OWL: This interesting bird, like the others, is imprinted. He has displayed unusual possibilities but priorities have prevented a great deal of time being devoted to him. His training includes recall in free flight as well as responding to recall in almost total darkness.

FALCONS: The big reward with these birds is in their capacity for strong flight. It is an established fact that they are one of the fastest creatures on earth which, of course, gives them a decided advantage. For some, not well defined, reason any bird entering strange territory is subject to attack by all residents.

Avian Operational Support....

For the falcon this does not present a problem. He can outfly anything he might meet except another falcon and they display very little aggression toward each other.

Acquiring a sufficiency of them has been a frustrating matter. Governmental controls have made it most difficult to import them even when they have been bred in captivity. We have a commitment for an additional 3 Peale's falcons as soon as permit requests have been granted. We are satisfied the total number will give us enough depth for the operation. Of the 4 birds we presently have 2 of them are working 1 mile round trips from boat to shore. A 3rd one is ready to start and the 4th has a physical handicap and is in the process of being traded for one more suitable. It is our expectation falcons will be the choice vehicle for this project.

CHANGE OF TRAINING LOCALE. As a result of a number of considerations it was decided by both our Director and ourselves to move the base of operations from San Clemente Island,California to Point Loma, California. Both these locations are Naval Undersea Center Installations.

There were a number of disadvantages at the San Clemente location, not the least of which was erratic and unreliable transportation to and from the Island. In addition, we were completely without maintenance support for either boats or vehicles. In consequence days at a time were spent installing new brakes on cars or repairing boat malfunctions without the proper tools and equipment.

Most important, however, was the weather consideration. During winter months there were several weeks when wind velocities averaged 30 to 40 miles per hour. For a good portion of this time work was limited to 1 or 2 days per week. Another factor was prevailing wind directions. The side of the Island from which we were allowed to work was subject to wind directions opposed to what it would be relative to our project scenario.

POINT LOMA LOCATION The first order of business here was to provide housing for birds actively in training. Since there was no existing facilities available we purchased 10 metal utility buildings for this purpose. These were assembled and placed in a location suitable to the NUC Director. Wooden framing of a special design was constructed for the doors of the buildings. It consists of vertical 1" x 3" lath spaced 1" apart so that birds can avail themselves of daylight as well as protect their feathers from breakage. From the standpoint of appearance this arrangement satisfied the NUC

Avian Operational Support....

It appears the Point Loma location is very favorable in regards to this project. The prevailing wind direction is suitable and is much more moderate, allowing a great deal more training time.

Travel time from boat slip to working area is approximately the same as it was on San Clemente Island.

Commuting personnel [redacted] San Diego seems to be too time consuming so an apartment has been rented at a location only 5 minutes from the Installation.

Initial costs for utility buildings were a little over $1,000.00 with the apartment rental at $250.00 per month.

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Avian Operational Support....

TASK ASSIGNMENTS:

1 Bird Procurement

Requirements will be reduced considerably since new falcons have already been contracted for and quotas for other birds filled.

2 Care and Maintenance of birds

a. Dietary supervision is a 7 day a week obligation. Training procedures require that each bird be weighed daily on a sensitive scale in order to control weight within narrow limits. Charts must be maintained for each indivdual indicating what volume of intake is needed to hold constant body weight. Roughage (fur and feathers) must supplement feedings at regular intervals to act as a cleansing agent for the bird's crop. Bird ailments are very poorly understood even by the best authorities. It is, therefore a practice to have x-rays made of each bird in its normal state for later comparison in the event of serious illness. Since exercise is an important part of conditioning each bird is flown at least 5 times per week while in training or on deprivation.

b. Housing

Each subject once trained, or having reached a keen working edge, requires seperate housing or flyway. 7' x 10' areas are minimal. The enclosures must be made of smooth surfaces (no wire) with vertical lath strips on all doors and other openings to prevent feather damage. Approximately 30 birds are involved in the Project. Half this number will be located at the Point Loma location and the others housed at facility

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Avian Operational Support....

3 SA-5 Training

a. Preliminary training for new birds on an indivdual basis includes about 1 hour per bird of handling-taming and short flight training on tether. Considering the addition of at least 8 new birds this schedule is a full day's work for 1 man.

b. Condition all vehicles to become accustomed to 50-80 gram package attached to harness.

c. Training of all vehicles for minimal flight of 24 nautical miles from boat to shore and back.

d. Recognition relating to overall target area and specific target within that area.

e. Condition vehicles to assume various positions on immediate target for photographic purposes before starting return flight.

f. Last portion of schedule necessitates converting trainees to respond to sail boat with distinguishing features rather than power boat used in earlier training.

TRAINING PROCEDURE FOR TASK 3

a. As described.

b. Heavy package training is achieved by graduating weights upward from 10 grams to desired level. Additional muscular development occurs to compensate for increased weight.

Avian Operational Support....

c. The vehicle must become so strongly reenforced to the boat that it will start its flight to sea without, we may assume, having visual contact. The distance of the flights start at only a few hundred yards in the beginning and are gradually increased. Under normal conditions the vehicle will be heading into a head wind which will require the greatest output of energy. When the length of flights become longer the vehicle learns to reach for higher altitudes to conserve strength. As proficiency on both legs of flight is reached the order will be changed from shore to boat to boat to shore and return.

d. A broad semi-open area is sufficient for the initial recognition as bird approaches shore. Specific portion of target could easily be seen for at least 2 miles. It is taken into consideration that target simulation on a large scale may not be practical so training has been predicated on training to a specific portion which is moved from one area to another without regard to similarity.

e. Concealed rewards are positioned in various positions on target in unscheduled pattern which causes the bird to move from point to point in a searching behavior. This concept is proving valid.

f. Stimulus transference from power boat to sail boat will require approximately 3 weeks. This estimate is based on the difficulty of removing, from the bird's point of view, the frightening appeaance of the sails.

4 Overfly Operation

a. Refine present methods of handling procedure to correct problems in bird transportation. Recent excercises were not satisfactory due to putting bird on work call shortly after a 400 mile car trip. When operation was attempted bird was listless and without appetite. After 1 day's rest it was back to normal. Stange territory was not a factor since former training had included many short trips to strange areas where performance was satisfactory.

b. Further refinement suggests training bird to fly inside simulated luggage rack on moving car or truck.

c. Using falcons for this scenario would increase considerably its options for usage. The falson's flight is a direct one and it has very little dependence on wind conditions. The time element would be much shorter thus reducing the risk factor.

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5 Package Orientation

a. Experimental efforts have been made in orientation using a simulated compass to establish feasibility so this task would, in part, deal with acquiring a compass with stable characteristics needed for training. A cockatoo was used in the experiment and it was able to reliably orient the simulated compass by rotating a double layered disc until a red indicator on the bottom disc was lined up exactly with a hole in the top disc. No other test bird has been tried but it is almost certain that a raven, at least, would be capable of the same behavior.

b. Package delivery on shorter flights of several hundred feet would be achieved by training the bird to hold it between its upper and lower mandible. On longer distances involving more physical stress it would be necessary the package be attached to a harness for release at destination.

c. Combining the 2 parts of the above task with the additional schedule of quick location identification is our proposal. It would mean training the bird to deliver to a new location after a minimal rehearsal time or in response to an audio or visual signal such as a beam of light.

Avian Operational Support....

It is understood that certain modifications may be required to complete this proposal. This is, therefore,a rough draft so we look forward to receiving your comments. There has been some film shot with the intention of putting together a sequence for presentation. Time considerations, however, have not allowed us to assemble anyhting as good as what you already have. A picture of the [redacted] is enclosed but since it was taken all the construction has been completed. We will also be sending still pictures of the bldgs. at the other site and anything else we think might be of help.

[redacted]

SECRET

[redacted]

PROPOSED BUDGET FOR AVIAN SUPPORT
13 Sept. 1974 - 12 Sept. 1975

CONTRACT		$102,693.82		
DIRECT COST:			UNITS OF PAY	RATE
Labor: [redacted]	$20,800.00		220	$94.55
	14,300.00		220	65.00
	9,100.00		220	41.36
	6,760.00		220	30.72
Other (Part time)	5,200.00		150	34.67
	56,150.00			
MATERIALS & SUPPLIES Meat, Feed, Vitamins $1.11 Lb 4,500#s	4,995.00		104	48
TRAINING EQUIPMENT Fixtures, Release cages, Project Props, Misc.	1,000.00			
Film Project Reports and Camera Expense	1,000.00			
TOTAL DIRECT COST	$63,155.00			
INDIRECT COST:				
Trucks, cars, Depreciation	3,000.00		2 trucks used in S.D.	
Tires, Repairs, Fuel	1,000.00		1 truck commuting	
Veterinarians	2,900.00			
Apartment Rental & Utilities At San Diego	3,500.00		3 people S.D., 1 commuting	
[redacted] Location For Additional Birds (Utilities, Operating Expenses, Bldg.	2,500.00		Building constructed to conform to wildlife regulations	
INSURANCES & TAXES				
Workmans Comp.	1,516.05		2.7%	
Payroll Taxes	2,776.41		5.85%	
FUCA	105.05		0.05%	
SUI	462.00		2.2%	
Truck & Auto Ins.	750.00			
Liability	300.00			
Phone	3,000.00			
Accounting	1,500.00			
Mail & Postage	50.00			
Travel, San Diego [redacted] Other Training Locations	4,500.00			
Rental Boats, (Motor Sailer, Larger Boat For Final Phase	2,500.00			
Jib (sail) Training	200.00			
Use & Expense Wind Machine Trainer	500.00			
TOTAL INDIRECT COST	$31,059.51			
TOTAL COST		$94,214.51		
NET PROFIT		8,479.31		9%

OTS/SDB Memo #104-76
30 March 1976

MEMORANDUM FOR: OC/DOMCA

ATTENTION: [redacted]

SUBJECT: Radio Frequency Backstopping

1. Per our telephone conversation of 30 March, it is requested that your office provide backstopping for Agency two-way radio activity as follows:

FREQUENCY	:	162.125
PLACE OF OPERATION	:	[redacted] Oklahoma
EMISSION TYPE	:	FM
BAND WIDTH	:	± 5 KHZ
POWER OUTPUT	:	5 Watts (Portamobile) GE Mdl EV HN36LCS66 (ET-62-A ER-44-A)
NO. UNITS IN NET	:	2
ANTENNA	:	Omnidirectional Whip
EXPECTED USE DURATION	:	60 days (beginning 5 April)
USERS	:	Agency personnel and cleared Agency contractor personnel

2. The above mentioned radio activity is in support of a technical collection systems test being administered by DDS&T/ORD (contact [redacted] x2901, green 3166) in cooperation with DDO/SED (contact [redacted] x6267, green 3118) and DDS&T/OTS (contact the undersigned, x3278, green 5321) and is tasked by the TACANA/TCT.

3. Your cooperation in this matter is greatly appreciated.

[redacted]
Chairman, TACANA/TCT

Distribution:
Orig - Addressee
1 - ORD Attn: [redacted]
1 - SED Attn:
2 - SDB
E2 IMPDET
CL BY [redacted]

Approved for Release: 2019/07/30 C06527500

3.3(h)(2)

6.2(d)

~~CONFIDENTIAL~~

DD/S&T# 1872-73

ORD 2382-73

20 JUN 1973

MEMORANDUM FOR: Deputy Director for Science and Technology

SUBJECT: Request for Approval of Proposed Research with the U.S. Department of Interior, Division of Wildlife Research

1. This memorandum requests approval for the committment of funds to support the continuation of a research program. The request is contained in paragraph 7.

2. The ultimate goal of this program is to utilize migratory birds as sensor vehicles and/or as detectors of environmental substances in specified areas of interest. In the first case, the bird might transport and return a sensor package from an area of interest, or perhaps merely fly through the area. In the second case, the birds which have temporarily resided in a target area would be retrieved and subjected to intensive analysis to determine environmental stimuli or substances to which they have been exposed during the period of residence. The proposed project is primarily concerned with the second case, i.e., utilization of the bird as a biosensor. An orinthological survey has been conducted by [redacted] which delineates the frequency and species of birds that might be expected in specified target areas. The Department of Interior, Division of Wildlife Research, is the foremost authority on migration of birds and possesses highly qualified scientific personnel, equipment, and a unique computer bank of bird banding data. Consequently, the assistance of the Division of Wildlife Research will be invaluable in determining the feasibility of achieving the desired goal. In brief, this assistance would consist of providing statistical models of bird migration patterns and probable distribution through the flyways and at the destination. Specific

...NG NOTICE
...TELLIGENCE SOURCES
...HODS INVOLVED

~~CONFIDENTIAL~~

CLASSIFIED BY [redacted]
EXEMPT FROM GENERAL DECLASSIFICATION
SCHEDULE OF E. O. 11652, EXEMPTION CATEGORY:
§ 5B(1), (2), (3) or (4) (circle one or more)
AUTOMATICALLY DECLASSIFIED ON
[illegible]
(unless impossible, insert date or event)

target area destinations will be provided by the sponsor. Such data are required for cost effectiveness evaluation of the potential system as well as the establishment of experimental field trial design should this initial statistical analysis indicate potential application.

3. The essential goal of the proposed effort is to select several Western Hemisphere birds analogous to those known to reside in and migrate from selected target areas. On the basis of available Department of Interior banding data, a statistical model of bird distribution along flyways and at destination will be constructed. (See attached Work Statement.) Such data will allow cost effectiveness decisions to be made concerning the number of birds that would have to be retrieved for biochemical analysis to provide reliable target area information. The analytical study will provide means and standard deviations for geographical distribution and mortality of birds along the flight paths as well as probable distribution in the target area. The designated target for which western analogs will be selected is the Shikhany CW test site. Attachment I, Utilization of Migratory Birds as Biosensors, provides evidence as to the feasibility of the concept. That is, migratory birds will incorporate CW trace material from low level concentrations in the target habitat and these signatures will be detectable by available biochemical techniques. Attachment II indicates probable bird populations in selected target areas.

4. The proposed research will extend over a six-month period at a cost of approximately $25,000. In addition to the obviously required coordination with the Department of Interior, internal coordination has been established with Dr. Karl Weber (OSI), Mr. Donald Reiser (ORD), and Mr. David Boston (OTS).

5. It is anticipated that this will be a five-phase program from initial feasibility investigation to operational test and evaluation. Each successive phase will provide decision data for determination of program continuance. The first phase of the program was completed under contract to [redacted], in which the frequency and reliability of migratory bird habitation in [redacted] targets were determined. The proposed effort with the Department of Interior constitutes the second phase of the program. Follow-on efforts

ORD 2382-73

will consist of: (a) field evaluation of the statistical pattern analysis derived from the bird banding computer data (FY 74, $70K); (b) determination of bird uptake, metabolism, and excretion of controlled amounts of CW degradation products (FY 75, $40K); and (c) field evaluation of migratory bird absorption and retention of CW degradation products in the concentrations and dietary form (natural vegetation, seeds, etc.) anticipated in the selected target area (FY 75, $150K).

6. The Project Officer for this contract will be [redacted] extension 3658. The Sterility Code 1 is appropriate for this contract. All other aspects of the contractual effort, other than Agency-Department of Interior association, will be UNCLASSIFIED.

7. The Office of Research and Development recommends the transfer of funds to the Department of Interior, Wildlife Research Division for the execution of the work described herein. The funding will be $25,000 for a six-month period.

[redacted]
Sayre Stevens
Director of Research and Development

APPROVED:

[redacted]
Deputy Director for Science and Technology

23 June 73
Date

6.2(d)

☐ UNCLASSIFIED ☒ CONFIDENTIAL ☐ SECRET ☐ ________ (specify)

3.3(h)(2)

REQUEST TO PROCUREMENT DIVISION FOR SERVICES
(*other than property or building maintenance and repairs*) ORN 484806

OFFICE/DIV/BR	REQUEST NO.	DATE OF REQUEST	I CERTIFY THAT FUNDS IN THE ESTIMATED AMOUNT OF $ 25,000 ARE AVAILABLE CHARGE TO FAN 2162-4848
LS/ORD/DD/S&T	62-8013-73	June 1973	

PROJECT TITLE	PROJECT OR CONTACT OFFICER	EXTENSION		DATE
Migratory Bird Sensor System	[redacted]	B-3658 R-	[redacted]	6/20/73

CONTRACTOR (*if known*)	PROPOSAL NO. AND DATE	CONTRACT & TASK ORDER NO. (*if known*)
Department of Interior Division of Wildlife Research	Work Statement Attached	

TYPE OF SERVICE REQUESTED

X	RESEARCH/DEV
	GRANT
	REPAIR
	MAINTENANCE
	MODIFICATION

TRANSFER OF FUNDS TO OTHER GOVT. AGENCY (*specify if applicable*): Dept. of Interior Div. Wildlife Res.

APPLICABLE ONLY TO REPAIRS AND MODIFICATIONS

TECHNICAL INSPECTION IS REQUIRED BY ☐ RECEIVING DEPOT T & I ☐ TECHNICAL MONITOR

☐ ITEMS TO BE PICKED UP OR ☐ SERVICES PERFORMED AT:

ITEMS TO BE REDELIVERED TO:

STERILITY		CONTRACT CLASSIFICATION	WORK CLASSIFICATION	HARDWARE CLASSIFICATION	REPORTS CLASSIFICATION
	SC 0	confidential	unclassified	unclassified	unclassified
X	SC 1				
	SC 2				

SHORT SUBSTANTIVE TITLE AND/OR DESCRIPTION OF SERVICE TO BE PERFORMED

The Division of Wildlife Research, Department of Interior, will select Western Hemisphere migrating birds which are optimal analogs to birds known to migrate to or through specified Eurasian target areas. A statistical analysis will be made of computerized bird banding data to determine flyways and distribution patterns of the analog birds.

CLASSIFIED BY [redacted]
EXEMPT FROM GENERAL DECLASSIFICATION SCHEDULE OF E. O. 11652, EXEMPTION CATEGORY:
§ 5B(1), (2), (3) or (4) (circle one or more)
AUTOMATICALLY DECLASSIFIED ON
IMPDET
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DD/S&T# 1877-73

WARNING NOTICE
SENSITIVE INTELLIGENCE SOURCES AND METHODS INVOLVED

ORD 2382-73/1

(*See reverse for specific information required on R&D requests.*)

APPROVAL

DESIGNATION	SIGNATURE	DATE
D/ORD	Sayre Stevens [redacted]	20 JUN 1973
DD/S&T	Carl E. [redacted]	23 JUN 1973

PROCUREMENT DIVISION USE

DATE RECEIVED IN PD	RECORDED BY	SECTION ASSIGNED TO	NEGOTIATOR

FORM 3-67 2420 REPLACES FORMS 2420 AND 2416 WHICH MAY BE ☐ UNCLASSIFIED ☒ CONFIDENTIAL ☐ SECRET ☐ ________ (specify)

1. JUSTIFICATION FOR SOURCE SELECTION

This is a transfer of funds to another Government Agency. The Division of Wildlife Research, Department of Interior is the only organization possessing sufficient valid data to conduct the analysis required.

2. PROPOSAL

See attached.

3. DELIVERABLE ITEMS

REPORTS REQUIRED 5 NO. OF COPIES [ ] MONTHLY [X] INTERIM Status [ ] QUARTERLY [X] FINAL

HARDWARE (state type and number)

OTHER N/A

4. GFE REQUIRED

N/A

5. SPECIAL INSTRUCTIONS

The only classification of this work effort will be Agency association, hence, the SC-1 classification. It is of extreme importance that Agency support of Department of Interior activities not become public knowledge.

~~CONFIDENTIAL~~

Attachment

STATEMENT OF WORK

I Evaluate existing report from Phase I contract in terms of:

a. species selection

b. characteristics of selected species

II Update or supplement existing report in terms of a and b above.

III The sponsor will designate target area. Western Hemisphere analogues to Eurasian birds known to frequent the target area will be selected. The Wildlife Research Division of the Department of Interior will evaluate existing bird banding data to provide statistical pattern analysis of banding and release major and secondary flyways and distribution at destination. Relevant variables would ~~be~~ include, but not be limited to, age, sex, flight time, nesting, molting, and other relevant factors available from the computerized bird banding records.

IV On the basis of available knowledge concerning migratory flyways, nesting, and wintering habits of birds visiting the target area, the contractor will indicate probable similarities and differences that might be expected between birds utilized in the western analog analysis and the same species in the target area.

~~CONFIDENTIAL~~

Attachment #1

UTILIZATION OF MIGRATORY BIRDS AS BIOSENSORS

A presentation was made to the PRB concerning the use of migratory birds as direct in vivo sensors or as sensor emplacement vehicles. The background of the original ORD research effort in this area, which involved migratory characteristics of selected bird species nesting or wintering in the vicinity of ten target areas, was outlined. Approval was requested for transfer of funds to the Department of Interior, in the amount of $25K, for an analysis of existing bird banding data to establish the flight and residing distribution patterns of western analogs to the Eurasian birds. The PRB recommended that prior to approval of fund expenditures, a meeting be held with cognizant personnel to discuss specific target requirements, energy, or substances to be detected and technical approaches for accomplishment.

As per PRB request, a meeting was held 13 April 1973 to discuss the questions posed above. It was the concensus of opinion that, for the present time, the project goal should not include utilization of birds as package emplacement vehicles, but rather as in vivo biological sensors. Further, it was decided that CW degradation products would constitute the signal substance and that CW test area at Shikhany would serve as the designated target.

Subsequent to the above discussion, the question arose as to the probability of in vivo detection of CW signatures at the concentrations to which the birds would be exposed. Although specific tests have not been directed toward the solution of this particular problem, the available evidence, as cited below, indicates a high probability of detection at the concentrations to be expected. In addition, numerous bird species migrate to the Shikhany Volga River Basin and are accessible from undenied areas. This general question may best be approached in terms of its components, i.e., in view of normal safety and security precautions, can we expect CW products in the target area which will be ingested by the migrating birds;

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WARNING NOTICE
SENSITIVE INTELLIGENCE SOURCES
AND METHODS INVOLVED

UTILIZATION OF MIGRATORY BIRDS AS BIOSENSORS (continued)

are the CW degradation products retained in the organism and detectable by available techniques; and do we have access to birds migrating from the target area.

Considering these component questions in sequence we may ask:

(a) Can we expect CW contamination in the target area?

Assuming other countries exercise safety and security precautions equal to that of the U.S., available evidence indicates a high probability for the presence of CW material or degradation products. This statement is substantiated by the current LS/ORD research program: organophosphorus compounds were detected in soil samples surrounding a VX plant in Newport, Indiana, which has been inoperational for over a four-year period; soil samples taken from Rocky Mountain Arsenal showed GB traces four years after test cessation; recent analysis of soil and water samples from the Cold Creek Organic plant in Alabama indicated contamination in surrounding areas and more than a mile downstream from the plant. FI/DDP are sufficiently interested in this finding to warrant possible application to [redacted] R&D operations. Inasmuch as the Shikhany target is a CW test area, as opposed to a production or storage area, one would expect significant levels of CW material.

(b) Are the CW products of sufficient concentration to be retained in the organism and be detectable by available analytic techniques?

Voluminous research data from the Environmental Protection Agency and the Department of Interior indicate that birds and other wildlife absorb and retain infinitesimal amounts of toxic products which are readily detectable by x-ray spectrometric and emission spectrometric analysis, neutron activation and atomic absorption techniques, as well as via the more traditional wet chemistry laboratory analysis. The extent to which the organisms environment provides detectable chemical clues to its habitat is evidenced by an investigation which demonstrated that coho salmon, "had natural chemical tags that could be directly related to their rivers of origin."[1] Numerous other studies are cited in the literature which demonstrate the capability to differentiate the habitat of identical wildlife species on the basis of tissue analysis. For instance, aligators reared in Florida show a different neutron activation signature than those reared in Louisana; two populations of snow geese in the Hudson Bay area could be differentiated on the basis of emission spectrometric analysis; Oregon geese can be differentiated from Colorado geese on the basis of manganeese content of the liver. An organism is what it has eaten. Most of the research relevant to our immediate CW problem is concerned with the effects of insecticides and pesticides on wildlife. These compounds are detectable at levels of 6-10 parts per million in the bird population. Examples of such research findings are as follows:

> In a general survey of the pesticide pollution problem it was concluded that, "all mallards, black ducks, and starlings tested in recent years contained DDT or its derivitives DDE or DDD. Starlings carried a much heavier concentration, probably reflecting their feeding habits."[2] In an experimental program at the Patuxent River Wildlife Research Station, sparrow hawks were fed dietary dosages of DDT and dieldrin and "for the first time provided statistically demonstrable proof of a cause and effect relationship between ingestion of these pesticides and eggshell thinning and associated deletious effects on reproduction."[3] The Denver Wildlife Research Station reports "Semidomesticated mallards were treated with 0,4, 10, and 30 parts per million of dieldrin to learn if the pesticide would effect the chromosomes of bone marrow and lymphocytes. The mitotic index, the number of cells undergoing mitosis per 1000 cells examined, was reduced more than five times in birds treated with 30 ppm dieldrin."[4] Since the publication of The Silent Spring

and the growth of the ecology movement, the literature is saturated with evidence of the lasting effects of minute quantities of chemical substances on wildlife health and survival. Of more immediate relevance to the CW problem are studies concerned with the organophosphate-type pesticides. Although the literature is considerably less voluminous in this area, there is evidence of bird uptake, retention, and laboratory detectability of the substances. The effects of organochlorine and organophosphate pesticides on the ring necked pheasant population were studied in Canyon County, Idaho. Exposed to very minute quantities of the material, the birds exhibited symptoms of organophosphate poisoning and modified cholinesterase levels.[5] A study in Dawson County, Nebraska, showed that a mere eight fluid ounces of malathion (an organo-phosphate pesticide) dispersed over an acre of land had a significant detrimental effect on the wildlife of the area.[6] A study is currently underway at the Patuxent River Wildlife Research Station to determine the relative lethal toxicities of ninety different pesticides, including the organophorphous compounds, on four species of birds. Initial data show detectable signatures of the organophorphous compounds.[7] A preliminary study with [redacted], sponsored by LS/ORD, in which mice were exposed to CW degradation products substanciates the Bureau of Wildlife research findings.

The research programs cited above were not directed toward the problem of CW detection. To arrive at a more definitive conclusion, a specific project should be initiated in which target analog birds are provided dietary intake of appropriate CW substances in concentrations that might be expected at the Shikhany test site. Appropriate chemical analysis over varying periods of time would then demonstrate the presence and degree of CW signatures existing in the organism. However, considering the chemical similarity of the pesticide-insecticide compounds with the CW agents, it is logical to assume from existing data that migratory birds residing in the target area would incorporate CW signatures in detectable amounts and provide a qualitative and quantitative index of CW activity at that site.

(c) Species and distribution of birds in target area and access for analysis during migratory cycle --

The above question was posed to the Office of Basic and Geographic Intelligence. Their response constitutes Attachment II. In brief, large numbers of migratory birds temporarily reside in the Shikhany area. Considering the nature of the terrain, a river basin with large reservoirs, one would expect a significant bird population. Fortunately, many of the species present are those for which western analog bird banding data exists, i.e., mallard, teal, merganser, osprey, etc. During the winter months, the birds migrate to the warmer climates of the Caspian Sea, Iran, Iraq, Turkey, India, and other undenied areas in which they would be accessible for capture. Many of the species are hunted birds and are of concern to international wildlife protection groups so that capture for "tagging" or biological study should not arouse undue concern.

4. The preceding discussion of available research data indicates that a migratory bird biosensor system would be feasible in terms of probability of CW signature detection. However, as stated previously, a definitive answer to the question would require definitive research. This does not imply that the proposed migratory distribution pattern analysis should be postponed to await the results of a long-term CW signature study. Although both types of data are required for the specific Shikhany CW project, bird migration pattern analysis has many more applications than this particular requirement. It is a fact of nature that migratory birds constitute a multitude of ready-made vehicles which circumvent the globe in predictable patterns and are readily available for intelligence utilization by ourselves and others. It would seem essential that an R&D organization, anticipating future requirements, should have available data concerning the distribution pattern characteristics of selected species. Such data would be applicable to future intelligence requirements in South America, Africa, or other parts of the world not currently considered as threats to our national security. The development of atomic weapon capability in the Third World areas may produce intelligence requirements that could be

supported through signature analysis of migratory birds. The voluminous research programs conducted by the AEC contain positive proof of wildlife adsorption of radio active materials. Utilizing immunological memory techniques, it is quite possible that migratory birds could be used to detect the presence of any substance to which the bird develops an antibody defense system. Probably the most significant threat to our national welfare would be the use of migratory birds as vehicles for the spread of human, livestock, and plant diseases. A migrating bird is the ideal host and vehicle for such purposes. Considering the tremendous influx of seasonally migrating birds into the U.S. from Central and South America, it would seem essential that the CIA establish the techniques and plans for selected bird distribution pattern analysis to support countermeasures for such a threat. If we delay analysis of existing data for intelligence purposes until the threat has materialized, it will be too late to institute effective countermeasures. If such a hostile action has not been anticipated by the Agency and an effective detection and countermeasures plan placed on file in the archives, immediate program action should be initiated regardless of the relative merit of the minor $25K project support requested for the subject investigation.

5. The basic and primary consideration regarding the use of migratory birds as emplacement vehicles; as biosensors for nuclear, CW, and other products; or as hosts and transport vehicles for bacterial dissemination is the reliability of the bird vehicle. Such questions as the following must be addressed: how many birds that depart from point A arrive at point B? What proportion return to point A? What is the bird distribution pattern around the target area? What is the mortality and distribution pattern along the flyway from point A to point B? Knowing the migratory paths and the statistical distribution pattern in the target area, how many birds would have to be captured and analyzed to provide a reliable index of biological signatures? Obviously, the proposed project will not answer all of these questions for all potential requirements. However, a statistical pattern analysis of the existing Department of Interior bird banding computerized records, utilizing western analogs for the Shikhany target area, will provide crucial data concerning migratory bird reliability as sensor vehicles to meet this requirement. In addition, such a study will provide data and a model for determination of migratory bird utilization to serve future requirements or to counteract such action by others.

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ORD 7772-67

28 December 1967

MEMORANDUM FOR THE RECORD

SUBJECT: Review of the Animal Programs with the Executive Director

1. On 27 December 1967, the Executive Director, Dr. Lauderdale, and I met to review the Agency's position with respect to continued participation in the animal programs. Col. White was brought up to date on the Defense Department's counterproposal which involved both the dog and the dolphin programs.

2. The Defense Department wishes to have ORD be the technical monitor for continued efforts in both programs. Since the Agency has no requirement for the dog program, our role will be confined to technical management. No funds will be provided by the Agency. We discussed the continuation of the dolphin program and it was decided that we would provide approximately 200K out of '68 funds and that ARPA will provide an as yet unspecified amount in '68 and '69 (probably on the order of 400K). Some time later this year the Agency will reconsider the possibility of providing funds for the dolphin program in '69.

3. Col. White emphasized the need to maintain as much control as possible over the dolphin program because of its potential usefulness to the Agency. I pointed out that we feel that we could maintain some reasonable control by using our own funds at the critical points in the program. However, we recognize that ARPA has a legitimate right to exert considerable influence since they are providing the majority of the funds.

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4. We reviewed the revised missions of both programs and I indicated that I thought the current arrangement, which will involve a systems contractor, will slip the program until 1 January 1969 (approximately six months). I will draft a memorandum for Mr. Duckett's signature and review by the Executive Director, addressed to the DDR&E, confirming this new arrangement.

[redacted]

Stephen L. Aldrich, M.D.
Deputy Director
for
Research and Development

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ORD # 0084-75

AVIAN TRAINING PROGRAM

FINAL REPORT

Approved for Release: 2019/07/30 C06527547

28 December 1974

[redacted]

AVAIN TRAINING PROGRAM
Contract Order No. [redacted]
Final report (No. 7)

INTRODUCTION:

Chronologically, the 7 months which ended this contract period was 5 months shorter than preceding contracts. It did, however, produce the most positive results with relation to the TACANA operation to which it was devoted.

Experience and knowledge acquired during former contract periods was a strong factor although it was during the months just past when all the right components came together at the right time.

Additional training procedures were developed, such as overflight of bird with camera in strange areas.- bird flying from one building window to another up to distances of 1 mile. - flying bird locating and flying into window of moving car or to an operator who wears specific items of apparel.

Feasibility tests were made in package orientation in which the determination was made that a bird can orient a compass, or other object, to a given direction.

There are, at the present time, a stable of trained birds capable of performing a number of behaviors which could readily be adapted to a variety of scenarios.

Following is a list of trained birds, comprised of 4 different species. It is to be noted that these birds, once trained, never lose acquired behaviors. It is necessary, however, to recondition them again for a period of 2 to 3 weeks after they have been idle for any length of time.

AVIAN TRAINING PROGRAM.....

BIRDS ON HAND:

	untrained	trained
Red Tail Hawks	0	8
Harris Hawk	0	1
Ravens	5	5
Golden Eagles	0	2
Falcons	4 (partly)	1 (fully)
	9	17
TOTAL	26	

AVIAN TRAINING PROGRAM......

LOCATION CHANGE:

A decision between the Program Director and the Contractor was reached early on in this contractual period to change the base of operations from San Clemente Island, California to Point Loma, California. Both of these locations are Navy Undersea Center Installations and the proper clearance from them was first obtained before the move was made. There were a number of reasons for this change. We list the most important of these in the following:

SAN CLEMENTE ISLAND:

Objectional features:

a. Weather conditions, wind direction particularly, was contrary to any existing condition which might be expected at site of final task.

b. Weather severity, especially during winter months, precluded working a full schedule. Due to geographical location and open sea exposure there were several weeks when wind velocity was so great it was impossible to work more than 1 or 2 days per week.

c. Isolation with regards to maintenance support for vehicles, both automobiles and boats, was always a serious problem. When breakdowns occured parts would have to be transported from the mainland. This caused unreasonable delays due to the erratic air service to and from the mainland.

AVIAN TRAINING PROGRAM....

SAN CLEMENTE, CONT.

d. Further support for mechanical difficulties was non-existant. Personnel who should have been attending to training schedules were often involved in mechanical work they were not properly equipped to perform.

POINT LOMA:

This location has resolved most of the afore-mentioned problems. Progress in training has been accelerated considerably. Weather conditions have been favorable. North west winds have been the rule. This would be the relative in-shore off-shore direction to be expected within 10 miles of any mainland.

TELEMETRY:

A number of telemetry systems have been tested on this project. None of them proved satisfactory until the one presently in use was acquired. Its use immediately allowed the flight range of the vehicles to be extended with a margin of safety. Recounting the scenario in question, takes into consideration the fact that the vehicles are in sight of the operator for only a short time. This poses a substantial risk during the initial training during the period of time when the distance is first being extended.

(CONT.)

AVAIN TRAINING PROGRAM....

TELEMETRY

The telemetry system consists of 2 units - a small beacon, weighing approximately 50 gms. and which is attached to the vehicle. The other unit is a portable direction finding receiver. Attached to the receiver is a hand held antenna which produces a null and peak mode in relation to the direction of the beacon. The system is in use from the first when the vehicle is started only a few yards to and from the boat.

Until the vehicle has flown several miles to and from the boat it is still in the learning process. He is still learning how to handle wind velocities and how to gain sufficient pitch, or altitude, required for such a flight.

In the beginning he may make mistakes. If he comes in too low from either direction he may be attacked by resident birds. This can cause confusion and panic. Although the vehicle eventually learns to control these situations he is vulnerable in the beginning and the telemetry provides a means of recovery under such conditions.

When the bird has acquired a range of 5 miles he is considered to have the necessary training to go all the way. At this point it would be possible to eliminate the telemetry. Its use, however, is continued as a safeguard.

AVAIN TRAINING PROGRAM....

PROGRESS:

Of the 5 birds being used on the TACANA operation 1 has a physical handicap which eliminates it for further training. Attempts are being made to trade it for another bird suitable for this project.

3 additional falcons, acquired during this contract time,have just recently been released from quarantine. They are presently in training and show promise of completing their training well within the limits of this schedule.

The remaining bird is considered to be ready to perform the scenario at this time. He is subject only to additional training which includes a sail boat needed for recognition purposes on the outflight. This aspect will move forward as rapidly as the logistics of acquiring a suitable boat and other related factors are resolved.

CONCLUSION:

The conclusion of the Contractor is that the schedule as it is presently proposed can be met if all the necessary elements are available in time to allow for proper final training.

Respectfully,

[redacted] [redacted]

28 July 1974 6.2(d)

Report No. 4 3.3(h)(2)

PROGRESS REPORT, AVIAN FLIGHT TRAINING

1. Present bird census

Species	Juveniles	Adults	Trained	In trainin
Red Tail Hawks	0	7	7	0
Ravens	8	3	0	11
G.H. Owl	0	0	1	0
Harris Hawks	0	1	1	0
Peale's Falcons	0	2	2	2
Prairie Falcons	0	1	1	1
Pigeons (bandtails)	0	7	1	6

2. Birds to be acquired

	Juveniles	Adults
Peale's Falcons	2	1
Prairie Falcons	0	1
Gyr Falcon	1	

3. Remarks

a. The Red Tail Hawks listed above are all basically trained to the extent that any one of them is capable of being used in a scenario that lies within their scope. This is the result of at least 1 year of training. At the present time only 2 of them are being actively worked. This implies that the ones not being so worked are being kept on fill-up both for the sake of their well being and further inducement to the molt. The 2 which are kept at working weight have a molt rate significantly slower. We assume this is nature's provision for periods of deprivation.

b. The Harris Hawk is fully trained and, being unusually bright, is capable of acquiring sophisticated behaviors in a short period of time, although this does not include flying greater distances of several miles.

c. The Horned Owl is well trained to free flight as well as visual and audio orientation. His full capabilities have not been fully explored but it has been ascertained he will respond and "home" to a high frequency dog whistle in almost total darkness. It is our present evaluation that the owl does not have visual discriminatory potential of either the hawks or ravens in the presence of daylight.

d. Bandtail pigeons, contrary to our first estimate, have been quite easy to tame and train to recall. The ones we obtained were extremely wild but in a matter of 3 weeks one of them [redacted]...............

readily responds to a whistle in free flight. It is noted, however, it does not have the degree of discrimination we are used to in our other birds at this stage of its training. We also observe it does not appear to have the faculty of carrying the amount of weight we had hoped it might.

e. Regarding the birds to be acquired: arrangements have been made with Canadian exporters for the PEALE'S Falcons. With the blessings of the proper Fish and Game authorities it will only be a short time until they are in transit. The amount of time they will be in quarantine is still not determined. The additional PRAIRIE Falcon mentioned above should be in our possession in the coming week but, again, we defer to the Fish and Game officials. Arrangements have also been made for the GYR Falcon but because of certain restrictions we will not be able to take possession until some time in October.

f. The 8 juvenile RAVENS are all exceptional prospects. As the result of many years of experience and of past mistakes, we are confident these birds have a very special place in our future plans. Fortunately, they were acquired at almost the exact time best suited to imprint them to humans and not too young to impede their proper start in life. In this regard, a matter of only one or two days is critical. Experience has also taught us that these birds must be entirely hand fed and must proceed to a condition of full growth before subjected to deprivation. At this stage they are in perfect condition and, in our judgement, almost ready to start training.

4. <u>Training schedule</u>

a. While daily reports are included herein, we feel some further definition is needed to round out the picture of the past several weeks. We are, of course, in short supply of falcons, a situation to be resolved in the near future. The male PEALE'S has shown both outstanding potential and ability. He, like all falcons, require a very delicate touch until behavior patterns have been firmly established. We feel the daily reports do not present an accurate picture of this bird. In part, we must accept some of the responsibility in attempting to avoid live stimulus in training. We have recently adopted another course and the difference was noticeable almost instantly. The falcon has changed from a reluctant trainee to a charger who needslittle or no persuasion. He is presently performing to what we feel is the limit of our safety factor which will be covered in more detail later in this report. The same story applys to the PRAIRIE [redacted].........

falcon except for the fact that this bird has always shown strong motivation. His limitation was due to impaired wing feathers which have now molted. In spite of his small size it is our belief he will live up to all our expectations. Both of these latter birds are flying one mile round trips from boat to shore. We feel they can be extended immediately when we are equipped with the proper telemetry.

5. The Saga of Do da

We feel thatthose who have suffered through former reports must be familiar with Do da the RAVEN. I suspect they are also familiar with the fact that I had very small expectations for one of his species on this project even though I had raised and trained him from the time he was a small downy fledgling. [redacted] he was in a class by himself, [redacted] too numerous to mention, [redacted] In any case, he had a very large bag of tricks and was loved by all. In view of these talents I suppose I shouldn't have been too surprised when he so quickly became a star on this project. The accompanying resume gives some notion of his brief but spectacular career on San Clemente Island. In a little over 3 months he was doing up to 6 miles from shore to boat and very nearly that same distance on return. The resume, however, does not tell the full story. Hoping for your indulgence, I would like to recap some of the day-to-day experiences that do not become apparent in the rather terse daily report. When one is not personally involved in handling these birds it would not be easy to visualize how they are not only learning to do what is expected of them but, at the same time, are learning what they must do in order to perform such a feat. Here the trainer is helpless. With each training period we were able to observe Do da as he discovered which altitudes he had to maintain under various wind conditions. In addition, he was acquiring sufficient guile to outwit the native ravens and gulls. These excercises, on his part,had reached some stage of sophistication, although, it is our belief that it was ultimately a pair of ravens that finally did him in. In the early stages the native birds did not pose such a threat but, it is a fact that, as they became more familiar with our schedule they would time their attacks to coincide. Do da had found out how to maintain enough altitude to out fly the errant gulls but other ravens were a different matter. They had developed the technique of hiding behind a nearby bluff, waiting for the most opportune time to attack. Typically, Do da would parry these tactics with small dog fights during the first mile at which point the pair of ravens would turn back toward shore. From that point our observer would usually lose visual contact. There was always a tense few minutes until Do da appeared from out of the blue and the trainer on the boat breathed another sigh of relief. His condition upon arrival was always good. Unless weather conditions were extreme he was never breathing heavy and our impression was that he could have done twice the distance without much stress. What may have occured on June 19th is only a matter of conjecture. After leaving the release point Do da was seen being attacked by the usual pair of ravens. The shore operator observed one of these birds pecking Do da in the back of the head. The final sighting was only seconds later when all three birds disappeared behind a bluff. A full week's search on land and sea failed to show a trace of Do da. It is our firm conviction that he was either killed near the shore line by these same birds or, being wounded, attempted to make it to the boat and failed. In any case, it is a certainty his relations with the native birds were not such that he would have taken up with them but instead would have looked to us for security. In spite of our deep sense of loss we do understand such tragedys are inevitable and, we may add, this is not the first one. To be sure, it was some kind of a thrill the first time we saw him head out to sea, on his way to a boat the keenest eye on land could not see. If his performance is any indication, our new flock of 8 young birds should give us ample back-up protection.

The other documents with this report are self explanatory. Others will be included in report No. 5.

6. Telemetry

We have located what is purported to be the most reliable telemetry system available for use on birds and other wildlife. The system includes a small beacon which is attached to the bird and a receiver which picks up the beacon signals up to distances greater than 10 miles when the bird is in the air and approximately 1 mile on the ground. The name of the company is [redacted] We hope to work out something with the Contracting Officer in the shortest possible time for the purchase of one of these units.

Respectfully,

[redacted]

Do da

On San Clemente 2/25/74 780gr

Introduced to boat 2/25/74 780gr

3/4 mile to boat 3/18/74 805 gr

1 mile to boat 3/19/74 805 gr

1 1/4 mile to boat 3/20/74 805 gr

1 1/2 mile to boat 3/25/74 775 gr

Break 3/26 to 4/8 At studio

1 mile to boat 4/8/74 750 gr

1 3/4 mile to boat 4/11/74 770 gr

2 1/4 mile to boat 1/2 mile to shore 4/17/74 750 gr

3 mile to boat, 2 mile to shore 5/3/74 770 gr

4 mile to boat, 2 mile to shore 5/4/74 770gr

Start flying from out of sight over top of Island. 5/9/74

4 3/4 mile to boat 5/16/74 755gr

5 mile to boat, 4 mile return 5/21/74 750gr

6 mile shore to boat, 4 mile to shore 5/22/74 750gr

3 mile to shore 5/28/74 760gr

New target introduced 5/30/74 760gr

Break texas trip 5/31 to 6/11 74

4 mile round trip to target 6/13/74 760gr

6 mile to boat 6/14/74 750gr

6 mile to boat 6/18/74 750gr

Lost 6/19/74 750gr

~~SECRET~~

31 OCT 1975

MEMORANDUM FOR: Director, Office of Research and Development

SUBJECT : Scenario for Development of Trained Birds

1. Attached is step-by-step description of one possible scenario for the use of trained birds to perform a photographic mission in the USSR. Please ensure that the contractor designs the bird training program to fit these scenarios.

2. There are two particularly vulnerable points in the scenario--items 6c and 7b. The actual transfer of the birds from [redacted] a case officer's car (6c) must be performed in full view of at least one observation post. The birds must be trained, therefore, to tolerate transfer from the [redacted] to a closed, possibly even light-tight concealment device for transfer to an automobile. They may have to remain in this concealment until the actual release.

3. The actual launch of the birds (7b) is equally vulnerable to hostile observation, in this case by surveillants. Therefore, various launch techniques must be investigated and thoroughly tested. The launch scenario might dictate that the birds be launched from the side window of a car moving up to 50 miles per hour, from a knapsack on the back of a skier or from the lunch basket of a picnicker. We need to know, for example, whether two or more birds can be launched simultaneously from the same concealment, what speed is acceptable for a car launch if 50 mph is too fast, etc.

4. Before any birds can be shipped to Moscow they must be tested in the U.S. following a scenario as nearly identical as possible to that which will ultimately be employed. For the test scenario we suggest that an OTS/Headquarters building simulate the [redacted] that a target be selected in the [redacted] area, and that the birds be launched from a point south or west of [redacted]

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BIRD SCENARIO

1. Birds trained in US at contractor's facility.

2. Birds shipped to Moscow, ideally in late spring or early summer, by

   a. [redacted] or
   b. Driven in from [redacted] by case officer or [redacted] officer.

3. Birds released in [redacted] to

   a. Establish themselves, i.e. assert territoriality, and
   b. Orient themselves, so they will always return to loft.

4. Trainer or [redacted] officer maintains birds

   a. During time they establish territoriality,
   b. During time they orienting themselves to new surroundings, and
   c. Until there is an opportunity for deployment, maybe one week after they established and oriented, but possibly not for two months.

5. Trainer reinforces birds' training.

   a. Sand table in loft?
   b. Black and white photographs in loft?
   c. Color photographs or slides in loft?

6. Preparing for mission.

   a. Birds captured in loft by trainer.
   b. Trainer attaches cameras.
   c. Birds put in container for transport from [redacted] to case officer's car and in case officer's car to launch point.

7. Mission

   a. Bird(s) transported in car to launch point. Camera activated.

   b. Launch, from <u>moving</u> car, at point which may be up to five miles from target. Target may <u>not</u> be on straight line between launch point and [redacted]

   c. Bird flies over or actually lands on target, which will be very specific, i.e. one of several storage tanks, buildings, electrical installations, etc.

   d. Bird returns to [redacted] Trainer removes camera and film

8. If necessary, above scenario repeated, possibly with a different officer launching the bird from a slightly different point.

SE Division is prepared to assist in the formulation and execution of the test scenario. We assume that funds are available to determine whether birds can be trained to follow this scenario and that the tests can be accomplished by March 1976. Upon completion of these tests a decision would be made as to whether the bird training program should be continued.

[redacted] 6.2(d)

SE/COPS

Attachment: as stated, h/w

ORD 3593-73

3 August 1973

MEMORANDUM FOR: Project Review Board

SUBJECT: Support Requirements for Project TACANA

1. The specific target selection and operational scenario for subject project is being constructed through the joint efforts of LS/ORD, [redacted] of the Air Systems Division, and [redacted] of the Defensive Systems Division. In general terms, the scenario required that the target be located not more than two miles from the open sea, and that commercial or private boats may pass within 12 miles of the coastline (preferably closer) without arousing undue suspicion. Several of the potential targets possess these characteristics. More detailed information concerning the general terrain, meteorological conditions, general sea states, types of boats, and routine traffic in the vicinity, and other relevant data are being accumulated for the most likely targets.

2. Regardless of the specific target(s) selected, field training for the bird vehicles will require a marine environment, boat launch, overwater flight, and simulated targets placed at varied points having ground characteristics similar to selected target areas. The training program must also take place in an area reasonably secure from inquisitive bystanders.

3. In response to a request for military support, the JCS approved DOD support in principle and assigned OP 009 coordination responsibility. Cmdr. Krieger, OP 009M, visited and comparatively evaluated Point Loma, San Clemente Island, Camp Pendleton, Point Mugu, and Port Hueneme as potential training sites. Other sites meeting the physical requirements were investigated through the assistance of the DOD. Taking all factors into consideration, San Clemente Island was selected as the most appropriate operational training site.

CLASSIFIED BY [illegible]
EXEMPT FROM GENERAL DECLASSIFICATION
SCHEDULE [illegible] CATEGORY:
§ [illegible]
AUTOMATICALLY DECLASSIFIED ON
[illegible]
(unless impossible, insert date or event)

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ORD 3593-73

4. Coordination of Agency-Navy activities on San Clemente Island have been assigned to the Naval Underwater Center, San Diego. The Underwater Center will provide necessary boats, fuel, seaman boat handler, air transportation to and from San Clemente, barge services for transport of vehicles if required, storage facilities, personnel billitting, and other general support such as minor maintenance, tools, expendable equipment, etc. Attachment I is an authorization for Navy expenditure of an amount not exceeding $15,000 to provide the above mentioned support.

5. One constraint specified by the Underwater Center prior to agreeing to support subject project is that an Agency representative with marine experience be physically on site during the training program and serve as the interface between Naval and Agency contractor personnel. In brief, they require that a person experiences in boat handling, marine communications, maritime regulations, safety, etc., be responsible for the boat operations as opposed to a civilian "bird trainer." In addition, the Underwater Center wishes to avoid dealing directly with an Agency contractor and prefers that the interface take place with an Agency representative. In view of the reasonableness of this constraint, SOD was requested to provide an individual with the required characteristics and have complied in the person of [redacted] Attachment II requests the transfer of funds in the amount of $2,500 to provide travel and per diem for the required Agency personnel support.

6. It is requested that the PRB approve Attachment I and Attachment II as described above to provide facility and personnel support for Project TACANA.

[redacted]
LS/ORD/DD/S&T

Attachments: 2

Distribution:
15 - Project Review Board
1 - LS Chrono
1 - ORD Chrono
LS/ORD/DD/S&T [redacted] av:3658

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2 August 1976

MEMORANDUM FOR: Chairman, TACANA TCT

FROM : SE/COPS

SUBJECT : System Development

1. Whereas recent flight tests in Oklahoma showed that an A-B-C pattern can be flown under overt conditions, TACANA is a long way from being a clandestinely deployable collection system. As an operations element SE cannot judge whether there is solid scientific basis for continued development of such a collection system. However, we offer the following comments as an approach to that question.

2. A requirements/target study should be made of installations in the Leningrad and Moscow areas which could be covered by TACANA. These must be high priority, not accessible by other means, and geographically suitable for a TACANA capability. Once catalogued these targets should be evaluated carefully against projected TACANA capability. We assume TACANA might photograph targets in two ways: flying directly to a distinctive target which they locate due to its unique shape, size, etc; flying an A-B route which passes over targets of interest which are photographed while in flight (birds do not recognize any specific target).

3. A description or TOD of the desired clandestine TACANA collection system should be written. This requirement must emphasize the conditions under which it would be deployed to and in the USSR.

4. Using the two above papers the DD/S&T should prepare a proposed research-development plan with estimated costs and timetable. This would be used to decide whether to spend more money and effort on TACANA.

WARNING NOTICE -- SENSITIVE INTELLIGENCE SOURCES AND METHODS INVOLVED

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5. Observations of TACANA over the past eight months do not make us as laymen optimistic that a clandestine collection system can be developed. However, a more systematic scientific/zoölogical study approach seems essential before embarking on any expensive development. One final note concerns the TACANA camera system. This appears to have excellent capability; indeed, it far exceeds delivery capability. Thus, we suggest further engineering on it might be deferred pending decision on the aviary capability.

cc: NIO/SA
C/SE/USSR

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ORD-1712-74

18 April 1974

MEMORANDUM FOR THE RECORD

SUBJECT: TACANA (Mock-Up)

1. Attendees: [redacted] ORD
[redacted] ORD
Dave Boston, OTS
[redacted] OTS
[redacted] OTS

2. A budgeting estimate of the build-up of a full-scale and a one-third scale mock-up of the "Square Pair" radar will be given to ORD by OTS. At the present time, ORD personnel do not know whether or not the type of birds used on TACANA will be able to correlate or adapt to scale changes in a particular target or how much detail is necessary. Inputs for both contractors [redacted] will be necessary to steer this course of action.

3. [redacted] and [redacted] have arranged to have an 18-inch model of the SA5 sent to ORD from Huntsville. This is now in the possession of ORD, and the OTS people would like to study this model before they firm up any quotes to us.

[redacted]
Operations Technology, ORD

Distribution:
0 - OTD/ORD
1 - OTD Chrono

OTD/ORD/DD/S&T/[redacted]:kmc/2763

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~~S E C R E T~~

OTS/SDB Memo #154-76

14 May 1976

MEMORANDUM FOR: Director of Research and Development

SUBJECT : TACANA Program

REFERENCE : DDO/SED Memo dated 7 May 1976, SE Comments on TACANA

1. It is requested that ORD respond to the technical aspects of the referenced memo, per my discussions with Mr. Don Reiser. The pertinent items mentioned in the referenced memo are outlined below.

a. Clandestine acclimatization.

b. A-B-C flight behavior, with search at A for B, and clandestine release at A.

c. Retention time of A-B-C behavior.

d. Impact of major location change on behavior.

2. I would like to recommend the following procedure for your consideration, per our discussions of 12 May.

a. Continue the present training, in Oklahoma, of the A-B-C flight behavior, including clandestine release at A and the search behavior at A for B, until this behavioral set is demonstrable on site in Oklahoma.

b. Begin at once a collateral effort to determine the proper training procedures, and associated problems, for clandestine acclimatization above. Some suggestions for the accomplishment of this are (1) move 10-12 additional birds from California to Oklahoma for collateral training; (2) move 10-12 birds from California to North Carolina for acclimatization at

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SUBJECT: TACANA Program

the [redacted] (3) move four-six birds from Oklahoma to California [redacted] for acclimatization there by [redacted] personnel. I will deliver a written statement of definition of "clandestine acclimatization" if this is required.

3. Please note that I fully realize that the above efforts have not been "put together" and as such do not serve as definitive tests. However, I believe that later efforts will allow full scenario testing and that the suggested procedure best utilizes available resources.

4. Both the efforts mentioned in para 2 above should be completed prior to 25 June. Upon completion of each of the efforts, I should be notified so that the TCT and the NIO/SA can arrange for an inspection tour. By 25 June the findings of the NIO/SA and the TCT will be formulated into a recommendation for or against continuance of the program.

5. Assuming the program proceeds, it is further suggested that a training/testing site be prepared to receive the Oklahoma birds by the end of June. The birds should be transported to this new test site [redacted] clandestinely acclimatized, and tested on the A-B-C behavior against a simulated target. Upon satisfactory performance of this task, final reinforcement prior to moving to Washington should be accomplished. Please advise the TCT if this cannot be accomplished by the first week in August.

6. In order to answer questions re the retention time, it is suggested that the Washington test be conducted as follows:

a. Clandestine acclimatation	three-four weeks
b. Flight test, group one	one week

SUBJECT: TACANA Program

c. Maintenance period — two weeks

d. Flight test, group two — one week

e. Maintenance period — two weeks

f. Flight test, group three — one week

7. It is requested that the ORD response be directed to the Chairman, TACANA/TCT, who will respond to the referenced memo.

[redacted]
Chairman, TACANA/TCT

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6 August 1976

MEMORANDUM FOR : Director, OWI
Director, OSI

SUBJECT : TACANA Project

REFERENCE : NIO-2414, 14 November 1975

1. The TACANA project has progressed to the point that the actual target selection process should begin. A successful demonstration of significant elements of the capability was conducted several weeks ago. Although several operational aspects remain to be demonstrated, a program to complete the development of this system is now underway.

2. Members of the TACANA Technical Collection Team (TCT) from ORD, OTS, and NPIC will soon brief [redacted] (OWI) and [redacted] (OSI) on the results of tests to date. These two analysts are invited to participate in the TACANA TCT for the purpose of selecting a limited number of actual targets in the Soviet Union. This selection should be based on TACANA's unique capability compared to overhead or ground photography. For your information, the TACANA collection capability is approximately described as follows:

a) One time or recurring coverage of target.

b) Photographic resolution of one inch or better including <u>color</u>.

c) <u>Oblique</u> photography of target.

d) Contiguous frames - during approach to target and possibly beyond.

3. Your assistance in this effort would be appreciated. Please call [redacted] Chairman, TACANA TCT, if you would like any additional information on the project.

[redacted]
Barry Kelly
Special Assistant for
Strategic Intelligence

cc: ADDS&T
D/ORD
C/OTS/OPS
C/OPS/SE
Chairman TACANA TCT

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11 FEB 1976

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MEMORANDUM FOR: Mr. Barry D. Kelly, NIO/SA

SUBJECT : TACANA TCT Meeting - 16 January 1976

1. A meeting of the TACANA Technical Collection Team was convened on Friday, 16 January, at 10:00 a.m. in Room 716, Ames Building with the following present:

[redacted], OTS - Chairman
SE/USSR - Vice Chairman
[redacted], LSR/ORD - Executive Secretary
OTS
Dr. Charles W. Adkins, OT/ORD
[redacted], OT/ORD
[redacted] Recording Secretary

2. The following subjects were discussed at this meeting:

a. Documentary Films

Two documentary motion picture films were viewed by the TCT. The first was 27 minutes in duration and provided comprehensive coverage of the various demonstrations [redacted] on 7-9 October 1975. The other was a short motion picture depicting a 30 minute training session accomplished with a raven. The film showed a raven learning a new response (picking up a water sample in a tin cup) and extending its flight distance with the water sample from approximately three feet to 60-75 yards.

b. Operational Test Scenario

(1) [redacted] presented the following scenario for the TACANA test to be accomplished in the Washington, D.C. area:

DEFINITIONS:

(a) SAFEHAVEN: The Safehaven will simulate [redacted] country. It will consist of Room 222 East

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Building, which will simulate [redacted] East Building is circa [redacted] from the target.

(b) RELEASE POINT: The release point will simulate an actual operational release point as nearly as possible. It will consist of either the church parking lot located on [redacted] directly opposite the church (on the South side of the road) just inside the sparse wood line.

(c) TARGET: The target will simulate an actual target. It will consist of the [redacted] radome [redacted] which is 2.95 miles almost due west of the release point. The radome is spherical, with a truncated bottom for the base. The radome is light or white-colored.

(d) SHIPPING: The TACANA assets should be shipped from the contractor's holding point to Washington, D.C. [redacted] OTS [redacted] Prior to the arrival of the assets, all support equipment should have been shipped and be on hand at the Safehaven. The OTS reps will take the cargo directly to the Safehaven and open it in Room 222. The assets should then exit and enter the Safehaven only in concealment or through a special exit.

(e) ACCLIMATIZATION: Per contractor instructions.

(f) DEPLOYMENT: The assets should be taken from the Safehaven concealed in a container no larger in size than an L.L. Bean Canvas bag. They should be taken directly to an auto which will be parked close to the Safehaven Building.

(g) RELEASE: At the release point, the auto should pull into a turnoff from the road. The person making the release should step from the auto into a covered position for actual release as quickly as is consonant with natural movement. The assets should depart the area quickly.

(h) RETURN: The assets, equipped with cameras, should proceed directly to the target, circle over it for two to three minutes, then return directly to Room 222 East Building, entering it via the special entrance.

c. <u>Camera Equipment Status</u>

(1) A special high-resolution thin-based film designated as 3400 or 3414 has been received from Kodak. A film slicer has been obtained from OTS and a $5,000 work order has been established [redacted] for the purpose of using their photographic laboratory. The [redacted] laboratory will be used to slice film and process initial photographic test samples for determining camera resolution capabilities and calibrating blurring due to linear motion of the camera.

(2) During the week of 5 January several rolls of film were sliced to 16 mm format to be taken to [redacted] during the following week for test [redacted] in the initial prototype camera.

(3) Flight tests of new camera configurations are scheduled to take place during the latter part of January. At this time the probable resolution on the ground is estimated to be about one and one half to two inches per 100 feet of altitude. It is estimated that the birds will fly at an altitude of approximately 100 feet.

(4) A thin Mylar film harness weighing approximately one half gram which is about three - four grams lighter than the pigskin harness currently in use was fabricated and tested for fit and utility on two locally owned pigeons. The harnesses were sent to the contractor for test. After a number of flights with the new harness the contractor decided not to use it because he felt it was not flexible enough when fully tightened.

(5) Dimensions for the radome target to be used

for the ultimate tests at [redacted] were found to be as follows:

(a) Target sphere is [redacted] in diameter.

(b) The sphere sits on a truncated base [redacted] in diameter.

(c) The height between the base and the top of the sphere is [redacted]

(6) A portable test target was mailed to the contractor on 26 December 1975. It was supposed to be inflatable to a diameter of 20 feet. However, it was only possible to inflate it to a diameter of approximately eight feet. This target is being retained for possible use later in the program even though the contractor does not expect to use it and is fabricating several simulated targets which he thinks will be more realistic and easier to use.

d. Contractor Project Status

(1) The contractor has trained two flocks of pigeons to home 30 miles with a payload. One of these flocks was relocated to [redacted] area from San Diego. The contractor is procuring new birds from pigeon racers in California and is also attempting to selectively breed some strong flyers and good homers.

(2) On the basis of experience gained to date, the contractor considers the following project schedule to be possible.

(a) January - February

1. Complete training of pigeon to home 50 miles with a payload.

2. Determine effect of 35 gram payload on homing performance.

3. Train pigeons to execute dog leg and return to home loft.

4. Fly cameras for test purposes.

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(b) March - April

Preliminary full scale test in California.

(c) April to May

Dress rehearsal in Oklahoma.

(d) May - June

Full scale test in Washington, D.C. - The conctractor considers this schedule to be very pessimistic and intends to be constantly working toward being ahead of this schedule wherever possible.

Secretary, TACANA TCT

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23 January 1976

MEMORANDUM FOR: NIO/SA

SUBJECT: TACANA TCT Meeting - 17 December, 1975

1. On 17 December 1975 a TCT meeting was held to review progress on the TACANA feasibility study. The following subjects were discussed:

a. TCT membership and tasking for team members.

b. Operational test requirements

c. Contractor proposal and project status

d. Camera design

The following Agency personnel attended the meeting:

3.5(c)

[redacted]-OTS
[redacted]-SE/USSR
[redacted]-LSR/ORD
[redacted]-SOG
[redacted]-IAS
[redacted]-NED/OSI
[redacted]-OT/ORD

Charles Adkins-OT/ORD
[redacted]
Donald Reiser-DD/ORD
[redacted]
Harry Wood-C/OT/ORD

2. TCT Team Membership

Since the first TCT meeting, a number of agency offices expressed definite interest in having technical personnel participate as TACANA TCT members and sent representatives to attend this meeting. As the discussion progressed, it was evident that most of the attendees were unaware that TCT membership required a full time commitment to the TACANA project. When this became clear, it was decided to limit TCT composition to three working members: [redacted] OTS/SDB, Chairman; [redacted] SE/I/USSR, co-chairman, and [redacted] LSR/ORD, secretary. In this configuration

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the team includes two people [redacted] who are extremely familiar with the actual operational requirements underlying the TACANA project and one team member, [redacted] (ORD) who is directly responsible within ORD for accomplishing an objective test of Avian capabilities and limitations in relation to TACANA objectives.

Four ad hoc teams were formed to provide expertise to the TCT as necessary. The target analysis team reports to [redacted]. It consists of members from IAS, OSI, and OWI. These are: [redacted] OSI, [redacted] /IAS, [redacted] /OSI, and the OWI member has not been named yet. The Camera Equipment Team reports to [redacted] This team includes Charles Adkins/ORD, [redacted] /ORD, [redacted] OTS, and [redacted] OTS. The other two teams; the Support Team, (consisting of SOG pilots) and the TACANA Birds Team (consisting of contractor personnel) report to [redacted] /ORD. The ORD camera development team also maintains close coordination with [redacted] because he is responsible within ORD for the development and test of the complete Avian system, not just the bird subsystem.

3. Operational Test Requirement

[redacted] presented and discussed the operational requirements for a test program to demonstrate the operational utility of the Avian asset. These requirements can be summarized as follows:

SE Division/DDO has provided information which is being used to design a denied area operational analog in the continental United States which simulates an actual operational scenario. For the purpose of this analog, contractor facilities in California will be used as a safe training area in the United States. Metropolitan Washington will correspond to a denied area capital. An Agency building in Washington will simulate the safe haven, and the [redacted] will represent the actual target area. All representations of the analog target area to the Contractor in his training phase will utilize information and support realistic for a denied area. There will be no access to the safe haven or target area for any Avian asset prior to the period of acclimatization during the analog test, and the contractor will not have access to the target area. The contractor will not use full scale outside models of the target area that would be recognizable from overhead photography. The contractor will be provided photography which is equivalent to the resolution limits of KH-8 photography.

Contractor Proposal and project status.

[redacted] reported that the contractor's TACANA proposal had been received and approved by the ORD project review board for funding in January. The contractor's work statement outlines a program that is designed to provide three distinct and separate tests of the denied area analog. These tests adhere to the guidelines established in the operational test requirements and will enable the contractor and ORD researchers to detect possible limitations of the Avian asset prior to the final test in Washington, D.C. The first test will take place in California, the second in the Mid West, and the third and final test in Washington, D.C.

Prior to this meeting, the contractor had successfully moved and relocated a flock of birds from Point Loma near San Diego, California [redacted] California. These birds readily accepted their new home and within a few weeks were homing from a distance of 15 miles while transporting a simulated camera package. The contractor sees this a positive sign that changing these and new birds from location to location will be an achievable goal. The results of the camera studies conducted to date and some additional tests slated for mid-January will be used to configure a final camera design to be completed in early February. Two cameras are scheduled to be constructed, that will include a low F-number lens. The new camera design will increase the film size from 9mm to 16mm in width. The film roll will be capable of taking 180 pictures at a rate of one picture per second for a total coverage time of three minutes. The field of view in the direction of motion will be roughly 30° and result in an approximately contiguous pictures along the ground. The increased film width will almost double the lateral field of view and thereby increase the probability of photographing the target. In addition, this new design doubles the number of pictures, thereby nearly quadrupling the overall probability of recording the target. This new camera design is scheduled for final flight testing by the end of March 1976. Final modifications and analysis should be completed by early April.

[redacted]
Secretary, TACANA TCT

TACANA-TCT Meeting - 20 November 1975

1. The first meeting of the TACANA TCT was held on 20 November 1975, with members and observers from SE Division, OTS, ORD, and the NIO/SA.

2. It was reported by [redacted] (DDO/OPS Staff) that TRB approval had been obtained to expend funds for the Project. Barry Kelly (NIO/SA) advised also that the DCI had been briefed on the Project.

3. It was agreed that ORD will consult with an independent expert regarding the expected behavior of birds when transported to a widely differing environment. At the request of SE/COPS, the Team agreed to consider a preliminary and limited test of the birds' adaptability to the Moscow environment as a part of the test program, to be run concurrently with planning for the Washington test scenario, unless the results of ORD's consultations mentioned above and/or results of early contractor testing are sufficiently conclusive as to make this test unnecessary. This decision will be made by the Team at the earliest possible date, but no later than mid-February.

4. ORD reiterated that its budgeted allotment of $100,000 would suffice to pay the contractor for training and miscellaneous expenses involved in the Washington test scenario. ORD further estimated that, if the Washington test is successful and we proceed with the actual operation, the contractor's costs to re-train the birds for the operation would be in the $50,000 - $75,000 range.

5. There was considerable discussion of the need to improve the performance of the camera to be used in the operation. ORD estimated that the cost for optimizing two cameras for the Washington test would be approximately $30,000, to be funded by ORD. This includes fitting an improved lens (wider aperture) and re-engineering the film advance mechanism. Also discussed was the possibility of using high resolution film (slower speed) and the resultant need for a faster shutter speed. The bird harness for the camera, camera attitudes and photo sequence rate will be determined in conjunction with the bird training phase and in coordination with the contractor. OTS/VOB AND OTS/VEB will provide support for the camera work.

6. As soon as possible a sub-test will be run to determine whether the analysts will have any significant problems with mensuration of bird photography and relating it to existing photography. ORD will work this out with the contractor.

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7. There was considerable discussion of the limitations that will be imposed by Soviet realities on our ability to train the birds to recognize and fly to our ultimate target. It was reiterated that the training for the actual operation will be done in the U.S., using slides and mock-ups. The birds would then be transported to [redacted] for several weeks getting acclimated to the new environment prior to the actual mission. Accordingly, the Washington test scenario will impose similar restrictions to make it as realistic as possible, i.e., the birds will be trained from slides and mock-ups, will be transported [redacted] to the Washington area, and will not be allowed to fly free in the Washington area ([redacted], before the test flight. ORD advised that the contractor has two types of pigeons on hand (homers and Russian high flyers) and has a loft and test grounds picked out. ORD estimated that the test could take place in April 1976. Subsequent re-training of the birds for an actual operational mission could take two to three months.

8. It was agreed that [redacted] of SE Division and [redacted] of OTS would prepare an operational scenario for the Washington test. They will seek assistance from DDS&T analysts and other components as necessary. It was decided that henceforth the team should be a relatively small working group which would pursue the project, prepare periodic reports on progress and call meetings of interested components from time to time for consultations. At the suggestion of SE/COPS, [redacted] of OTS was named Team Chairman, and [redacted] of SE Co-Chairman. The following personnel will be team members:

ORD: to be named
OTS/VOB: [redacted]
OTS/VEB:
SE/TO:
SE/RR:
OWI/PAD:
OSI/NED:
IAS: to be named

9. Based on discussions at the 20 November meeting and subsequent individual conversations among team memebers, an outline of the requirements for the test program has been drawn up by the team chairman and co-chairman and is attached herewith.

[redacted]

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Detailed below is the requirement for a test program to demonstrate the operational utility of the AVIAN asset. This test program is to be labeled TACANA/TCT Task #1.

1. TACANA/TCT Task #1 is to develop a valid test program which will allow a subjective determination by DDO/SE of the feasibility of utilizing the AVIAN asset to perform photographic intelligence collection missions against denied area targets.

2. In order to accomplish Task #1, the TACANA/TCT will solicit adequate information from SE Division to design a denied area operational analog in the continental United States which will simulate an actual operational scenario. For the purposes of this analog, the contractor facilities in California will be considered as a safe training area in the United States. For example, the metropolitan Washington area will correspond to a denied area capital, an agency building in Washington will simulate the safe haven, and the [redacted] will represent the actual target area. The actual target must be defined as a discrete element of the target complex, and should be a key feature of the target area lending itself to use as a stimulus for the asset. All representation of the analog target area to the contractor in his training phase will be made utilizing the same type information and support which would be realistic for a denied area. Thus, it will be accepted that there will be no access to the safe haven or target area for any AVIAN asset prior to the period of acclimatization during the analog test, nor will the contractor have access to the target area.

3. To train the AVIAN asset, certain restrictions must be accepted by the contractor in compliance with the already stated restrictions to realistic operational conditions. There will be no full-scale outside models of the target area that would be recognizable by a photo analyst from overhead photography as a mock-up of the actual target complex. This should not preclude, if required, using a limited full-scale outside mock-up of a finite portion of the target area as a target acquisition stimulus, so long as said mock-up does not violate the stated restriction.

The contractor will be provided photography of the target area (and safe haven area if required) which will not exceed the resolution limits of KH-8 photography.

4. A detailed operational scenario for the analog test will be presented to the contractor no later than 1 January. During the analog test, this scenario must be followed as precisely as possible, to maintain the integrity of the test. This shall include the method of transport of the AVIAN asset to the safe haven, familiarization period at the safe haven, secure deployment of the asset equipped with camera in the target area (from a vehicle either stopped or moving), target acquisition and photographic mission performance of the asset and subsequent independent return to the safe haven, and, finally, transport of the asset back to the controlled training area.

For purposes of the analog test, the safe haven holding area should be considered to be approximately 100 by 50 feet, with a 25 foot ceiling.

5. Within the confines of the TACANA/TCT task #1, the task will be considered completed a) as soon as a determination is made by the TCT that the AVIAN asset will be unable to perform the analog test, or b) when the asset completes the analog test. If the analog test is completed, then a qualitative determination of the relative success (or lack of success) of the collection mission will be made by SE Division. In this consideration, SE should employ TCT's draft Final Report to evaluate the validity of the test. The results of the SE evaluation and determination should be reported in writing to the TCT for incorporation in the TACANA/TCT task #1 Final Report prior to publication.

6. During the actual conduct of the TCT's work on Task #1, it will be the responsibility of the TCT members representing SE to ensure that the restrictions and details of the test scenario conform to realistic operational parameters, but not place unrealistic restrictions which might jeopardize the chances of a favorable outcome of the test. The ORD TCT representative has the responsibility to keep the TCT informed of the progress of the training of the asset, so that modifications of the test scenario which do not violate the primary principles can be made in a timely manner.

7. It should be understood that if the TCT must address itself to any follow-on operational effort utilizing the AVIAN asset, such work should be the subject of separate tasking. This is necessary to avoid incorporating unwanted bias to the test.

8. For purposes of fixing some variables, it will be accepted that the distance to the safe haven to the target is ca 50 miles, that the distance from the release port to actual target is 2 - 3 miles and that the target resolution required of the photography is 1/2".

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ORD 0647-76

15 March 1976

MEMORANDUM FOR THE RECORD

SUBJECT : TACANA TCT Meeting of 20-21 February 1976

ATTENDEES : [redacted] TCT Chairman
[redacted] TCT Vice-Chairman
[redacted] TCT secretary
[redacted] /ORD
[redacted] /ORD

Observation of TACANA Training Methods

On 20 February, 9:00 a.m., the TCT members met with [redacted]. Two flocks of pigeons are housed [redacted] and these pigeons are being trained to fly a dog leg and then return to their home loft. [redacted] had placed the simulated target in a parking lot [redacted] which was approximately 250 yards from the home loft. The flocks were transported approximately one half mile away and released to fly to the target and then return to their loft. The first kit consisted of the older birds which [redacted] had used at the [redacted] demonstration. Four of the birds did not perform well on this particular flight. For some unknown reason, two of them flew to the [redacted] ranch which is located 8 miles from [redacted] The other two remained in the local area and flew in with the second flock when it was released. The second kit which consists of younger birds flew almost directly to the target after ringing up high enough to be able to see it. The target was approximately 50 to 75 feet higher than the release point and the birds were forced to circle up to an altitude where they could spot the target and then fly to it.

During the course of the day, the birds were flown four times with the target being moved around to new locations in the parking lot and the birds also were released in different directions from the target. As the trials progressed the birds got progressively better. The older birds that had remained and flown correctly in the first flight of the morning required very little if any time to orient themselves to the target when it

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SUBJECT: TACANA TCT Meeting of 20-21 February 1976

was within line of sight. In fact, on one release which was slightly above the target, the older birds upon release from the cage, flew straight to the target without deviation, received their reward and returned to the home loft. On that same flight which was the last flight of the day, the younger birds made approximately two circling flights and then homed directly to the target and returned to the loft.

At this point in the training the birds are still being rewarded at the target. Later the reward will be eliminated at the target so that the birds will learn to fly in an orbit and cris-cross pattern over the target before returning to their home base. The target is currently located close to the home base so that when a pigeon flies directly from the release point to the home loft without appearing at the target he is not reinforced which causes him to return to the target again and then to the home loft where he is finally rewarded. This is done to insure that the flight to the target and orbiting behavior is firmly established.

In general, the TCT was pleased with the flight performance of the Avian assets during this demonstration. It was gratifying to see the birds flying to the target from a considerable distance with very little error. Prior to the meeting and telephone discussions with [redacted] it was thought that the team would be able to observe flights of only about a few hundred yards. However, by the time the TCT arrived in California the birds were flying from approximately three quarters of a mile and [redacted] indicated that he felt it would not be difficult to take the birds out to a mile or two. This discussion arose after several flights and it was decided not to try the greater distance because the birds appeared to be partly satiated and their performance might prove to be erratic from the greater distances which in turn might weaken their response patterns for the next day or two.

On completion of the demonstrations at [redacted] [redacted], the team traveled to [redacted] ranch in [redacted] The purpose of this visit was to show [redacted] the updated pigeon facilities at the [redacted] ranch. [redacted] has obtained approximately 90 pigeons and has installed several new lofts at the ranch. It was learned at the ranch that when older birds are obtained, (birds raised by someone else for five months or longer) they do not perform well from the outset of the initial stages of operationally oriented training. For example, when one flock of twenty older birds which had been located at the ranch for approximately three weeks was released for exercise purposes, only six birds returned to the loft after the exercise period. Later, when the six birds were flown again only three birds returned to the loft at the ranch. These birds seem to be steadfastly fixed on the ranch now. [redacted] feels that this behavior on the part of the older birds reinforces his theory that successful operationally oriented training can only be accomplished with younger birds. He has another flock of older birds which he is allowing to become acclimated to his ranch for a longer period of time before releasing them.

The findings of [redacted] research activities to date can be summarized as follows:

(1) It is important to begin training operational forms of behavior with young birds. That is to say, with birds that have either been raised from the egg or have not been exercised by someone else.

(2) Using [redacted] techniques, it is quite possible to move the birds from one location to another. For example, the original kit of birds used at Point Loma have now been moved six times to new locations. Each time they are moved, it takes a fewer number of days for them to become acclimated to their new home position. It appears that they are homing to the loft rather than to the site.

(3) The fifty mile range for homing does not appear to be a problem. The birds have already homed from 44 to 46 miles while carrying 37 gram payloads.

SUBJECT: TACANA TCT Meeting of 20-21 February 1976

(4) On a preliminary look, it appears as though the A, B, c dogleg is well on the way to being established in the training process. The target is currently situated very close to the home loft, but within approximately two weeks a new and larger target (20 foot in diameter radome cover) will be obtained and relocated in increments of 15 to 25 to 30 miles from the home loft location. At that time the ultimate mission oriented training will be in the final stages.

<u>Discussion of Project Schedule</u>

On Saturday, 21 February 1976, the TCT and [redacted] and Mr. Reiser met with [redacted] to discuss future activities of the project. The primary purpose of this meeting was to be certain that [redacted] understood the milestones included under the Avian project schedule and to determine if there might be ways in which that schedule could be speeded up slightly. As a result of these discussions, [redacted] agreed not to move the birds in California anymore. It was felt that the number of moves that he has already made with the various kits has clearly demonstrated the feasibility of numerous moves to new locations and that it was now more important to establish the mission behavior in the birds so that the project could progress more rapidly to the operational testing stage. It was reconfirmed that the intent of the move to [redacted] Oklahoma was to complete an interim test of the operational scenario. [redacted] agreed that it should be possible to adhere to the existing project schedule and was relunctant to promise an earlier completion date. The schedule [redacted] is currently adhering to is as follows: March 1 through April 3 the training required to cause the birds to fly to a target two or three miles away from the release point, orbit, and then home to a home loft located at least 25 miles away from the target will be completed. On 5 April through 21 May the project will relocate to [redacted] Oklahoma and an interim test of the entire operational scenario will be performed. The final test of the operational capability of the Avian assets will occur between 24 May and 25 June.

SUBJECT: TACANA TCT Meeting of 20-21 February 1976

[redacted] agreed to remain in California until 23 and 24 February to search for site locations for the new radome type target. [redacted] requested [redacted] to contact the TCT as soon as the A, B, C behavior was clearly established. At that time, we would anticipate returning to California to observe that performance and complete preliminary California testing of the Avian capability.

Camera Development Progress through 19 February 1976

One dummy configuration of the latest camera and timer was presented to [redacted] during the TCT meeting for testing with the bird harness. Camera number 1 was modified for image motion compensation by the contractor was returned and tested against moving targets (resolution chart on a car) at distances of 50 and 100 feet and volocities from 0 to 50 miles per hour. The results of this test showed proper motion compensation. A number of negative aspects of the test were as follows:

(a) A small hair line crack in the camera case caused occasional fogging (approximately 10% of the pictures).

(b) In one or two percent of the pictures, the shutter stuck open causing over-exposure.

(c) The center of the field of view was slightly defocused, whereas the edges which are clamped showed good focus.

The camera has been sent back to [redacted] to enable him to correct these problems. There still appear to be problems in developing 3414 film as per Kodak instructions, especially with regard to pulling the developer to compensate for varied lighting conditions. Since the supply of film in 16mm format is exhausted, and using the film slicer is a risk when accomplished by people unfamiliar with the equipment, a meeting was held with [redacted] of NPIC to discuss the possibility of obtaining NPIC assistance in dealing

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SUBJECT: TACANA TCT Meeting of 20-21 February 1976

with the above problems and also to obtain their assistance in developing enlargements of selected negatives. As a result of the meeting with NPIC the following assistance and recommendations were offered:

(a) NPIC will develop all film and make proper adjustments for varied lighting conditions.

(b) [redacted] advised that tests be conducted with 5069 film which permits good resolution under lower light levels while still using the fast shutter speed to minimize motion blurring.

(c) NPIC will task Kodak to provide 16mm format film so that unnecessary handling and slicing in-house can be eliminated. [redacted] estimated that he would have some 16mm film delivered in approximately a week.

(d) NPIC will provide good quality enlargements of selected negatives.

(e) NPIC will provide technical assistance in determining resolution capability and does not necessarily require a resolution target in the field of view during flight testing.

At this time, the camera development problems appear to be under control. A refitted camera is scheduled for delivery during the week of February 23 and tests with it will be conducted during the first week in March. NPIC intends to develop this film and provide advice on handling the film in the field during subsequent tests of the camera. The new F 2.5 lens [redacted] is on schedule for delivery in early March. It is expected that a simulated field test will be conducted in mid-March at the [redacted]. Some film will be developed there so that any further camera problems can be dealt with directly by [redacted] It is estimated that a second flight test to be conducted in early April will provide a comprehensive test of the new F 2.5 system.

[redacted]

Sec'y TACANA TCT

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3.3(h)(2)
6.2(d)

ORD 0648-76

15 March 1976

MEMORANDUM FOR: NIO/SA

SUBJECT : TACANA TCT Meeting, 1 March 1976

ATTENDEES : Mr. Barry Kelly, NIO/SA
[redacted] Assistant NIO/SA
[redacted] TCT Chairman
[redacted] TCT Vice Chairman
[redacted], TCT Secretary
DD/ORD
Dr. C. Adkins, OT/ORD
[redacted], OT/ORD

Purpose of Meeting:

The purpose of the meeting was to provide the NIO with a quick verbal update of TACANA project progress. The information presented is identical to that appearing in the TCT report of 5 March 1976.

The second purpose of the meeting was to discuss security aspects of the Avian Program and establish some firm security guidelines for future project activities. The following security guidelines were established for the project:

1. Labels will be developed and attached to the camera requesting their return to [redacted] in the event of inadvertant loss.

2. The training and demonstration procedures used in the TACANA program will stringently avoid any photographic targets that could even remotely be considered an invasion of individual privacy.

3. All practice targets will be U.S. Government installations or contractor mockups.

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E2 IMPDET CL BY [redacted]

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SUBJECT: TACANA TCT Meeting of 20-21 February 1976

4. These targets will only be used after obtaining the express permission of the host Agency.

5. At no time will the camera be left in the hands of the contractor. Agency employees will control and operate the camera system during each phase of testing. This also applies to the film used in the camera.

6. A log of film useage will be maintained.

7. Only target related pictures will be retained in Agency files.

8. Non-target related pictures (if any are obtained) will be examined for technical purposes and then be destroyed.

These procedures have been established in coordination with Mr. Barry Kelly to ensure that TACANA training efforts in the United States can in no way be construed to be a form of "domestic spying".

Just prior to the conclusion of the meeting Dr. Adkins presented a description of camera development progress to date and displayed a number of excellent pictures that had been obtained in a recent flight (bird and camera) of the camera systems.

[redacted]

Sec'y TACANA TCT

3.3(h)(2)

6.2(d)

ORD-030-76

10 FEB 1976

MEMORANDUM FOR: Mr. Barry D. Kelly, NIO/SA

SUBJECT: TACANA TCT Program

REFERENCE: Memorandum from Mr. Barry Kelly, NIO/SA, to Chairman, TACANA TCT, dated 12/11/75; Subject: Guidance from the PCP/TCT Evaluation Group (TS-206672-75)

1. The purpose of this memorandum is to call your attention to the fact that the TACANA TCT project is entering a new phase which involves certain risks you should be cognizant of officially.

2. To review, the purpose of the project is to test the capability of pigeons to perform photographic intelligence collection missions against denied foreign targets. The birds will carry a small camera which is automatically actuated while they pass over the target area. The training program will take place in the United States against targets which will simulate the performance in a foreign country. The training and test sites which have been selected are in California, Oklahoma, and the Washington, D. C., area. The latter location has been selected for a final test mission prior to the conduct of a foreign intelligence mission. In this final test the birds will be trained to fly from a release point approximately three miles from the [redacted] to the simulated target at [redacted] and then fly to their "home" approximately 50 miles away in Washington, D. C. The "home" location will be one of the Agency buildings in the area. During the course of testing and training, it is possible that some birds will be lost along with their cameras. Should a camera be recovered by an unauthorized citizen and the film developed, there is the potential for unfavorable publicity to ensue. This publicity could conceivably take the line that the Government is releasing birds to photograph unwilling private citizens as another form of illegal domestic spying. In an effort to preclude or forestall such erroneous conclusions, we are instructing the contractor, [redacted] to label the camera and camera harnesses. The labels will be marked HOMING RESEARCH and will carry [redacted] telephone number. If questions arise regarding the purpose of the camera, [redacted] response will be that he uses the cameras to document the flight routes of the birds in connection with research he is doing in

Cl by [redacted] E2 IMPDET

SUBJECT: TACANA TCT Program

preparation for the publication of a book. In fact, he does indeed intend to publish a book that will deal with the knowledge gained from his lifetime experiences in the training of birds.

3. If you feel that it would be advisable to take other precautions or to obtain other official authorization to continue with this work, please advise us at the earliest possible date.

[redacted]

Donald L. Haas
Director of Research and Development

Distribution:
Orig. - Addressee
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Rewritten 2/6/76/DD/ORD:nrp

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ORD 1085-76

16 August 1976

MEMORANDUM FOR: NIO/SA

SUBJECT: TACANA TCT Report, 4 June 1976

TCT MEMBERS: [redacted] TCT Chairman
TCT Vice Chairman
, TCT Secretary

1. The primary purpose of the Avian contract is to train pigeons to carry an approximately thirty-seven gram camera from a release point (point A) to an offset target point (point B) three miles distant from the release point, obtain pictures of the target at (point B), and return to their home loft (point C) located approximately fifty miles from point B. In addition, an operational scenario requires that the birds be transported black approximately 3,500 miles to a new homesite, including homing to it from varying distances, and performing the A-B-C maneuver against a new target which they have only seen simulated versions of prior to leaving the United States. Progress toward these training goals has led to the modification of the Avian contract work plan in an effort to improve the likelihood of success for the upcoming operational test and future operational clandestine employment of the Avian System.

2. A schedule of Avian project activities was established early in the contract to ensure orderly progress toward the goals specified in the preceeding paragraph. The schedule was considered to be tentative because a number of factors, such as, bird training times, fabrication of appropriate simulated targets, logistics of moving the birds to several new homesites, and time periods involved in acclimating the birds to their new homes, might delay the scheduling of the simulated operational test. This has indeed been the case.

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3. The first order of business in the schedule was to train the birds to home fifty miles in California, move them to a new site in California and perform a complete test of the A-B-C scenario. This work appeared to progress in an excellent manner. The contract was initiated on 1 January 1976 and by the fifth week of the contract, the flock (kit) of birds used in the [redacted] demonstration (the latter part of 1973) had been successfully relocated from San Diego, California (approximately fifteen miles north of [redacted] They learned to home from forty-four miles while wearing thirty-seven to forty gram simulated cameras. These birds were subsequently relocated four different times and they appeared to be "learning to learn". At this same time, additional birds obtained by [redacted] were homing to the farm, with weights, from approximately three miles.

4. The next step in the schedule called for training the A-B-C maneuver to an A to B distance of two to three miles and a B to C distance of twenty-five miles. Although this work progressed smoothly, it became apparent that the use of an area approximately 20 miles to the north [redacted] as a training site imposed a number of serious constraints limiting the capability to perform a preliminary test of the operational capability of the Avian System. [redacted] This topographical configuration resulted in a predominantly north to south orientation in bird flight paths. Second, the birds tended to use the freeways to ease their passage between intermediate mountain ranges and a number of excellent birds were lost to the program as they flew low along the freeways and were struck by automobiles. Finally, it was extremely difficult to obtain permission from area Landowners to set-up the inflatable, twenty foot in diameter radome at varying locations to train the birds to search for the target.

5. Despite these drawbacks, it was decided to complete the A-B-C scenario training in California on the scheduled date of 3 April 1976, and move the project to Oklahoma and perform the interim test of the Avian Systems in Oklahoma at a farm owned by an acquaintance of [redacted] The bird lofts were moved to the top of the [redacted] and A-B-C training was initiated. The parking lot [redacted] was used in the early stages as the base for setting up the target. As

the birds extended their homing range and their learning of the A to B connection was strengthened, the inflatable radome was set-up at a location approximately twenty-seven and one-half miles from the home loft. Once again, the birds learned their tasks extremely well. So well in fact, that project personnel began to suspect that the birds were using topographical features of the area rather than a true search behavior to find the target. This fact was later verified in Oklahoma. Thus, although it was possible to test the system in California with the distance from A to B at two and three-quarters miles and the distance from B to C at twenty-seven and one-half miles, and with the collection of excellent photography, the birds had actually learned an inappropriate method of finding the target. In effect, this meant that although the project appeared to be three days ahead of schedule, the desired A-B-C behavior had yet to be established in such a way that it could be applied in the operational environment.

6. On the basis of the foregoing knowledge and an evaluation of time remaining on the project, it was obvious that Oklahoma was to become the "real" training site, and that another location would be needed to perform an interim test of the system in order to trouble-shoot the procedures to be utilized in deploying it for the operational test.

7. The birds were transferred to a farm in [redacted] Oklahoma, and training of the desired search behavior commenced on about 1 May 1976. It took three weeks for the birds to become accustomed to the Oklahoma homesite and "home" from distances of ten miles. By this time the A to B search behavior was also becoming well established.

8. Two factors interfered with rapid progress at the Oklahoma training site. The [redacted] training crew was due to be on site by 5 April 1976 and did not arrive until 11 April 1976 because [redacted] was forced to delay his California departure in deference to a serious illness suffered by his wife. [redacted] personally lost an additional four days to negotiating the disposition of a number of his other birds; crows, ravens, and eagles with the California Fish and Game Commission. [redacted] carried on at the Oklahoma training site for [redacted] Even so, approximately seven and one-half days were lost to rain,

high winds and tornadoes. By now it was evident to all concerned that although the work effort appeared to be making satisfactory progress, the project was approximately one month behind the originally scheduled completion date.

9. As a result of the delays incurred in Oklahoma, some modifications to the program were suggested to the TCT by ORD. These modifications included moving the birds directly from [redacted] Oklahoma to the Washington, D.C. area, acclimating them and training them to perform the A-B-C maneuver in geographical locations significantly removed from the [redacted] target. The rationale was that this procedure would probably allow the contractor to complete his program within the existing contractual funding and possibly enable the initiation of an operational exercise prior to October of this year.

10. In order to examine these recommendations with potential users, a TCT meeting was held on 6 May 1976. User representatives included [redacted] SE/COPS, and personnel from SE, OTS, and ORD. In general, the reaction to the proposed direct move to the Washinton, D.C. area from [redacted] Oklahoma was unfavorable. [redacted] stated his reservations in a formal memorandum on 7 May 1976. The memorandum noted that the required extension of approximately one month to complete the contractual work seemed to eliminate the possibility that an operation could be accomplished in the field this year. Therefore, it was felt that it would be inappropriate to bring the birds to Washington, D.C. until they were ready to perform the operational scenario agreed upon early in the program. In short, SE held the strong opinion that the birds should be held away from the Washington area until they could be trained against the [redacted] target, moved clandestinely to Washington, acclimatized covertly, and deployed against the [redacted] target with a return to home base. Further, the memorandum indicated that it was important for the TCT to obtain as complete an understanding as possible of the acclimatization process in terms of its impact on covert operations under simulated Moscow conditions. It also indicated a strong interest in determining whether the birds can demonstrate an ability to retain a target orientation after being relocated and acclimatized to a new geographical location.

11. In response to the memorandum issued by the SE/COPS, the TCT developed a modified work effort which provides a straightforward demonstration of whether or not the A-B-C flight behavior (with photography) can be accomplished successfully, and an interim test of the operational capability including acclimatization target training, and target retention capabilities prior to moving the birds to Washington, D.C. for their final test. This modified work plan includes a functional test of clandestine acclimatization procedures in [redacted] Oklahoma and an inspection of project status with regard to the A-B-C flight behavior by the NIO and the TCT to be completed by the latter part of June 1976.

12. The following procedures will be utilized in preparing for the June test.

a. Present Avian training of A-B-C flight behavior, including clandestine release at A and search behavior at A for B, will continue in [redacted] Oklahoma. The training will include clandestine release at point A which will be located two to three miles from target B, search-oriented flight to target B (in a direction that is opposite from the return flight to the home loft) landing on the target and obtaining pictures of the target and the target area, and, finally returning 50 miles to the home loft located in [redacted] Oklahoma.

b. On 28 May 1976, a collateral effort was initiated in [redacted] Oklahoma to determine if the Avian assets can be acclimatized to a new geographical location on a clandestine basis. On this date a simulated second story clandestine loft was fabricated. Ten additional birds will be moved from the [redacted] in California to the Oklahoma training area via air freight on 4 June, 1976. These birds will be housed in the simulated clandestine loft and their only view of the outside world will be provided through the housing of an air conditioner. These birds will be acclimatized by means of exercise releases and will return to the loft through the air conditioner until homing training is started. During homing training, the birds will still return to the home loft through the air conditioner, however, they will be taken to an initial release distance of at least one mile for the initiation of homing training. One or two additional birds will be taken from the home loft after acclimatization and transported to a distance of fifty miles for their first release.

13. The results of the acclimatization procedures and the operational A-B-C behavior (including Avian camera photographs of the target area) will be demonstrated during the latter part of June 1976. This demonstration will be arranged to enable the NIO/SA and other designated visitors to observe the test from the various A-B-C positions.

14. On the assumption that the June test will be successful, a new interim test site will be prepared for the birds by the end of June 1976 (possibly [redacted] California). [redacted] and the ORD/COTR will travel to [redacted] to make a final determination of the suitability of the [redacted] area as an interim test site. If it turns out to be an acceptable area, the birds will be transported to this new test site [redacted] acclimatized to a home loft by clandestine means, trained to "home" by clandestine means, and tested on A-B-C behavior against a simulated operational target. Upon satisfactory performance of this task, a short period of reinforced target training will be accomplished to strengthen the "flight-to target" behavior prior to moving the birds to Washington, D.C. The move to Washington will be completed during the first week of August and after a suitable period of acclimatization by clandestine means, separate A-B-C flight tests will be performed with three kits to determine the effects that differing time delays have on the retention of the A-B-C behavior.

Camera Development Progress

15. The final camera design has been completed and submitted to preliminary testing. This camera, referred to as "camera number three" has undergone ground tests and has been flown six times on birds at the Oklahoma training site. The camera used the MINOX lens, has a weight of 35 grams which includes timer, film and batteries. The total flight weight of the system, including the bird harness is 39.5 grams. A primary feature of this camera is the inclusion of a focal plain flattener which permits

accurate positioning of the film in the focal plain and a reduction in motor torque, and hence probability of jamming. Ultra thin base film appears to work well in this design and more pictures (200 black and white, 140 color) per roll are possible. The shutter speed on this version of the camera has been shortened to 1/1400 of a second.

16. The current camera production schedule calls for the completion of five additional cameras by 1 June 1976. Approximately one week will be required to complete performance reliability tests of these cameras. By approximately 14 June 1976, these five cameras will be ready for flight testing. By the end of June, six cameras of the new design and two cameras of the old design will be ready for demonstrational use.

17. A meeting was held with [redacted] Chief/APSD/NPIC, to discuss various films and processing techniques. A number of problems involving these matters for both color and black and white film were discussed. During the meeting it was agreed that a series of tests will be conducted with the new camera and several film selections in order to determine the best film and processing trade-offs between shutter speed, film speed, and film resolution. These recommendations will be integrated into the camera test in early June and verified during the flight test in the latter part of June. Analyses of flight tests to date by NPIC supports the original estimate of 1.5 to two inch resolution when pictures are taken at 100 feet altitude.

18. The [redacted] lens has been assembled and tested in comparison with the new camera (camera number 3) design. Both lens systems have field flatteners. The [redacted] lens is an F2.5 lens (about a stop faster), has about the same resolution in the center and slightly better resolution at the edge of the field of view. It's major advantage is a faster stop which should allow for faster shutter speed or resolution. As time permits, a camera will be designed to incorporate this lens and ground tests will be conducted to verify performance.

[redacted]

Sec'y TACANA TCT

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3.3(h)(2)
6.2(d)

ORD-2015-74

6 May 1974

MEMORANDUM FOR THE RECORD

SUBJECT: TACANA

1. The following approach for the building up of an initial radar mock-up will be coordinated with [redacted] and [redacted]

2. In order to fabricate an inexpensive radar mock-up in a short period of time, the following is proposed as an initial training device. Essentially, the mock-up is broken into five major elements.

a. A van-type vehicle with storage space inside to store the other elements when the mock-up is moved from site to site and during periods of opposition satellite coverage. It will also be necessary to have an olive drab tarpaulin canvas that can cover the entire van to make it look more realistic.

b. A five-element helical antenna could be fabricated using five lightweight helical springs mounted on a Styrofoam reflector with the supporting boom attached where the rearview mirror is located on the base van.

c. Two main antenna reflectors could be fabricated out of Styrofoam and strengthened with cloth fiberglass and a fine silver screen mesh to reduce wind resistance.

d. An antenna feed system that could be essentially a Styrofoam box-like structure with treated Styrofoam feed horns.

3. This approach will be discussed with [redacted] during the week of 6 May 1974.

[redacted]

Operations Technology, ORD

E2 IMPDET
CL BY [redacted]

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~~S E C R E T~~

OTS/SDB Memo #290-75

12 December 1975

MEMORANDUM FOR: TACANA TCT Members

SUBJECT : TACANA/TCT Meeting

1. A general TACANA/TCT meeting will be held Thursday, 18 December, 1400 hours, at Room 717 Ames Bldg. It is requested that ORD furnish a recording secretary to keep minutes of this meeting. Subjects to be addressed at this meeting are:

a. Camara design report (ORD)
b. Contractor training proposal (ORD)
c. Training operational report (SE/OTS)
d. Tasking for team members

2. Attached herewith is a list of designated TACANA/TCT members. Parent units which wish to add/withdraw/change designated members may do so by contacting the undersigned on ext. 3278.

[redacted]
Chairman, TACANA/TCT
OTS/OPS/SDB

Attachment:
as stated above

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CL BY [redacted]

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TACANA/TCT MEMBERS

Barry Kelly	NIO/SA	5G00 Hqs.	x7301
[redacted] Chairman	OTS/SDB	221 East	x3278
[redacted] Co-chairman	SE/I/USSR	HD 3115 Hqs.	x6267
[redacted] Secretary	ORD/LSD	716 Ames	x2702
Don Reiser	DD/ORD	606 Ames	x2652
Charles Adkins	ORD/OT	616 Ames	x2763
[redacted]	OTS/VEB	331 South	x3606
	OTS/VOB	330 South	x3606
	SE/TO	5B29 Hqs.	x5953
	SE/RR	4D0119 Hqs.	x6441
	OWI/PAD	1A06 Hqs.	x6931
	OSI/NED	5G48 Hqs.	x6707
To be named	IAS		
[redacted]	SOG/AMB	GG1406 Hqs.	x4527

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 3.3(h)(2)

6.2(d)

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BL
C/OTS
COP
5D13

ORD-1102-76

5 MAY 1976

MEMORANDUM FOR: Mr. Barry D. Kelly, NIO/SA

SUBJECT: TACANA/TCT

1. Based on a detailed review of the history, progress, and current status of the TACANA/TCT R&D program, it is the firm opinion of ORD that some changes in the program direction and scheduling should be put into effect at this time. As outlined below, we believe it is not practical to plan for operational use this fall.

2. A number of problems have been encountered in the course of the program, the impact of which causes a projected delay in the completion. In order to attempt to reduce the full impact of this delay, it is planned that the work scheduled for the [redacted] area be deleted from the program. In using this approach, it is planned that at the completion of the Oklahoma training phase, all program efforts will be transferred to the Washington, D.C., area. Specifically, it is planned to have a kit of no more than six birds housed in the East Building of the OTS complex. An additional group of up to 24 birds will be housed in a remote rented facility (location to be determined) in the Washington area. Both groups will be trained against simulated targets in this area, but in no event will they be permitted near [redacted] The kit of birds taken to the East Building will be brought into the area under [redacted] conditions to demonstrate the feasibility of coping with this operational requirement. This same kit will be trained for release by covert techniques such as "coat pockets," etc. The training of the other group of 24 birds is required to assure that many of the behavioral unknowns in this potential application will have been examined to some degree. When the birds are conditioned for the [redacted] demonstration, a notice will be provided to those interested parties that wish to witness the test.

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Cl by [redacted]

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Subject: TACANA/TCT

3. As some background explanation to provide you with some insight into delays incurred in the training, it should be pointed out that there were three major factors, all of which were unanticipated.

a. A number of birds contracted an illness.

b. High winds and tornado weather lasting over an extended period were encountered in Oklahoma.

c. Most important, it was determined upon analysis that the successful A-B-C flight demonstrations in California were due to the birds becoming acclimated to the terrain features rather than to the targets and thus it is felt that additional reinforcement is required to specifically train the birds to the target devices.

Item c is related to one of the reasons for moving to Oklahoma, an area in which the target location can be moved on a daily basis, whereas in California, because of the metropolitan area in which the work was being carried out, such relocation was considerably restricted.

4. The Office of Research and Development believes that although the goals of the program are still very difficult, significant program progress has been made so far. Based on these results, there is a reasonable probability of achieving the desired behavioral training for the denied area operation.

[redacted]

Donald L. Haas
Director of Research and Development

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3.3(h)(2)

6.2(d)

ORD-0008-76

5 January 1976

MEMORANDUM FOR THE RECORD

SUBJECT: TCT Activities Regarding Bird Camera

1. This memorandum covers the period between 16 December 1975 and 5 January 1976 regarding the progress for developing and testing a bird camera. Requirements and program scheduling have been completed for the ultimate test at the [redacted] in late April 1976. A TCT meeting was held in mid-December during which activities in the 16 December memorandum were discussed with the team members. Also, the bird camera development schedule (attached) was discussed. At this meeting, the probable resolution on the ground was estimated to be about 1-1/2 to 2 inches per 100 feet of altitude, and it was further estimated that the bird would fly at an altitude of about 100 feet. [redacted] of MSD/IAS was asked if this was adequate resolution for gathering meaningful intelligence. His estimate at that time was that it probably was adequate but he would study the problem in some detail and let me know if it was not. At this time, I have received no communication from [redacted] The issue of vertical versus oblique angle for taking pictures was discussed, but no firm decision was made except that vertical is probably as good as any since the right and left edges of the picture will be about 30 degrees off the centerline even if the camera were pointed straight down.

2. Film has been ordered and received from Kodak. This is a special high-resolution thin-based film designated as 3400 and 3414. The film slicer has been obtained from OTS; and a $5,000 work order has been established [redacted] for the purpose of using their photographic laboratory to slice film and process test samples of resolution charts, etc., for determining resolution and calibrating blurring due to linear motion of the camera. During the week of 5 January, several rolls of

E2 IMPDET
CL BY [redacted]

SUBJECT: TCT Activities Regarding Bird Camera

film will be sliced to 16 mm format and will be taken to [redacted] for test by [redacted] next week in the initial prototype camera. Following these tests, the camera will be brought back here for subsequent tests, probably during the early part of the week beginning 19 January.

3. A new harness for the camera has been designed out of a thin Mylar film weighing approximately 1/2 gram as opposed to the previous 4-1/2 gram harness weight. Two pigeons have been purchased and fitted with the new harness and a mock-up of the new camera. A prototype harness and dummy camera were sent [redacted] on 29 December. This mock-up system is being flight tested now on pigeons [redacted] Resolution charts have been ordered and should be here by the end of this week. Three Midland transceivers have been obtained and checked out for use in the prototype flight tests at the end of this month. In addition, portable audio recording equipment has been collected and checked out for use in the field during these same tests.

4. Dimensions for the Radome target to be used for the ultimate tests [redacted] in April were found to be as follows:

a. Sphere is [redacted] in diameter;

b. A truncated base [redacted] in diameter;

c. A height between the base and the top of the sphere of [redacted]

A portable test target for use [redacted] has been selected and was mailed to him on 26 December. This is a rubber balloon which inflates to a diameter of 20 feet in approximately 30 minutes. It comes with an air compressor at a total cost of approximately $500.

5. At this time, the camera development program is pretty much on schedule. It is estimated that preliminary flight tests on the West Coast will take place during the latter part of this month. The purpose of these tests

SUBJECT: TCT Activities Regarding Bird Camera

is to take pictures of Air Force resolution charts placed on the ground whereby preliminary estimates of resolution and motion blurring can be determined.

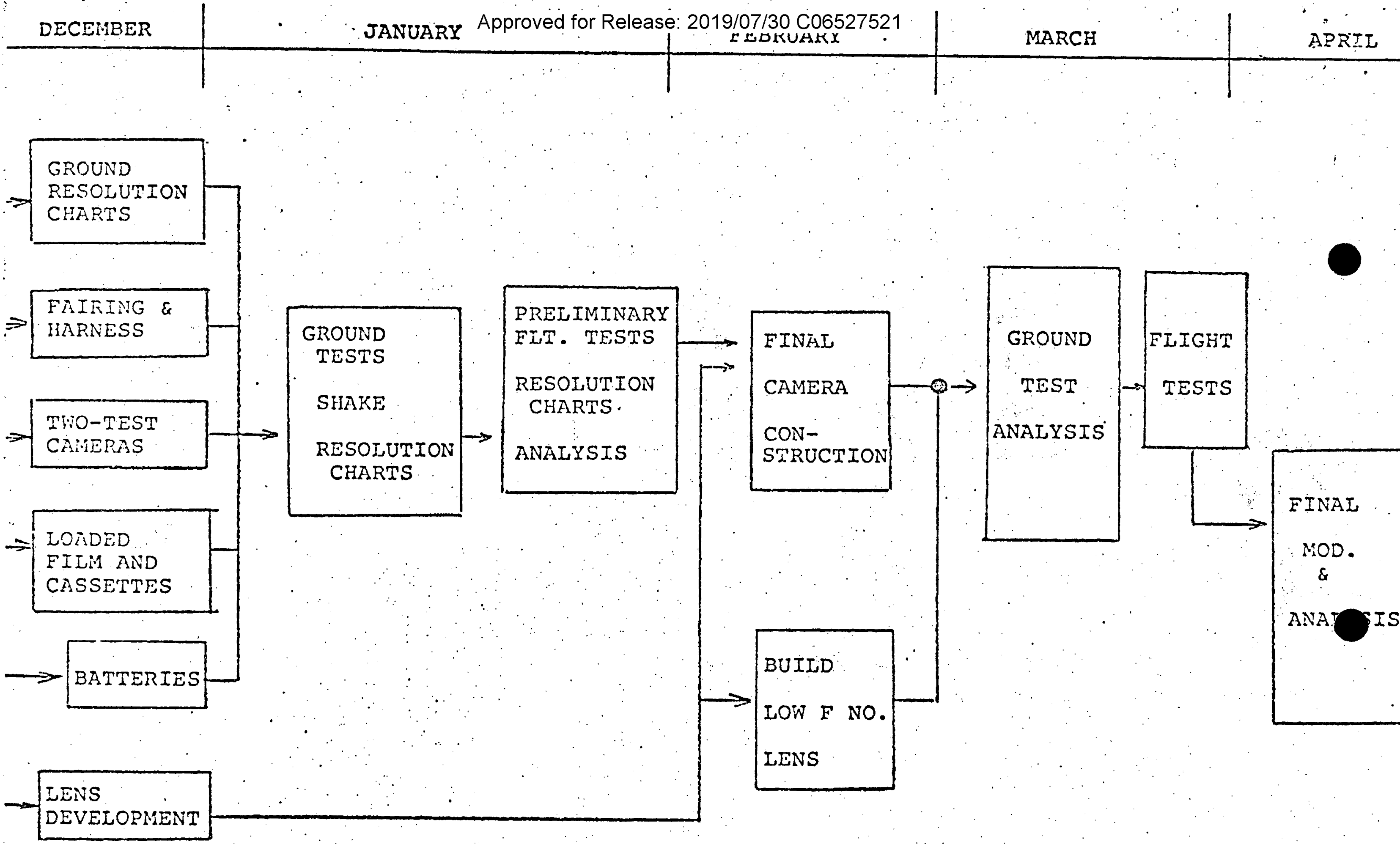
[redacted]

Charles N. Adkins
Operations Technology, ORD

Attachment:
Camera Development Schedule

Distribution:
0 - C/OTD then file w/att
1 - CEB/OTD Chrono w/o att
1 - OTD/ORD Chrono w/o att
1 - ORD Registry w/o att

OTD/ORD/DD/S&T/CNAdkins:kmc/2763


DECEMBER
JANUARY
MARCH
APRIL
GROUND RESOLUTION CHARTS
FAIRING & HARNESS
TWO-TEST CAMERAS
LOADED FILM AND CASSETTES
BATTERIES
LENS DEVELOPMENT
GROUND TESTS
SHAKE
RESOLUTION CHARTS
PRELIMINARY FLT. TESTS
RESOLUTION CHARTS
ANALYSIS
FINAL
CAMERA
CON-STRUCTION
BUILD
LOW F NO.
LENS
GROUND
TEST
ANALYSIS
FLIGHT
TESTS
FINAL
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&

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ORD-0327-76

5 February 1976

MEMORANDUM FOR THE RECORD

SUBJECT: TCT Activities Regarding Bird Camera

1. This memo covers the period between 5 January 1976 and 4 February 1976 regarding the progress for developing and testing a bird camera. The memo dated 5 January 1976 contains the original program schedule. At this time, the program is on schedule.

2. On 12 January 1976 the first model of the new 16 mm camera was received from [redacted] and tested. The frame rate of this camera is about one frame per second with a field of view corresponding to a footprint on the ground of 50 feet along the flight path and 90 feet transverse to the flight path at an altitude of 100 feet. Since the velocity of the bird is about 50 feet/second, (perhaps a little faster), this geometry yields approximately 140 contiguous pictures. From an altitude of 100 feet, this gives a strip 90 feet wide and 7,000 feet long for a total area coverage of about 630,000 square feet or 14.5 acres.

3. On 21 January 1976 [redacted] went to [redacted] with camera #1 to conduct further tests with [redacted] and to pick up camera #2. Tests conducted at this time showed a resolution of about 0.75 to 1.0 inch at 100 feet when the camera is fixed and not moving.

4. On 23 January, these two cameras were test flown on live birds at [redacted] facility in California. The purpose of this test was to obtain in-flight pictures and to ascertain firsthand the problems of working in the field. Three full rolls were taken in flight. One roll of the 3400 film (ASA -64) was used with camera #2 and a neutral density filter #1. Two flights were also made using the high-resolution 3414 film (ASA -5) since the illumination was very good (the light meter reading showed 16,000 foot candles). Prior to each flight, pictures were taken of a resolution chart at 50 feet, and an additional ten resolution charts were placed horizontally in the compound (about 100 feet on a side) to determine resolution from the air.

2 [redacted]

SUBJECT: TCT Activities Regarding Bird Camera

5. Some of the positive results of this test are as follows:

a. Of the 140 pictures on a roll, approximately 70 will be of good quality. This means about the same resolution transverse to the direction of motion (1 inch per 100 feet) and a degradation of two to four in the direction of motion.

b. About 14 pictures (10 percent) included some part of the compound (about 100 feet on a side) and about ten pictures include at least one resolution chart. Of these ten pictures, about half showed the "good quality" described in item (a).

c. The bird orbits were about 200-300 feet in diameter with several straight-line crossings directly over the compound at 75-100 feet altitude.

6. Some of the results of this test which indicate corrective measures are:

a. The 3414 film is highly sensitive to the humidity buildup in the dark bag used for the camera loading. This causes a degradation in film resolution, a defocusing of the camera due to warpage of the film, and a sticky texture of the film which unduly loads down the camera motor.

b. An additional silver cell battery (4 grams) was required to provide reliable camera operation in the field.

c. The timing circuit failed due to lack of proper potting and did not fit well in the forward fairing.

d. There was a lack of selection of neutral density filters for use with the 3400 film. The filter used caused the film to be underexposed.

e. The recommended developer (MX-819) for the 3414 film did not appear to work as well as the more conventional D-19 developer. Development should be undertaken only by experts familiar with this highly specialized film.

7. At this time, the following actions are under way:

a. The timing circuit has been reconfigured to fit around the camera next to the body of the bird and includes

SUBJECT: TCT Activities Regarding Bird Camera

two silver cell batteries. A pull tab around one battery will start the timer when yanked out. A dummy configuration including camera and timer will be sent to [redacted] next week for checking compatibility with the bird.

b. Camera #1 has been modified to provide a continuous film speed of 0.44 inch per second. This will compensate exactly for linear image motion blurring when the bird is at 100 feet altitude flying at 54 mph, or at 75 feet altitude flying at 37 mph. It is felt that on an average this will reduce motion blurring by at least a factor of two. This camera is in the mail and will be tested next week against moving targets (resolution chart on a car).

c. An appointment has been made to see [redacted] (Extension 3514) of NPIC on 9 February 1976 to discuss the possibility of using NPIC to process all 3414 film and provide guidance on dealing with humidity problems.

d. A series of neutral density filters is being collected for use with the 3400 film.

e. The new camera has also been modified so that the film can be attached to the take-up reel prior to going to the field. This will reduce handling and load time in the field by a factor of three or four.

f. The design of the larger (lower F number) lens is completed and will be delivered in early March. This will allow for a faster shutter speed with the 3414 film which will further reduce motion blurring. Also, the new camera (with present lens) will be fitted with a faster shutter speed for use with 3400 film.

g. Plans are now underway to test the latest modifications under simulated field conditions in [redacted] where any camera problems can be dealt with directly by Mr. [redacted] Hopefully, the film taken during this simulated field test can be processed by NPIC.

8. At this time, the results of the flight tests indicate that the original estimate of 1.5-to-2-inch resolution at 100

SUBJECT: TCT Activities Regarding Bird Camera

feet can be obtained, and the probability of getting several (five to ten) good pictures of the target per roll of film is better than originally expected.

Charles N. Adkins
Operations Technology, ORD

Distribution:

0-C/OTD/ORD then file
1-OTD/ORD Chrono
1-ORD Registry
OTD/ORD/DD/S&T/CNAdkins:amb/2763

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13 August 1974

NOTE TO: Clint

SUBJECT: Telecon with [redacted] 9 August

1. The prison overflight was not successful, strickly speaking. Two flights were attempted -- not at Folsom (because of the unusual security precautions at that installation) but at [redacted]

2. First flight, the bird went high and not directly over the prison. Some pictures of the periphery of the prison grounds were obtained but are not recognizable as such.

3. Second flight, the bird flew right over prison gate but took a long time to get there. All film had already been exposed.

[redacted] Two valuable lessons were learned: (1) the trip to [redacted] threw the bird out of kilter -- not use to it and didn't perform well until the second day. Solution will be to: (a) get the bird used to travel or (b) always plan to arrive ahead of time (or both); (2) the parked, pick-up vehicle was conspicuous (I think they got stopped). Cruising back and forth would have been fine. They plan to implement the luggage-rack scenario (with open back end).

Tom

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ORD # 1476-65

21 MAY 1965

MEMORANDUM FOR: Deputy Assistant Director, Office of Research and Development

SUBJECT: The Dolphin as a Potential Sensor Emplacement Asset

REFERENCE: ORD Memo 1284-65, dated 5 May 1965, same subject

1. The following ideas on possible dolphin missions have been suggested by components of the Office of Scientific Intelligence. We would be pleased to discuss these with you in more detail.

2. Atomic Energy

a. Considering the likelihood of acquiring information through use of the dolphin, the possibility of obtaining acoustic tapes of Soviet nuclear submarines which would be free of noise from the receiving platform perhaps is of most significance in the atomic energy area. Results could vary from a general assessment of the overall noise-frequency spectrum and its relation to US passive surveillance systems, including SOSUS, to a detailed recording of the internal noise generated by pumps, motors, drive systems, and other equipment. The more detailed recording, possibly obtained through attachment of the recording apparatus to the hull, may lead to a definitive understanding of the primary, secondary, and drive circuits of the nuclear propulsion systems used aboard the different types of Soviet nuclear submarines.

b. Of lesser current importance, though possibly of more significance in several years, would be the sampling of rivers at the upper limit of brackish water for the presence of induced radioactive elements. Sampling methods could include the use of concentrators for reactor activation products or the taking of small whole water samples for the

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GROUP 1
Excluded from automatic downgrading and declassification

[redacted]

SECRET

SUBJECT: The Dolphin as a Potential Sensor Emplacement Asset

presence of tritium. Logical sampling sites in several years would be [redacted]

c. There are several locations [redacted]

However, the short life of the currently available power supplies used in intercept equipment makes this less attractive.

d. If the weights of Teller light or electromagnetic pulse equipment could be reduced significantly, dolphins possibly could be used to emplace such equipment [redacted] Such equipment could obtain close-in data on the fine structure of nuclear explosions.

3. <u>Missiles</u>

[redacted]

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SUBJECT: The Dolphin as a Potential Sensor Emplacement Asset

4. [redacted]

a. Attach an acoustic noise-maker to the animal to test reaction [redacted]

b. Observation of submarine installations through use of a camera attached to the dolphin.

c. Testing of direction finding capabilities and reaction to a radio transmitter attached to a dolphin.

d. Emplacement of a sensor to establish movement patterns for [redacted]

5. Biological Warfare

a. Dolphin possibly could carry a sampler for BW material. This capability would be useful probably only in a very limited sense and only in installations which would be near enough to the sea to dump either their waste or products of testing into the ocean.

[redacted]

[redacted]

DONALD F. CHAMBERLAIN
Assistant Director
Scientific Intelligence

Distribution:
Orig & 1 - Addressee
2 - AD/SI
1 - [redacted]/SI

OSI:EXEC:[redacted]:bet/5609 (20 May 1965)

~~SECRET~~

4/13-65

ORD 2448-65
9 SEP 1965

ADM-6.1

MEMORANDUM FOR: Director of Logistics

SUBJECT : Transfer of Funds to the Office of Naval Research for Project OXYGAS/A (Dolphins)

REFERENCE : a. ORD Requisition 851-65 dated 27 December 1964
b. Navy Contract NONR 4568(00)

1. The Office of Research and Development requests that funds in the amount of $81,000 be transferred to the Office of Naval Research in order that new training facility construction may be effected by Navy on Project OXYGAS/A (reference a & b).

2. The new dolphin training facilities are to be constructed on the U.S. Naval Base at Key West, Florida. The attached maps and drawings provide specific details relating to the proposed construction. The Office of Naval Research should be instructed during the course of funds transfer that CIA does not wish to proceed with the construction of building B called for in the attached drawings.

3. The requirement for the proposed construction of a new dolphin training facility at Key West has been influenced by the following factors:

a. The dolphin training program has progressed to a point where simulated operational missions are now necessary. The security arrangements at the existing site at Grassy Key, Fla. are inadequate for this type of endeavor.

b. The existing facility at Grassy Key is inadequate from an animal housing and range area standpoint to accommodate the next phase of work.

4. Of the $81,000 to be used for construction purposes, $66,000 is earmarked for basic construction, e.g., animal pens, fencing, piers, etc. $15,000 is for an animal maintenance and storage building including refrigeration for food supplies for the dolphins. It will be noted in the attached proposal from [redacted] that the contractor originally requested $75,000 for the construction costs. Subsequent discussions with the contractor have resulted in agreements to have certain additional construction work done at this time which, if delayed further, would result in excessive construction costs. The proposed subcontractor for the basic construction

SUBJECT: Transfer of Funds to the Office of Naval Research for Project OXYGAS/A (Dolphins)

work ($66,000) is [redacted] Key West, Fla. This concern was selected not only because it submitted the lowest construction bid but also because of the high recommendations provided by U.S. Navy officials at Key West, Fla.

5. Detailed coordination meetings on all phases of the planned construction have been held with the Office of Naval Research and Admiral Christopher, Commander of the Key West Naval District. Complete concurrence on these plans has been received from all Navy officials involved.

6. Dr. John Adkins, Assistant Chief Scientist, Office of Naval Research, is the cognizant official on this project. There are no recommended changes in the previous security, reporting, or sterility code arrangements. [redacted], extension 4218, is the project officer on this contract and will monitor its execution.

[redacted]

ROBERT M. CHAPMAN
Director of Research and Development

Attachments
1. Letter proposal plus facility sketches, price quotation [redacted] and map of Key West, Fla.
2. Requisition ORD 851-66

CONCURRENCE:

[redacted]

16 SEP 1965
Date

Deputy Director
for
Science and Technology

Distribution:
Orig. & 1 - Addressee
1 - DD/S&T
2 - DD/S&T Registry
1 - LO/DD/S&T
1 - AO/ORD
2 - LS/ORD
1 - ORD Chrono

LS/ORD/DD/S&T [redacted]:jah/7822 (7 September 1965)

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ADM-6.1

DD/S&T-3958-65
9 SEP 1965

MEMORANDUM FOR: Director of Logistics

SUBJECT: Establishment of New Task with [redacted]

1. The Office of Research and Development requests that a new task be negotiated with the subject firm for work on "Dynamic Filtering of Speech Signals."

2. The scope of work to be accomplished is to study and develop methods of dynamic filtering of speech signals to suppress the effects of additive background noises. The attached proposal describes the program which will include a study aimed at determining the best signal processing methods for use in both general purpose digital computer implementations and later designs for real-time dynamic filtering systems.

3. The contractor will furnish a final technical report, monthly progress reports, and such other reports and briefing aids as may be required by the Project Officer.

4. Agency association will be classified CONFIDENTIAL. All reports are to be classified SECRET.

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GROUP 1
Excluded from automatic downgrading and declassification

5. Dr. John D. Sanders, extension 4227, will be the Project Officer and will monitor the program.

[redacted]

ROBERT M. CHAPMAN
Director of Research and Development

Attachments
[redacted]
2. Requisition ORD-612-66

APPROVED:

Signed: John F. Blake

ALBERT D. WHEELON
Deputy Director
for
Science and Technology

1 OCT 1965
Date

Distribution:
Orig. & 1 - Addressee
1 - DD/S&T
2 - DD/S&T/Registry
1 - SLO/DD/S&T
1 - AO/ORD/DD/S&T
1 - B&F/ORD/DD/S&T
1 - AP/ORD/Project File
1 - AP/ORD/Chrono
1 - ORD/Chrono

AP/ORD/DD/S&T/John D. Sanders:am (4227 - 3 Sept. '65)

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ADM-6.1

DD/ST# 3958-65/1

ORD-2405-65
9 SEP 1965

MEMORANDUM FOR: Deputy Director for Science and Technology

SUBJECT: Establishment of New Task with [redacted]

1. Approval is recommended for the establishment of a new task with [redacted] to study and develop methods of dynamic filtering of speech signals. This program is proposed for a 12 month period at an estimated cost of $49,684.

2. The program includes a study to determine the best audio signal processing methods for a real-time dynamic filtering system; that is, an electronic filter system which would periodically change its characteristics to best suppress the effects of additive background noises. This will improve the intelligibility of speech recordings that have been corrupted by additive noise and furthermore, will reduce the fatigue induced by listening to such tapes for extended periods.

3. The initial dynamic filtering experiments will be carried out by sampling and quantizing the speech plus noise signals and storing the digital data in a computer. Dynamic filtering operations will then be programmed and carried out digitally. The advantage of initial experimentation with a general purpose computer lies in the accuracy with which the operations can be carried out, and the flexibility with which the

GROUP 1
Excluded from automatic downgrading and declassification

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processing techniques can be modified for experimental purposes. These initial experiments will be done in non-real-time, but lead to the later design and construction of a real-time dynamic filtering system.

4. This project is part of a general program within AP/ORD to improve the recovery of intelligence from existing and future recordings made from audio surveillance devices. The proposed program is an outgrowth of a previous broad study, "Methods of Speech Processing for Communications" done by [redacted] for this Agency.

5. [redacted] was chosen to perform this task because of their capabilities in speech processing techniques, both digital and analogue, and because of their previously demonstrated familiarity with the problems of speech intelligibility degradation introduced by various background noises encountered in audio surveillance. [redacted], who will be in charge of this project, did the above mentioned study which was excellent and comprehensive. The mathematical models for such processing prepared by [redacted] AP/ORD consultant, proved too unwieldy for OCS to handle, but have been incorporated into this proposal. The overall proposal was evaluated by [redacted] and considered excellent; furthermore, it has been coordinated with [redacted] whose optical processings techniques are complementary with this work. In addition, interchange of any appropriate information among [redacted] will be effected to obtain maximum results from this work.

[redacted]

ROBERT M. CHAPMAN
Director of Research and Development

~~CONFIDENTIAL~~

12 May 1976

MEMORANDUM FOR: Director of Research and Development

SUBJECT: Transmittal of DDO/SED Memo

REFERENCE: SED Memo dated 7 May 1976, Subject: SE Comments on TACANA

Attached herewith is a copy of the referenced memo, which I am forwarding to you. I will follow-up this memo with a formal request for an ORD response to the points outlined in the referenced memo after discussions with Mr. Don Reiser.

[redacted]
Chairman, TACANA/TCT

attachment: h/w

E2 IMPDET
CL BY [redacted]

~~CONFIDENTIAL~~

330

7 May 1976

MEMORANDUM FOR: Chairman, TACANA TCT

FROM : [redacted]
SE/COPS

SUBJECT : SE Comments on TACANA

REFERENCE : ORD-1102-76 Paper on TACANA Program, 5 May 1976

1. After reading Reference and attending a TACANA meeting on 6 May, I offer the following comments and SE's position on the program. This is a collection system being developed by the DD/S&T for possible deployment by the DO against a priority target validated by OWI and OSI. SE Division continues to be willing to try to deploy this system against an internal Moscow-located target, provided:

a. The collection system is shown to be workable, i.e., can operate according to a script agreed to by the TCT. In short, birds trained against a target, moved clandestinely at least 2500 miles to target area, acclimated covertly, and deployed against target with return to a base.

b. A priority intelligence target in the Moscow area is validated by the DD/S&T and judged worth cost and risk involved.

2. Judging from remarks at the 6 May meeting, TACANA cannot be deployed during CY1976. It appears that two fundamental questions still need answers before any serious effort is made to run even a full, simulated exercise:

a. Full understanding of acclimation process: how long and can this be done covertly under simulated Moscow conditions? We apparently know the birds can adjust to new environs, but this has been done under non-clandestine conditions and we still lack full understanding of the process.

b. Can they be trained to search and find a particular target? What is their retention ability for this? What is impact of location change on this?

3. Given the current status of bird training there seems to be no reason to bring them to the Washington area this year. That step was

E2 IMPDET
CL BY [redacted]

planned <u>only</u> if they were ready to perform a full-scale dummy operation, and indeed I think this area should remain as a final test location. Whether the program should be continued must be a DD/S&T decision. Only its offices can truly evaluate the collection system/cost against similar developmental efforts, and certify/validate the targets. In any event the program should not involve bringing the birds to Washington until they are fully ready to meet an operational test script /per paragraph 1. a. above/.

cc: C/SE
NIO/SA
C/SE/I/USSR

3.3(h)(2)

6.2(d)

18 January 1965

MEMORANDUM FOR THE RECORD

SUBJECT: Trip Report - 12-15 January 1965

1. On the morning of 13 January 1965, [redacted] and I met with [redacted] to discuss the agenda for the Kinzel Life Sciences Panel meeting on 29 January. It was agreed that a discussion of [redacted] would take up most of the morning. The afternoon will be devoted to OXYGAS, KECHEL, and a discussion of the Limited Warfare Laboratory bird program. [redacted] suggested that the Panel meeting on 4 June be concerned with Soviet bioastronautics with emphasis on Soviet animal studies and fundamental research. Other topics may be added.

2. [redacted] has received the "B" clearances; and it is suggested that he, General Flickinger, and myself and possibly [redacted] visit the site, perhaps in February. We also discussed submission of a new grant to follow up on the current one. [redacted] reviewed the draft memorandum on [redacted] and had no changes to suggest. [redacted] suggested some additional themes for [redacted] including analysis of Soviet computers such as the Ural-2 with relation to their plan to function in the Soviet economic program. He also suggested careful study of the microwave and audio effects on man at low power but appropriate frequencies. Other suggestions on the audio side included careful study of the work of Manfred Shroder and Ed David at Bell Labs who use tracking filters which do five megacycle scanning over a broadband which is helpful in increasing the S/N. He would like to be briefed on the audio program the next time he is in. He also suggested that we inform ourselves of the work of Dr. Hugh Bradner, Scripps Institute of Oceanography, on the tracking of schools of fish and dolphin.

3. On the afternoon of 13 January 1965, [redacted] [redacted], and I visited with [redacted] at Pt. Magu. Their program is now directly under BuWeps (ASW) and no longer under China Lake. We discussed a number of areas

where the Pt. Magu facility could assist us. [redacted] were enthusiastic and will undoubtedly submit some programs. However, [redacted] is apprehensive that the ASW people may not like this idea. Dr. Sidney Galler, ONR, who joined us later said he could work this out. In later discussions with Dr. Wakelin, he indicated he could probably assist us with the Secretary of the Navy.

4. On 15 January 1965 I met with Dr. Wakelin and Dr. Kinzel in Dr. Kinzel's office in New York to discuss future plans in the life sciences for [redacted] Kinzel agreed essentially with our plan, although he suggested that the funding of nonrelevant projects be tapered off gradually rather than abruptly as of 1 July 1965. He plans to attend the meeting of 29 January, and we can discuss activities at that time. I also mentioned the fact that [redacted] had suggested John Sanders (sic), currently with [redacted] as a possible research director on perception. I also mentioned that Sidney Galler is definitely leaving the Office of Naval Research, probably to go with Orr Reynolds on the biosatellite program. He is another possible asset.

[redacted]

STEPHEN L. ALDRICH, M. D.
Deputy Assistant Director
LS/ORD/DD/S&T

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SECRET

[redacted] 3.3(h)(1)
3.3(h)(2)
6.2(d)
3.5(c)

ORD 601-64
18 March 64

MEMORANDUM FOR THE RECORD

SUBJECT: Trip to the West Coast on 9 - 13 March 64

1. On Monday, 9 March, [redacted] and I interviewed two ORD candidates for employment. Separate reports are available on the interviews.

2. On Tuesday, 10 March, we visited the Pt. Mugu Naval Missile Center and spent the day with [redacted] Head of Life Sciences at Mugu; [redacted] Head of Marine Sciences at Mugu; Mr. C. Scott Johnson who is from Notts-China Lake; Dr. Sidney Galler, ONR-Washington; and Mr. John B. Loefer, ONR-Los Angeles. [redacted] and his group reviewed the research which they are intending to carry out on dolphins and other marine life. Of particular interest are erythrocyte pigment differences, regional blood flow, migration, fasting, pathology, water balance maintenance, psychopharmacology, utilization of limited air supply, and dolphin heat exchanges through their flukes. They are also interested in hydrodynamic principles of these organisms. In effect they are trying to establish the performance limits of dolphins and the physiological reasons for their unique abilities. We visited their laboratory buildings and their dolphin tanks. My impression is that Pt. Mugu has lots of good equipment, animals, and people who are looking for a problem. In later discussions with Sid Galler, we think we can provide them with a problem and give this project more explicit direction. Some of the funds which we hope to transfer to ONR will be used to augment the Pt. Mugu operation.

3. On Wednesday morning, 11 March, [redacted] briefed us on their current activities related to a proposal which was forwarded to us. They have achieved some rather remarkable results in using different correlation techniques on EEG patterns and have some interesting studies planned which I feel are of potentially great significance to our stress program. Their proposal has been forwarded through ONR and will be supported by us by a transfer of funds.

SECRET

GROUP 1
Excluded from automatic downgrading and declassification

4. On Wednesday at noon, 11 March, [redacted] met with Dr. Sidney Galler, ONR, [redacted] has been using a cow Tursiops borrowed from Pt. Mugu to study echolocation ability. He uses a [redacted] He has done detailed dissections of Tursiops skulls, has done detailed studies of coronal sections, and has discovered that the echolocation receiving mechanism is through fat channels in the lower jaw. There is direct attachment from the center of the lower jaw to the middle ear. There is some resonance between this fat channel and very thin portions of jaw bone.

This summer [redacted] is going to Hawaii to determine the speed at which a porpoise can swim in the open sea and how deep he can dive.

X 5. On Wednesday afternoon, 11 March, [redacted] reviewed our plans for the meeting of 21 March (Kinzel Life Sciences Panel) and also reviewed the [redacted] proposal. [redacted] feels that it is a good proposal and should be supported. He also felt that [redacted] is underestimating the equipment costs. [redacted] also concurred on the proposal but was less enthusiastic. He recognizes the importance of getting adequate data for the polygraph but feels that this project will have to be very carefully evaluated periodically. His major concern is the cost of the project which involves a rather large percentage (approximately 40%) of this year's funds for Life Sciences. [redacted] questioned me further on the role which his Panel should play and particularly asked whether I wished them to review each proposal. I told him that I felt their major function should be in planning our program and in providing us with consultative advice rather than approving projects. I have the feeling that he agrees with this. This will no doubt be discussed at the 21 March meeting. [redacted] also seemed concerned about our budget which he feels is rather small in terms of the objectives of the program.

6. On Thursday morning, 12 March, [redacted] and I met with [redacted] who is the Project Director on [redacted] The results of our discussion will be part of a separate memo. In general, I believe [redacted] is doing rather well and is a highly competent chemist. We anticipate a follow-on to his proposal.

7. Early Thursday afternoon, 12 March, we met with [redacted] from the [redacted] to see whether his activities would be of value to our stress program. [redacted] is primarily concerned with biochemical and other physiological changes induced by stimulation to the hypothalmus. His orientation and experimental program is not the sort of thing that I believe we should support, although some of the results of his work may be of significance for the future. [redacted] will forward the results of his work to us and keep our program in mind.

8. Late Thursday afternoon and evening, 12 March, we were engaged in a major psychodrama with the [redacted] people. Neal and I met initially with [redacted] and with [redacted] the Director of [redacted] I explained again the reasons why we wished to have [redacted] as the Program Manager, particularly during the early phases of the program. After considerable discussion, [redacted] agreed to put [redacted] in charge of the program as the Staff Manager but with [redacted] as the Technical in-house Director. This appears to be satisfactory to all concerned. Later we met with [redacted] who is now head of [redacted]. He seems to me to be an extremely bright mathematician-engineer and should work well on our project. [redacted] from [redacted] is not yet cleared for the project although he has a TS clearance. I was somewhat less impressed by him, although his role will be very limited in terms of our project.

[redacted]

STEPHEN L. ALDRICH, M. D.
Deputy Assistant Director
LS/ORD/DD/S&T

cc: ADD/S&T
DAD/ORD

During the period 1963-1968, numerous research and development programs were undertaken in support of the Agency's interest and requirements. The diversity of programs reflected the multi-discipline character of biological sciences as well as the "common use" application of the researth and development product. The following program briefs represent the major programs and achievements of the R&D effort during the 1963-1968 era.

ANIMAL STUDIES

The state-of-the-art of remotely controlling animal behavior resided within the animal behavior studies was funded by the [redacted] Division. The feasibility for remote guidance of animals in the free environment was demonstrated in 1965 using a [redacted] as the subject and an [redacted] as the guidance cue. This achievement prompted a more intensive investigation of other animal species. In the period 1966 to 1968, [redacted] guidance system was developed using [redacted] techniques. In late 1968, the [redacted] program was advanced to the operational and engineering development phase. One of the more notable achievements of the animal studies was the demonstration in 1968 that the homing behavior of [redacted] could be controlled and maintained in an [redacted] environment. Coupled to all animal guidance programs was the successful training of behavior necessary to emplace, deliver and/or retrieve [redacted] as well as the development of the hardware and logistics subsystems necessary to support the [redacted] phase.

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3.3(h)(2)
6.2(d)
3.5(c)

CONFIDENTIAL

ORD-2007-74

16 May 1974

MEMORANDUM FOR THE RECORD

SUBJECT: Visit [redacted] Re Basic Bird Support Capability, [redacted] and Staff

REFERENCE: ORD-1992-74 (Progress Report #1)

1. The attached Progress Report accurately represents the R&D that has taken place since the recent initiation of the contract. As planned, bird procurement and facility construction has constituted the primary activity. Both efforts have exceeded expectations. As indicated in the referenced report, bird capture required more than 2,000 miles travelling in remote regions with improvised techniques for capture. The addition to the staff of a former employee of the Texas Parks and Wildlife Department has aided considerably in bird procurement and initial domestication. The expected hiring of [redacted] (who has an M.S. degree in Ornithology) will provide valuable scientific assistance to the project. The bird holding and training facilities have been expanded considerably--largely at company expenses. Photos of the new facilities are being provided. The sensory discrimination experiments are currently underway, and two red-tailed hawks have been conditioned to respond to a 6 Hz tone and to discriminate a triangle from other random geometric figures. Response generalization to these stimuli will be evaluated in accordance with the bird's conditioning rate.

2. The proposed experimental program was discussed with [redacted] and his staff. The program includes laboratory studies of target cue discrimination (both auditory and visual) as well as field training for generalization from a building model or simulation to a real life-size building in an environment to which the bird has never been exposed. It is [redacted] task, on the basis of our discussion, to write up the experimental program in detail and to forward same to sponsor for final approval.

WARNING NOTICE
SENSITIVE INTELLIGENCE SOURCES
AND METHODS INVOLVED

E2 IMPDET
CL by [redacted]

CONFIDENTIAL

SUBJECT: Visit to [redacted]e Basic Bird Support Capability, [redacted] and Staff

3. Taking all factors into consideration, there are no apparent problems associated with the project, and current progress is ahead of schedule.

[redacted]
LSR/ORD/DD/S&T

Attachment:
ORD-1992-74

Distribution:
Original - LSR & D/ORD
1 - LSR CHRONO
1 - ORD REG.

LSR/ORD/DD/S&T/[redacted];3658

P ect 13-3951-001
Progress Report #1
March 18 - April 18, 1974

ORD # 1992-74

LEARNING BEHAVIOR OF BIRDS BY STIMULUS GENERALIZATION

Most of the effort during the first month was expended in collection of raptors. The present inventory includes two Red Tail Hawks, four Harris Hawks and four Great Hroned Owl eyess. [redacted] in one telephone conversation stated that he will be able to supply us with two Red Tails that are conditioned to controlled flight. [redacted] is interested in the Prairie Falcon and indicates that it might be equal to or superior to the Peale Falcon. The Peale Falcon is the maritime species of the Peregrine and is on the endangered species list. Through a reference in the Texas Parks and Wildlife Department we obtained the name of [redacted] Ornithologist, [redacted] for contact as a Prairie Falcon supplier. In a telephone conversation with [redacted] he seemed willing to send us two Prairie Falcon eyess in about 30 days. Moreover, he volunteered to send us tow Lanner Falcons for conditioning behavior experiments and for audio frequency testing.

We have requested the Texas Parks and Wildlife Department to modify our permit to increase the number of raptor species to include several falcons and the Black Headed Vulture. We also have conversed with the Department of Interior concerning issuing of a Federal permit. Applications are forthcoming. We have covered an area from South of Austin, Texas to Laredo, Texas on a belt approximately 50 miles wide in the pursuit of birds. The estimated number of miles covered was 2,000.

To help us in the collection of birds and in training exercise we employed a former employee of Texas Parks and Wildlife Department and are presently making arrangements with [redacted] in Ornithology to join us in early June.

Our plans are to increase the number of Harris Hawks, Red Tails (eyess and adults) and to obtain black headed vultures and falcons.

A muse for containment of owls is near completion. Two flyways or operant conditioning indoor areas have been completed. We have managed to maintain a continuous supply of mice for use in nutrition of birds and for positive reinforcement of behavior.

Presently we are in the process of conditioning two Red Tail Hawks to fly 20 feet from a perch to a black triangular target paired with a tone at 6,500 hertz. The speaker is located at the target site. These birds are responsive and are at the stage of conditioning where discrimination training can be practiced.