~~TOP SECRET~~

HANDLE VIA
BYEMAN
CONTROL SYSTEM

[redacted]

~~(S)~~ NATIONAL RECONNAISSANCE OFFICE

WASHINGTON, D.C.

THE NRO STAFF

Mr. Plummer has seen.

January 8, 1974

MEMORANDUM FOR MR. PLUMMER

SUBJECT: DISCOVERER XIV

Dr. McLucas asked for an assessment of the accuracy of the historical description of the DISCOVERER XIV mission (TAB A). I have determined that the technical parameters are generally correct, by consulting the NRO history prepared by Mr. Bob Perry and the CIA Program Office history published in the CIA Studies In Intelligence Periodical, Vol 17 No. 1-S. The statement that the capsule carried in it scientific data on propulsion, communications and orbital performance collected and stored in space is not accurate. The inclusion of this statement can probably be traced back to the cover story and unclassified information which appeared during the early days of the DISCOVERER program. At TAB B is an article from the June 1961 issue of The Airman magazine, which describes the DISCOVERER program in terms of its cover without ever divulging its true photographic mission. At TAB C is an extract from the STL Space Log, Volume 1, No. 2, September 1960. This describes the DISCOVERER XIV payload as being similar to DISCOVERER ~~XIII~~, which did in fact carry a tape recorder for on-board data collection. DISCOVERER XIII carried a diagnostic payload only; if this had not proven successful an additional diagnostic mission would have been flown as DISCOVERER XIV and would have carried a tape recorder. Because DISCOVERER XIII was a successful mission, the decision was made to fly the CORONA camera payload immediately.

There are very few records left to reflect in detail the configuration of the various CORONA missions. In

searching for the answer for Dr. McLucas' question I spoke with both Colonel Paul Worthman and Colonel Clarence (Lee) Battle, who were sure that there was no tape recorder on board DISCOVERER XIV. Mr. Roy Burks of CIA, who was part of the old CORONA team, could recall no recorder and referred me to Mr [redacted] of General Electric, who reportedly catalogued all items returning from space in General Electric recovery vehicles. [redacted] recalled no recorder but did not have ready access to the historical documentation. Through [redacted] in SAFSP, the LMSC people did go into the records and reported that the total instrumentation in the recovery vehicle for the DISCOVERER XIV mission consisted of telemetry indicating cold gas nozzle firing, deployment of the parachute cover, parachute deployment, and a tracking signal. The LMSC instrumentation records showed that there was no tape recorder in the recovery vehicle. Mr [redacted] of Lockheed also confirmed this for me.

The inscription to accompany the DISCOVERER XIV capsule can be made correct by deleting that portion of the sentence which refers to returning scientific data collected and stored in space. At the right is a retyped inscription which is correct.

FREDERICK L. HOFMANN
Lt Colonel, USAF

The Discoverer XIV capsule on display is the first item to be ejected by a satellite orbiting in space and to be recovered in mid-air. Discoverer XIV was launched into a polar orbit by a Thor booster from Vandenberg Air Force Base, California at 12:57 P.M. on 18 August 1960. After the Thor had exhausted its fuel, the Agena atop the Thor separated from it. The Agena's engine then ignited to increase the satellite's speed to 17,658 miles per hour, thereby achieving an orbit of 116 miles above the earth at the low point (perigee) and 502 miles at the high point (apogee). As the Agena streaked southward through space high over Alaska on its 17th pass around the earth, it ejected the capsule from its nose. Retrorockets attached to the capsule then fired to decrease its speed and the capsule began descending in a long arc towards the earth. After the capsule had entered the atmosphere, it released a parachute and floated earthward, carrying in it the scientific data on propulsion, communications, and orbital performance it had collected and stored while in space. The descending parachute was sighted by the crew of the C-119 recovery airplane 360 miles southwest of Honolulu, Hawaii. On the third pass of the C-119 over the parachute and its precious capsule, the recovery gear

trailing behind the airplane successfully snagged the parachute canopy. A winch operator aboard the C-119 then reeled in the Discoverer XIV capsule after its 27 hour, 450,000 mile journey thru space.

[redacted]

COORDINATION SHEET

GENERAL KULPA K

MR. SINGEL [signature]

~~TOP SECRET~~

DATE: 10 JAN 74

SIGNATURE ______
APPROVAL ______
COMMENTS ______
COORDINATION ______
ACTION ______
INFORMATION X

TICKLER ______
RETURN TO ______
FILE ______

SUSPENSE ______

AEROSPACE MUSEUM

DISCOVERER XIV

FRITZ HOFMANN DID A SUPERB JOB OF HISTORICAL DETECTIVE WORK TO FIND THE TRUE FACTS ON DISCOVERER XIV. THE INCORRECT PHRASE IS HIGHLIGHTED AT TAB "A"

BY ______

COMMENTS/DIRECTION:

YOU MAY WISH TO HOLD THIS FOR DR. McLUCAS' INFORMATION PRIOR TO TAKING ACTION ON HAVING THE RECORD CORRECTED

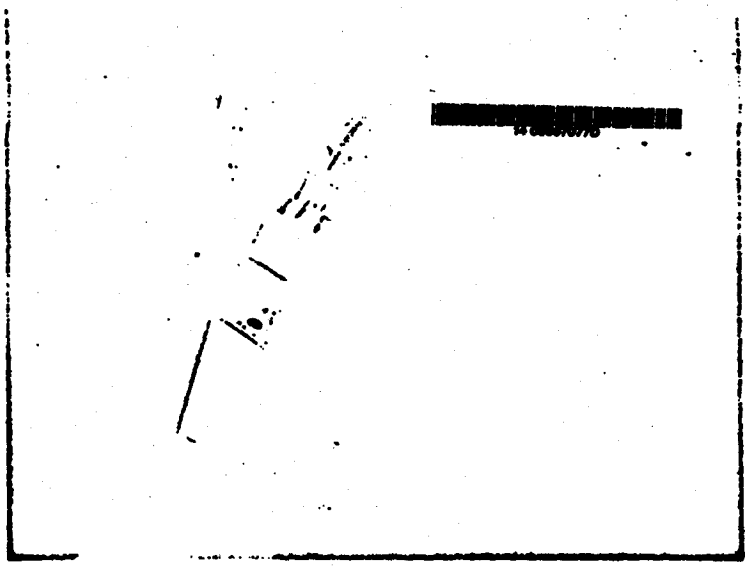
[redacted]

22 JAN 74

SAF/SS PLEASE HAVE THE CHANGE TO THE EXHIBIT ACCOMPLISHED I BELIEVE IT BELONGS TO SAFOI.

Mr. Plummer has seen

~~TOP SECRET~~ [redacted]



by MSGT. FRANK J. CLIFFORD, Airman Staff

DISCOVERER — TRAILBLAZER TO SPACE

FOR ALL WHO WERE ON THE SCENE, and for many, many more who were present in spirit only, January 21, 1959, at Vandenberg AFB, Calif., was a black day for the Air Force. That was the day *Thor* 160 was to boost an instrument-packed *Agena* satellite vehicle into polar orbit to begin the *Discoverer* series of experiments. Object: to develop basic techniques from which a diversified arsenal of satellite systems was to grow.

Thor 160 never got off the ground—that day.

But the research program did. A month and a half later, on February 28, *Discoverer I*, a *Thor-Agena* combination shouldering a 1,300-pound payload streaked upward from launch complex 75 at Vandenberg's Purisima Point overlooking the Pacific. Obediently on cue, *Discoverer I* heeded instructions from its "holes-in-the-head" brain, the perforated tape program which directed its guidance system, and entered a near-polar orbit.

All doubt that a polar orbit could be achieved vanished with this shot, belying a 1955 Russian pronouncement that such a path was all but impossible. Difficult, yes, but *Discoverer I* demonstrated that precision equipment in the hands of skilled technicians makes all the difference in the world—or out of it.

Discoverer I lived for less than two weeks, playing hide and seek with ground tracking stations whenever its stabilization gear became cranky. When in the mood, which was more often than not, her 30-pound instrument package transmitted data to her ground-hugging masters as she circled the earth every 95 minutes.

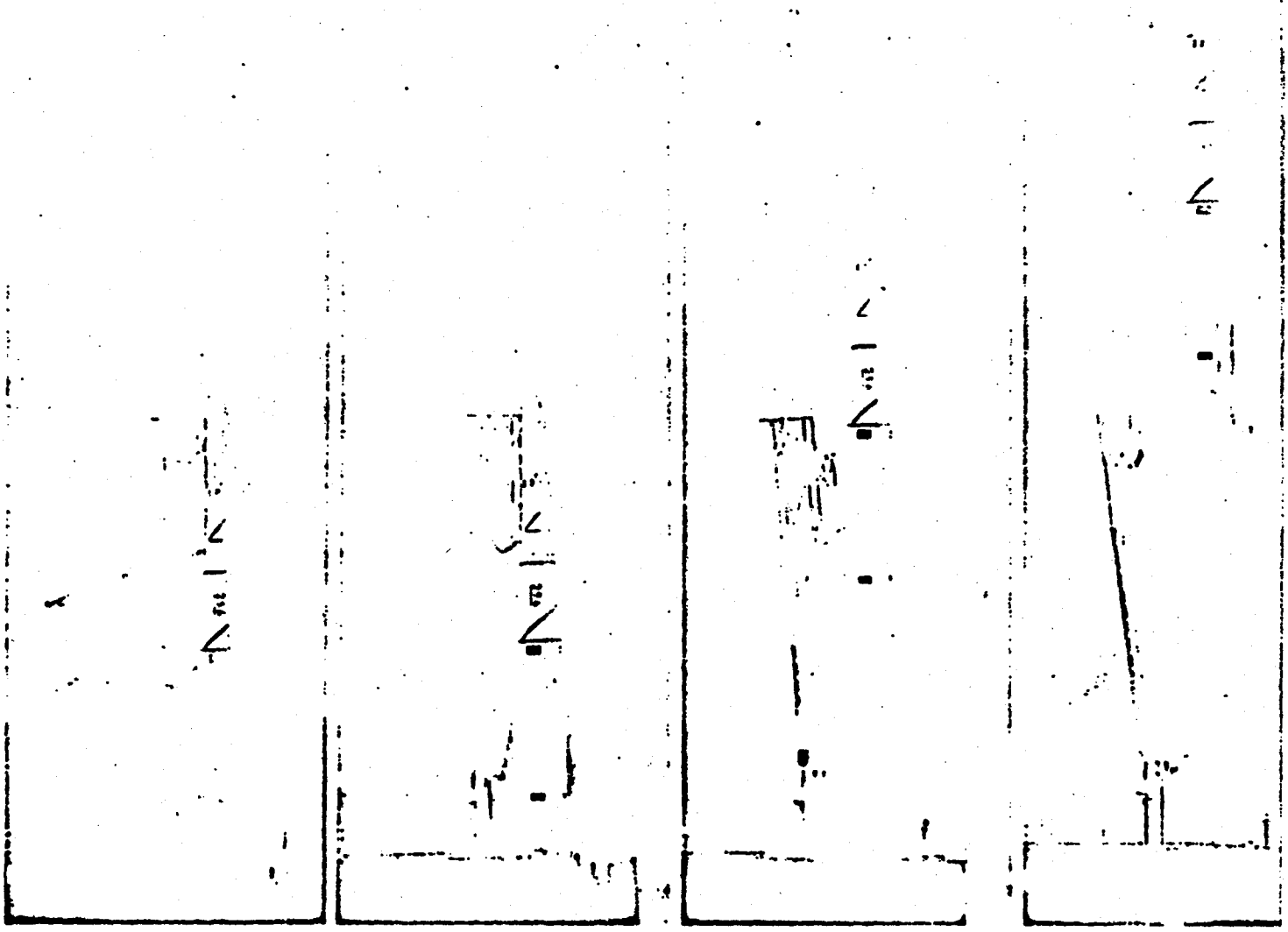
Discoverer I was the first in an "open-end" program to develop a dependable satellite system with the following capabilities:

Launch of earth satellites having on-orbit weights of 1,300 to 1,800 pounds.

Achievement of a high degree of reliability in putting satellites into exactly the desired orbit—low-altitude near-circular polar loops.

Stabilization of the satellites on orbit, re-positioning the vehicles at will, and re-stabilization in any desired attitude with respect to the earth.

A tracking and communications network able to determine precisely the orbital characteristics of satellites, acquiring data from the vehicles and issuing such



commands as are necessary to control future actions.

Separation of parts of the vehicles, the recovery capsules, which could successfully re-enter the atmosphere to be recovered from the sea or snatched in mid-air.

A most ambitious program! As of now, two and one half years later, how well has the Air Force succeeded in reaching the target goals? What is the outlook?

A one-sentence reply answers both questions: the Air Force has exceeded the original aims of the program and has at the same time opened the door to new frontiers in aerospace science. Since *Discoverer I* thundered upward toward its place in history, 20 others have followed it. More will come.

Seeds of an Idea

The *Discoverer* story had its beginning some 13 years before *Discoverer I* was lit-off in 1959, and long before its first-stage booster, the *Thor* IRBM, was an engineer's doodle on a drafting table. It began even some years before Russia's *Sputnik I* announced its orbiting presence with its eerie "beep-beep-beep" signal.

Following recommendations sketched out in a series of studies conducted under Air Force contract by the Rand Corp. in 1946-47, Gen. Hoyt Vandenberg, then Chief of Staff, urged in a 1948 policy letter that: ". . . research and development of a satellite should be pursued as rapidly as the state of the art permits."

Then, as now, the principal aim of the *Discoverer* program was to develop techniques and hardware to place at will and into precise orbit satellites capable of performing a variety of *military* missions. The military value was the first consideration; if other results of general scientific interest emerged, fine.

Early in the program the Air Force recognized that a polar orbiting satellite would produce the most effective military results since the earth, in its east-to-west rotation, would be turning beneath it, displaying itself completely with precise regularity every 24 hours.

An east-to-west, or west-to-east orbit would produce only a very limited military advantage because the satellite would over-fly only a narrow strip of the earth's surface, "seeing" the same ground over and over again. An equatorial orbit, for example, would place the satellite in flight over land that is largely uninhabited;

undeveloped masses of jungle and desert.

It had to be a polar orbit!

But this trick is more easily prescribed than performed. A satellite launch to the east is easiest of all since the launch vehicle gains additional thrust from the earth's rotation; a westward launch results in a loss of escape thrust since the rocket is, in effect, "taking off against the wind."

So it had to be a polar orbit for *Discoverer!*

Faltering Steps

This decided, the next order of business was the creation of the hardware to do what slide rules said *could* be done, and what military necessity said *must* be done to preserve national security.

Men make machines and men direct them to their tasks. Finding the men and welding them into a team fell to Maj. Gen. Bernard A. Schriever, then Air Force Ballistic Missile Division commander, now a lieutenant general and commander of Air Force Systems Command. That he succeeded is a matter of record, scrawled across the heavens by a long series of highly successful missile launches in a variety of programs.

To a trained athlete the stumbling performance of a novice is sometimes amusing; to an uninformed public the groping progress, the abortive starts, and the heartbreaking humiliating failures in the early days of the U. S. aerospace effort were not amusing. Strident voices, often without reason, were quick to utter criticism.

To seasoned engineers the U. S. aerospace progress was no rockier or more hesitant than they expected. Problems that never existed before demanded immediate solution—solutions that more often than not created out of thin air other problems unimagined the day before.

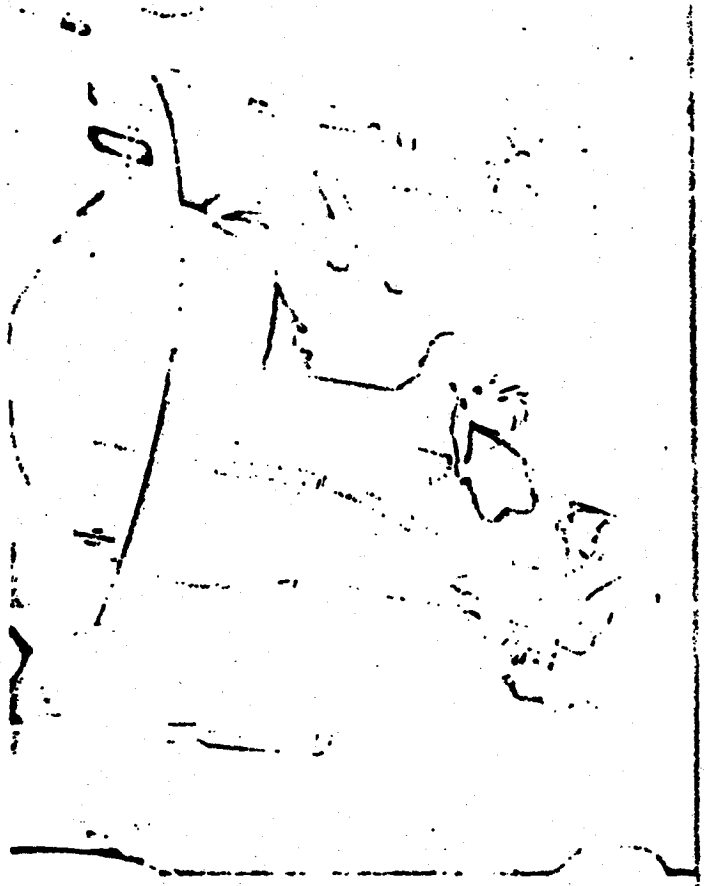
Meanwhile the clock ticked on, the days turned to weeks, to months, to years. Time and operational capabilities—the hardware and the technique—were the unrelenting lash.

Before *Discoverer I* blazed its way to glory a primary, or first-stage, launch vehicle had to be found, and to go with it, a satellite vehicle controllable either from the ground or by pre-set instructions "memorized" on perforated tape.

An Era Gains Momentum

It should be recalled, of course, that *Discoverer I* was by no means the first satellite launched by the U. S. and that missile and space programs were moving forward on several fronts. *Explorer I*, put into orbit February 1, 1958, is still swinging about the earth. A small satellite, weighing only 30 pounds on orbit, this vehicle discovered and reported the Van Allen radiation belt. *Vanguard I*, launched March 17, 1958, to determine the earth's shape more accurately, is not only still in orbit but its solar-powered transmitters still function. Another Methuselah of the missile age is *Vanguard II*, launched February 17, 1959 and still in orbit.

Heavyweight champ, now deceased, was the modified *Atlas* ICBM used in *Project Score*. Launched December 18, 1958, the *Atlas*, minus the half-stage, went into orbit weighing 8,750 pounds, a figure which included a 150-pound communication package. In this experiment a human voice was beamed from outer space for the first time. It was also the first satellite known to have been guided into orbit by a radio-inertial system.



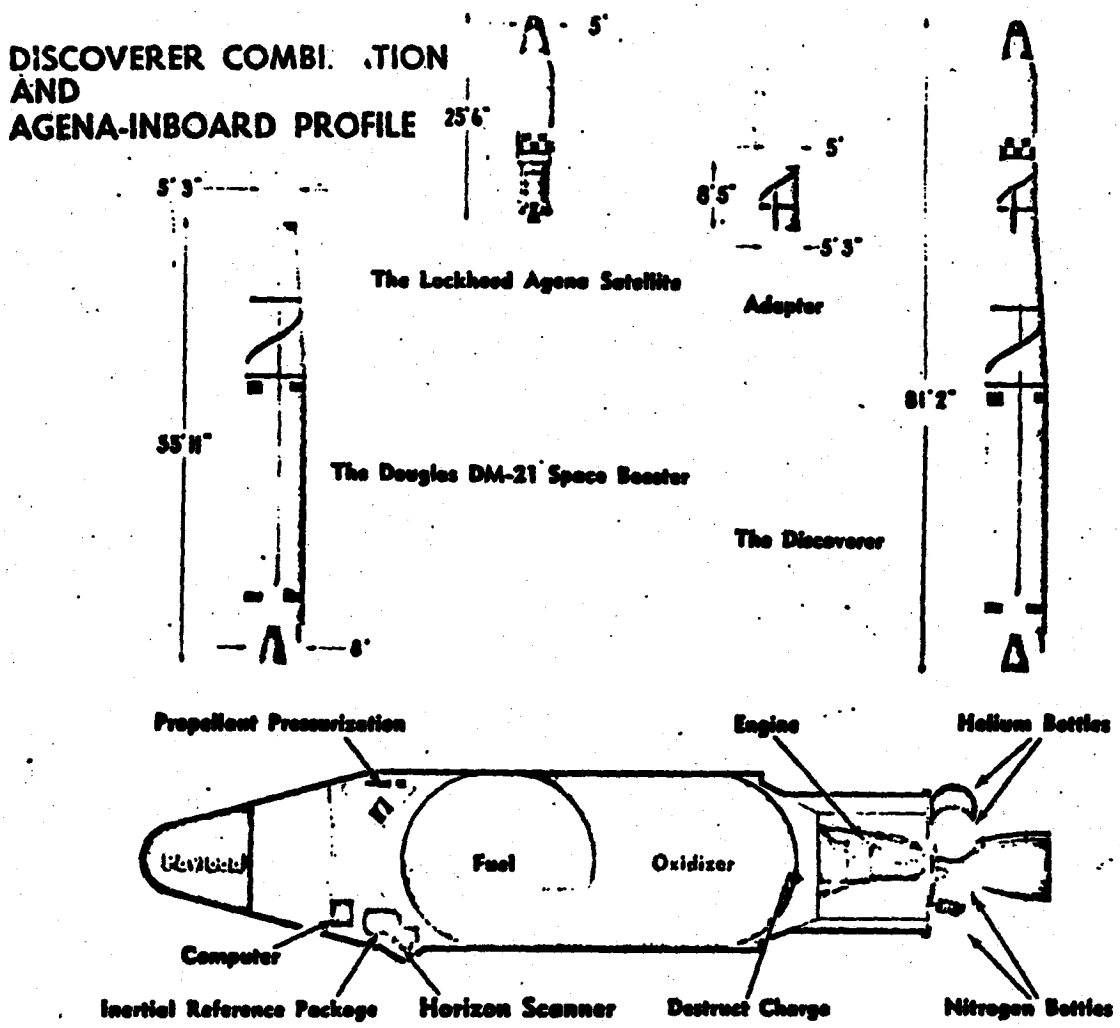
A tense moment! Capt. Donald Jansen checks and rechecks subsystems and components of *Thor-Agena* combination employed in the *Discoverer* program.

Thus hardware and the know-how were gradually accumulating. The search for *Discoverer's* launch vehicle centered on two proven boosters. On hand was *Atlas*, the U. S.'s first intercontinental ballistic missile, a stainless steel giant with a take-off weight of 260,000 pounds propelled by a 360,000-pound-thrust, liquid-engine powerplant.

Simultaneously, *Thor*, almost dainty by comparison with *Atlas*, was striding from drafting table to development shop, to prototype, to captive test, to successful launch. *Thor*, standing 62 feet tall, was 13 feet shorter than *Atlas;* her waist, eight feet in diameter, was two feet narrower; her rated thrust a modest 150,000 pounds, but more than enough to lift her 90,000-pound take-off weight.

Atlas or *Thor*, which would get the nod as the first-stage rocket to put *Discoverer* into orbit?

Thor was picked for the very practical reasons that she was further along in development, having by this time several dozen highly successful shots on her record,



was relatively inexpensive and available in quantity, dependable, and her launch facilities could easily be modified to suit *Discoverer* requirements.

Neither *Atlas* nor *Thor* of themselves had the power to loft a satellite into the precise orbit desired. What was needed was a second-stage vehicle, but not one that was just another simple powerplant. A sophisticated vehicle was required, capable of injecting itself into orbit at just the right instant, turning itself 180 degrees on its yaw axis, and correcting its relationship to the earth. In addition, the vehicle would have to be able to start its own engine, calculate the number of times it orbited the earth, make minor changes in attitude as ordered by self-contained instruments, and fire the retro-rocket that would separate the data package.

Such a vehicle is *Agena*. The name is a happy choice for Agena is also the name of one of the 10 most brilliant stars in the heavens. The celestial Agena is just east of the Southern Cross which marks the location of the celestial south pole, the area at which launch crews must aim to put satellites into polar orbits.

A Discoverer *Comes Home*

One of the more spectacular aspects of the *Discoverer* series is the recovery of a data capsule after the satellite has circumnavigated the earth a given number of times.

Snatching the device in mid-air as its parachute eased it to the sea was the obvious answer. How this air snatch would actually be carried out was not so obvious, but the Air Force got moving on the project almost three years ago with the formation of the 6593rd Test Squadron (Special) of the 6594th Recovery Control Group.

Flying C-119 *Flying Boxcars*, the airborne outfielders crisscrossed the sky trailing their trolling gear in practice snatches for "tame" capsules dropped from high-flying planes. The ponderous twin-boomed cargo planes, never considered aeronautical beauties by even the most partisan admirers, looked even less handsome with the addition of the recovery apparatus.

Two 38-foot poles arranged in a sort of "V" with the apex point forward extend from the gaping mouth of the loading hatch in the rear. A double loop of nylon cable with special grappling hooks stretches across the 15-foot gap between poles to form a trapeze. The nylon cable passes along one of the poles to the plane where an ingenious pay-out and "damping" system smothers the initial shock of snaring the dead-weight of the 300-pound data package.

A power winch is used to bring the capsule aboard the aircraft.

In practice sessions aircrews tallied a 95 percent score in air-snatch techniques. But this was with "tame"

capsules dropped from plane.. .hich were not literally flying out of this world. How would the technique work in snaring a capsule hurled from a carrier rocketing along at 18,000 miles per hour? Try it and find out, was the only answer.

Irony was to take a hand in the first recovery of a *Discoverer* capsule. On August 11, 1960, Capt. Harold E. Mitchell, flying with a crew of eight out of Hickam AFB, Hawaii, picked up a signal from *Discoverer XIII*. It was headed for his patrol area. Poor reception made setting an intercept course impossible; an assist was asked from a nearby radar control plane. Unfortunately, something went wrong and by the time Mitchell reflew his route the capsule was observed bobbing in the sea. A Navy crew recovered it.

Galling as this was to Mitchell and his crew, his sense of frustration was mild compared to that of another Air Force officer, the man who had sweated out 12 previous launches at the Test Controller's console in the Air Force Satellite Test Center, 140 miles north of the launch site at Vandenberg. Col. Charles G. "Moose" Mathison saw eight of the first 12 *Discoverers* go into orbit. He was now hovering over the launch of the 13th, having obtained permission to preside over "just one more" before moving to higher headquarters and new responsibilities.

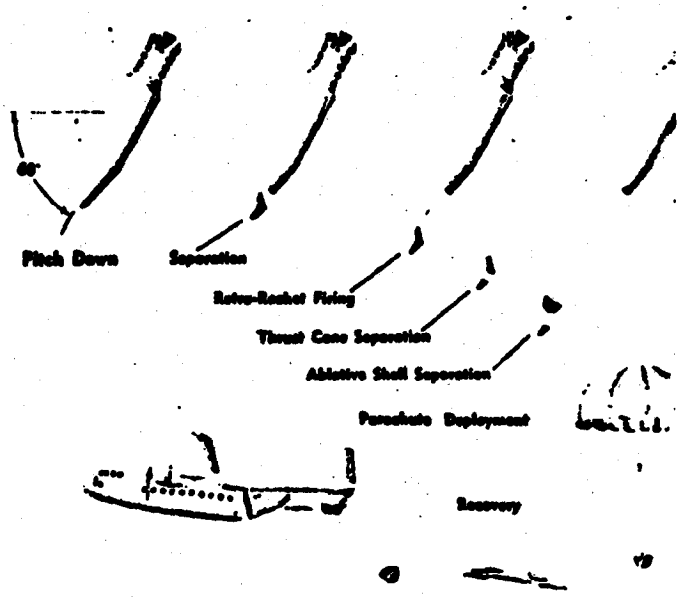
Six of the eight orbited satellites ejected capsules. One landed near Spitzbergen, Norway; two failed to emit radio signals announcing their whereabouts; two overshot the patrol area by several hundred miles. None had been recovered.

Immediately after presiding over the launch of *Discoverer XIII* at 1:30 p.m., p.d.t., August 10, "Moose" hustled to a waiting C-130 and winged off to Hickam, flying the four-engine turbo-prop transport himself part of the way. He was determined to see that this one did not get away.

When it was certain the capsule had survived the searing temperatures generated on re-entry, Colonel Mathison rustled up an SA-16 *Albatross* amphibian from the Air Rescue Service to have a look for himself after being told it was in the water. Advised that the Navy had recovered the capsule Mathison returned to Hickam but his eagerness to get his hands on the first *Discoverer* capsule to be recovered put him back in the air again, this time in a helicopter that deposited him aboard the recovery vessel. Claiming the capsule, he loaded it aboard the helicopter, along with the Navy men credited with the actual sea recovery, and returned to Hawaii.

Discoverer XIII is now on exhibit in the Smithsonian Institution, Washington, D. C. An interesting sidelight marked the try before "Lucky 13." *Thor* No. 160, the cranky booster that was to have launched the *Discoverer* series but fizzled on the pad, had been rebuilt and scheduled for another try. Her designation? *Discoverer XII*. Launched June 29, 10 days before *Discoverer XIII*, she got off the ground this time but burned up shortly thereafter on re-entering the atmosphere when she failed to achieve orbit. For having twice missed a

ORBIT EJECTION AND RECOVERY



niche in Air Force history *Thor* No. 160 slipped into the archives by a back door—often a bridesmaid but never a bride.

At Last

For a week Captain Mitchell contemplated the vagaries of fate. But for a navigational error not of his making he and his crew might very well have been the first to snatch a data capsule in mid-air. Was he to lose his chance forever? Were his two years of training to be added to his already well-stocked fund of experience?

Fate cast a wan smile toward Captain Mitchell when *Discoverer XIV* roared from its pad at Vandenberg at 3:15 p.m., e.d.t., August 18 and went into orbit as planned. This would give Mitchell and his crew another shot at "fielding" its capsule—but the "playing field" was to be an enormous rectangle, 600 miles north-south, 60 miles east-west. Thirty-six thousand square miles of water. He would not patrol it all, of course, and when he received his assigned sector, Mitchell realized that Fate was not through playing games with him. His 8,000-square-mile patch of sky and water was 400 miles from the expected impact area.

As if this were not enough his crew chief, TSgt. Lou Bannick, brought him the dolorous news that a cylinder on No. 1 engine would have to be replaced. With *Discoverer XIV* already in orbit could the engine be put back in running order in time for Mitchell to be on station? Mitchell slept uneasily that night as the ground crew struggled with the engine. The crew delivered the goods and when final briefing took place the next morning at 7:30 Captain Mitchell and his crew got their orders.

There would be 10 C-119 recovery craft in the grid,

Skilled AF paramedics, with full Scuba gear, . . .

plus one C-130, a much faster plane with a higher cruise altitude. In addition there would be four control planes fitted with powerful radar, seven planes with telemetry receiving gear, and two Navy ships with helicopters and frogmen aboard if a water recovery was indicated.

"Pelican" was the code name assigned to the 10 recovery planes, with Mitchell's plane being dubbed Pelican Nine. By the time Mitchell and the others took off at 9:10 for their station *Discoverer XIV's* 1,700-pound satellite was solidly in orbit with its 300-pound re-entry capsule. Once every 94.5 minutes it circled the earth at 17,658 m.p.h. swinging out in an apogee of 502 miles and in on a perigee of 116 miles.

Pelican Nine droned toward its patrol area at 250 m.p.h. *Discoverer XIV Agena* was performing perfectly, correcting a slight tumbling tendency. Capsule ejection was set for the 17th pass over Alaska.

The tenseness aloft was matched in the windowless Satellite Test Center at Sunnyvale, Calif., where men of Col. Alvan N. Moore's 6594th Test Wing (Satellite), along with high-ranking Air Force officers and scientists, were keeping a close vigil on *Discoverer XIV*. Information from tracking stations at Vandenberg, Point Mugu, on ocean vessels, in Alaska and New Hampshire, and the island of Oahu in Hawaii, cascaded into STC by instantaneous voice lines as well as teletype. Inclement weather over the recovery area might make a postponement necessary, for example. All was well. *Discoverer XIV* would eject its capsule on the 17th pass as planned.

Fate was fond of Mitchell again. The capsule ejected, but it was overshooting its intended impact area and heading for Pelican Nine, now cruising at about 16,000 feet. With Captain Mitchell were Capt. Raymond Apaka, copilot; 1st Lt. Robert Counts, navigator; TSgt. Lou Bannick, recovery team chief; SSgt. Arthur Hurst, flight engineer; SSgt. Algaene Harmon, A1C George Donahou, A2C Lester Beale Jr., and A2C Daniel Hill, all of the recovery crew. SSgt. Wendell King, photographer, rounded out the crew.

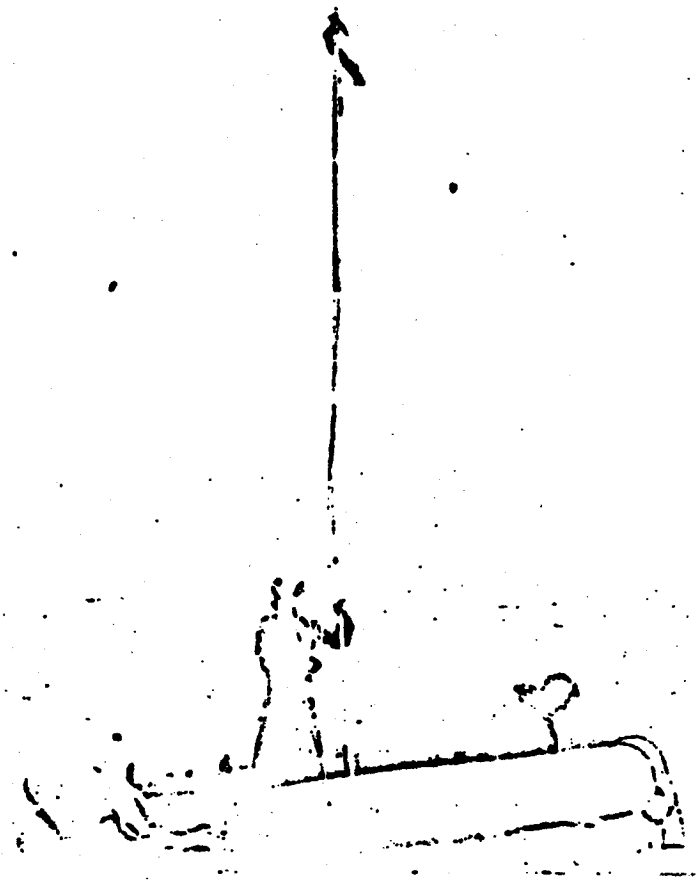
At precisely the right time aboard the Agena satellite vehicle, explosive bolts and springs separated the re-entry capsule from the vehicle. Its parachute opened a few moments later and with it the automatic radio beacon put the capsule "on the air." The load began to sink at about 1,600 feet per minute.

Minutes afterward the crew of Pelican Nine sighted the brilliant orange and white canopy of the capsule. More than two years of training would now meet the test.

Pelican Nine's recovery gear was ready, the crew at positions. More than 600 feet of heavy nylon line was reeled tightly about the recovery winch; the trapeze trailed its grappling hooks from a kind of cat's cradle. All that remained was to swoop down on the parachute that lay dead ahead. Easier said than done.

It took three passes, each one lower, as the ocean rushed up to meet the capsule before Mitchell felt the slight tug that signaled success. In the rear of the plane hundreds of feet of line played out from its nesting place before the winch took up the load. The hooks

. . . will jump after data capsules that may miss the "flying trapeze" to land in the ocean below.



were set, and good. The capsule, having shed its re-entry heat-shield and retro-rocket when the 'chute snapped open, was slowly "landed" aboard Pelican Nine, cruising thousands of feet above the Pacific.

Two more *Discoverers* were launched before Capt. Gene W. Jones, flying in Pelican Two, snatched *Discoverer XVII* on November 14 after its re-entry on its 31st pass in a two-day flight. Three weeks later, on December 7, Jones and the crew of Pelican Two played a repeat performance when they took *Discoverer XVIII* out of circulation after its 48th trip around the globe. The three catches put to rout the critics' cry that the air-snatch scheme was just a stunt.

Scientific Knowledge Accrues

While the *Discoverer* series remains true to its original concept to devise and explore techniques leading to a dependable satellite system, other scientific investigations and experiments have been integrated into the program.

Discoverer II, launched April 13, 1959, carried emulsion packages to measure radiation, and an environmental package equipped to measure and report on internal conditions for possible life-support. The data capsule was lost when it was ejected prematurely over Spitzenberg. *Discoverer II* was the first satellite to carry a recoverable instrument packet.

Discoverer III vanished without a trace soon after its launch June 3, 1959, carrying with it four black mice, plus radiation and environmental research devices.

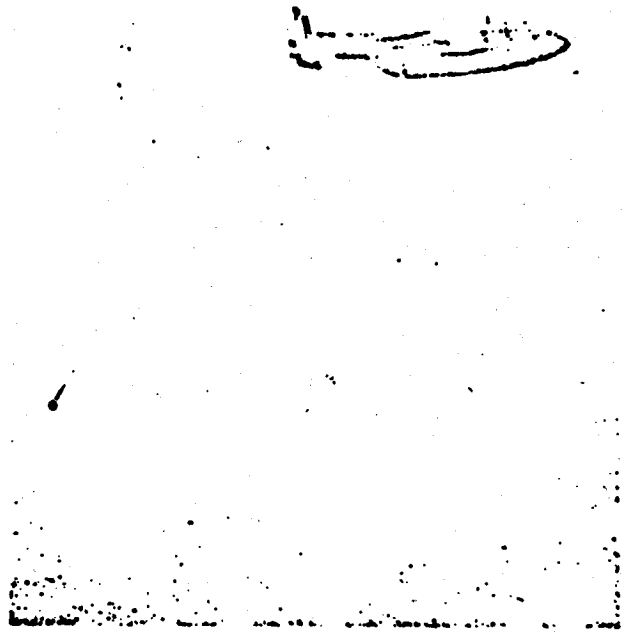
Discoverer XVIII, the third capsule snatched in mid-air, contained a wide assortment of physical and biological test materials. Included were algae, bone marrow, membrane from the underside of cyclid, gamma globulin, spores, gold foil, analine powder, and other material for a variety of medical and technical experiments.

Of great concern to Air Force officer-scientists who look to inter-stellar travel as something inevitable is the effect of cosmic radiation on human beings, and by extension, on other living things. Cosmic rays are particles smaller than atoms traveling with speed approaching the velocity of light. Since these are actually solid particles of matter they can be compared with ultra-microscopically small bullets.

Can these infinitesimal particles cause structural damage to the body? Could they produce mutations? Does the body have a tolerance on exposure to these rays? Or, are they completely harmless?

Mice exposed to cosmic radiation during high balloon flights have experienced hair color changes. But, they suffered no other apparent physical damage. One Air Force authority suggested the rays are harmless, that no shielding is necessary. Let the rays pass through, he says. The experiments go on.

The strange-sounding assortment of specimens listed above are not an arbitrary selection of odds and ends which happened to be lying about, convenient to the scientists. Each was selected after considerable study.



Mid-air catch of data capsule is no grandstand stunt, but is actually the most efficient way for recovering the instrument-filled container.

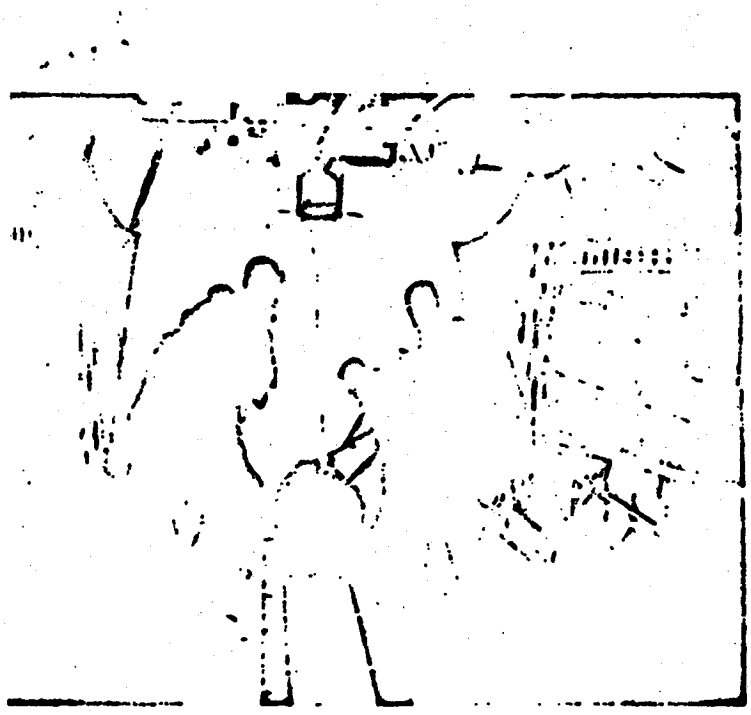
The spores were included because of their light weight, rapid growth, ready availability, and because a great deal is already known about their behavior under a variety of conditions. Seeds are sometimes included for the same reason. Each substance had to pass a rigid set of standards before going into the biophysics packet.

The *Discoverer* experiments, currently expected to last to the end of this year, have contributed immensely to technical aerospace lore. AFSC officer-engineers, working in close cooperation with their counterparts in industry, are already far along the road when they will have a dependable "screwdriver with a 300-mile handle" to make adjustments in satellites in orbit. Plans are afoot to enable ground-bound technicians to make a variety of repairs in orbiting bodies. The satellites themselves are being gimmicked to make simple repairs such as switching to alternate circuits when malfunction or expiration of the normal life of a unit requires the change.

With the precise polar orbit all but unfailingly within their grasp, AFSC scientists are talking of removing ineffectual satellites from orbit and replacing them, in exactly the same spot, with new ones.

Discoverer XXI, the latest in the series, demonstrated how close complete remote control of orbiting satellites is. Launched February 18, 1961, this satellite went in orbit as planned—and then changed orbit with a programmed restart of its *Agena-B* engine. While *Agena-Bs* have been in use since *Discoverer XVI* was launched October 26, 1960, this was the first attempt at a restart.

The frontiers of space are slowly giving way to the *Discoverer*.



Gotcha! Data capsule of *Discoverer XIV*, first to be recovered in mid-air, is hauled aboard C-119 after completing 17 orbital passes around the earth.

This gold-plated sphere contains a wealth of scientific information gathered as it whirled thousands of miles in orbit around the earth.

RIDING ATOP A *Thor* IRBM, the *Agena* goes into a coasting phase immediately after *Thor* burns out and explosive bolts separate it from the booster. During this period a pneumatic control system is activated. Compressed gas is metered through a series of external jets to position the vehicle. Initially, a programmer signals the pneumatic control system what to do. The vehicle begins to move in its pitch axis to a position which will be as close as possible to the local horizontal when it reaches orbital injection altitude. The infrared sensor carried aboard *Agena* "looks" for the horizon and sends corrections to the central system refining the programming actions.

During this crucial period ground tracking stations constantly monitor the vehicle on radar to measure velocity. Although ignition of *Agena's* 15,000-pound-thrust, liquid-rocket engine also is programmed, the ground station can compare actual velocity and position with the nominal and send radio commands to the programmer, advancing or retarding the moment of ignition. Once the ignition adjustment is made, an accelerometer in *Agena* measures the velocity gained and signals engine cutoff at precisely the right instant.

When the engine fires, the pneumatic control system is deactivated and a hydraulic system takes over. Guided by instructions from the infrared horizon sensor the hydraulic control linkage makes fine adjustments by gimballing the engine so that *Agena* is injected into orbit at just the right instant, the right place, the right altitude, the right velocity, and the right angle to provide the orbit desired.

In the two years the *Discoverer* program has been in existence the *Agena* vehicle has grown in size, weight, and complexity. The first *Agena-A* measured 19.5 feet in length, weighed 1,300 pounds on orbit, and carried no equipment for stabilization, reorientation, or capsule recovery.

Discoverer XVI saw the introduction of *Agena-B*, a sophisticated bird 26.5 feet tall with a weight of about 2,100 pounds on orbit. As the program moved ahead the thrust of *Thor* was increased from 152,000 to 167,000 pounds and that of *Agena* from 15,600 to 16,000. These power increases represent no great engineering changes in powerplants, but were achieved through weight reduction and the use of more efficient fuel. In the *Discoverer XX* flight, February 17, *Thor* was shortened about 10 feet by elimination of the unused guidance computer compartment with significant weight reduction. Additional thrust was gained by the use of a new fuel, RJ-1, which is slightly denser than the standard kerosene base rocket propellant.

DISCOVERER XIV

LAUNCHING VEHICLE

Same as Discoverer I, page 23.

GENERAL SHAPE, WEIGHT, AND DIMENSIONS OF SPACECRAFT

Same as Discoverer II, page 25, except that total weight was 1700 pounds. 300 pounds of which was the complete re-entry vehicle.

SPACECRAFT PAYLOAD

Similar to Discoverer XIII, page 31, except that an additional 10-pound tracking experiment was carried for Navy's Transit program.

TEST RESULTS

The first air recovery of an object from space, the 84-pound Discoverer XIV capsule, was accomplished on August 19, 1960, one day after launch from Vandenberg AFB in a polar orbit. The retrieval was made by an Air Force C-119 Flying Boxcar at an altitude of 8500 feet, 390 miles southwest of Hawaii. All beacons and telemetry operated as planned.

PARTICIPANTS

Same as Discoverer I, page 24.

The Discoverer XIV Re-entry Capsule, first man-made object recovered from orbit by air-snatch. An Air Force plane hooked its parachute in descent. This view shows some of the instruments that determined re-entry conditions and other valuable information.

DISCOVERER XIII

LAUNCHING VEHICLE

Same as Discoverer I, page 23, with a gross liftoff weight of more than 108,000 pounds.

GENERAL SHAPE, WEIGHT, AND DIMENSIONS OF SPACECRAFT

Same as Discoverer II, page 25, except that total weight was 1700 pounds, 300 pounds of which was the complete re-entry vehicle.

SPACECRAFT PAYLOAD

Similar to previous Discoverers. The cylindrical Agena A stage carried a telemetry system, tape recorder for storing telemetry data, receivers for command signals from a ground station, a horizon scanner for improving the accuracy of the radio command guidance in pitch and roll, and a separable capsule, best known as the recovery capsule. This 120-pound capsule had a configuration resembling a bowl 33 inches in diameter and 27 inches in depth. A conical afterbody extended from the flat area, increasing the total length to about 40 inches. The forward surface was covered by a heat-protective ablative shield until re-entry was completed; then the shield was jettisoned. A Thiokol retrorocket, mounted at the end of the afterbody, decelerated the capsule out of orbit. A smoke signal and two stroboscopic lights were attached to the 30-pound recovery parachute. A 100-pound monitoring system in the capsule reported on selected events, such as firing of retrorocket, jettisoning of heat shield, and others. These events were also recorded because of several minutes of radio blackout during re-entry.

TEST RESULTS

Discoverer XIII lifted off its launch stand at Vandenberg AFB on August 10, 1960, into a polar orbit inclined 82°51' from the equator. During the 17th pass, 27 hours after launch (August 11), a timing device initiated the recovery sequence. This time everything functioned as planned, and the capsule was picked up from the water, very close to the planned splash area 300 miles northwest of Hawaii. The monitor system and telemetered data brought back a large fund of valuable information.

PARTICIPANTS

Same as Discoverer I, page 24.

The DISCOVERER XIV capsule on display is the first item to be ejected by a satellite orbiting in space and to be recovered in mid-air. DISCOVERER XIV was launched into a polar orbit by a THOR booster from Vandenberg Air Force Base, California at 12:57 P.M. on 18 August 1960. After the THOR had exhausted its fuel, the AGENA atop the THOR separated from it. The AGENA's engine then ignited to increase the satellite's speed to 17,658 miles per hour, thereby achieving an orbit of 116 miles above the earth at the low point (perigee) and 502 miles at the high point (apogee). As the AGENA streaked southward through space high over Alaska on its 17th pass around the earth, it ejected the capsule from its nose. Retrorockets attached to the capsule then fired to decrease its speed and the capsule began descending in a long arc towards the earth. After the capsule entered the atmosphere, it released a parachute and floated earthward. The descending parachute was sighted by the crew of the C-119 recovery airplane 360 miles southwest of Honolulu, Hawaii. On the third pass of the C-119 over the parachute and its precious capsule, the recovery gear trailing behind the airplane successfully snagged the parachute canopy.

A winch operator aboard the C-119 then reeled in the DISCOVERER XIV capsule after its 27 hour, 450,000 mile journey thru space.

~~TOP SECRET~~

HANDLE VIA
BYEMAN
CONTROL SYSTEM

~~(S)~~ NATIONAL RECONNAISSANCE OFFICE [redacted]
WASHINGTON, D.C.

THE NRO STAFF

July 30, 1974

NOTE FOR GENERAL KULPA

SUBJECT: CORONA Film

We have been trying to obtain some film clips of Thor (Discoverer/CORONA) failures to be used in the movie the CIA is preparing. AVVS had set aside some film clips for review by an Agency employee traveling under DOD cover. The trip fell through when it was discovered he had not obtained cover and his exposure became a distinct possibility. We cannot send another Agency man out there. We on the Staff cannot preview the films and make the selection out there. It is not appropriate to task SAFSP or SAMSO to make the selection.

Our only alternative is to ask AVVS to send the films here whereupon we will forward them to the Agency. Apparently an internal AVVS policy precludes sending out repository films. However, they did agree to send the films then reneged.

The message at the right should serve to start the films moving our way. Recommend that you sign the message.

KEITH S. PEYTON
Captain, USAF

HANDLE VIA
BYEMAN
CONTROL SYSTEM

CLASSIFIED BY BYEMAN - 1 EXEMPT FROM GENERAL DECLASSIFICATION SCHEDULE OF EXECUTIVE ORDER 11652 EXEMPTION CATEGORY 5B2 DECLASSIFY ON IMP DET.

~~TOP SECRET~~

CONTROL NO Internal
COPY ____ OF ____ COPIES
PAGE 1 OF 1 PAGES

[redacted]

PRIORITY ROUTINE ● Rec'd SS-1 1 Aug 7[redacted]

SUBJECT: (TWX) Request for Films of Thor Launch Failures

PLUMMER: SIGNATURE
CONCURRENCE
INFORMATION

KULPA: SIGNATURE
COORDINATION
ACTION
INFORMATION

TYPED OR PRINTED NAME, GRADE AND ORGANIZ.	TO: (Responsible Officer)	ORG. SY	NO.	DATE ITEM(S) TO BE RETURNED	
STOCK NO.	DESCRIPTION		UNIT	QUANTITY ISSUED	COST
USAF # 29208	Color film, Launches of Discoverer XV, XVI, XVII - ~~CONFIDENTIAL~~ Reel 1		1	1	
USAF # 33263	B/W film, Aerials of Discoverer X Launch - ~~CONFIDENTIAL~~ Reel 1		1	1	
USAF # 34224	Color film, Thor Intermediate Range Progress - UNCLASSIFIED Reel 1		1	1	
SFP # 1028	Color Film, Optical Instrumentation at VAFB California - UNCLASSIFIED Reel 1		1	1	
	//////////NOTHING FOLLOWS//////////////				

I ACKNOWLEDGE RECEIPT AND RESPONSIBILITY FOR ITEM(S) SHOWN IN "QUANTITY ISSUED" COLUMN, WHICH WILL BE RETURNED ON DATE SPECIFIED ABOVE.

DATE	[redacted]	PHONE	ISSUED BY
Aug 20, 74			8/20/74

AF FORM SEP 70 1297 TEMPORARY ISSUE RECEIPT ☆ GPO: 1972—447-550

[redacted]

HIS-8-7 Sw

UNCLASSIFIF

71 01 2041924 PP PP UUUU 2375 231924Z JUL 74

SAF/SS

HQ AVVS NORTON AFB CALIF

UNCLAS

[redacted]

PER TELEPHONE CONVERSATION, REQUEST YOU SEND TO SAFSS, ATTN: CAPT PEYTON, FOR OUR REVIEW STOCKED FOOTAGES OR WHATEVER IS AVAILABLE ON EARLY THOR (DISCOVERER) LAUNCH FAILURES. THE MATERIAL WILL BE REVIEWED HERE AND SELECTED PORTIONS WILL BE IDENTIFIED TO YOU. THE INTENT IS TO USE THIS MATERIAL IN A FILM THE CLASSIFICATION OF WHICH WILL BE AT LEAST DOD SECRET.

WOULD APPRECIATE YOUR ASSISTANCE.

(2)

KEITH S. PEYTON, CAPT, USAF 52594
ASST DEP DIR FOR PLANS & POLICY

HAROLD S. COYLE, LT COL USAF

Harold S. Coyle

UNCLASSIFIED

HIS-B-7 Stu

UNCLAS EFTO

01 01 1841908RR RR EEEE 2044 031908Z JUL 74

CSAF

HQ AAVS NORTON AFB CALIF

ORIGINATOR COPY

UNCLAS E F T O

[redacted]

REF MSG FRM SAFSS, 141914Z MAY 74.

UNDERSTAND THAT YOU SELECTED AND SET ASIDE ABOUT SIXTEEN DIFFERENT STOCKED FOOTAGES OF EARLY THOR LAUNCHES FOR REVIEW [redacted] WAS UNABLE TO MAKE THE VISIT TO YOUR FACILITY WE WOULD APPRECIATE YOU FORWARDING THOSE FILMS TO THIS OFFICE, SAFSS, PENTAGON. POINT OF CONTACT AT SAFSS IS CAPTAIN KEITH S. PEYTON, TELEPHONE 695-2594. WOULD APPRECIATE YOUR ASSISTANCE. MANY THANKS.

SAFSS - 3

KEITH S. PEYTON, CAPTAIN, USAF
SAFSS, 52594, 25 June 1974

KEITH S. PEYTON, CAPTAIN, USAF

Keith S. Peyton Lt

UNCLAS EFTO

HIS-B-7 Shv

PRIORITY

DCA11 MS6555 PAGE 01 218 0036 SUSDUPE

18

054788

ACTION: NONE-00.
INFO: SAFSS-1

PTTUZFDY RUCIMAA4704 2172114 MTMS-UUUU--RUEFHQA.
ZNR UUUUU ZFD RUCIMAA
P R 052045Z AUG 74
FM MAC SCOTT AFB ILL/XPPV
TO RUWJABA/AAVS [redacted]
INFO RUEFHQA/OSAF/SAFSS/WASH DC
BT
UNCLAS
REF: SAFSS MSG 022006Z AUG 74 AND TELECONS, 3 AUG 74, BETWEEN AAVS/CC AND MAC/XPPV CONCERNING SAFSS REQUEST FOR RELEASE OF 16 DIFFERENT STOCKED FOOTAGES OF EARLY THOR (DISCOVERED) LAUNCH FAILURES TO BE FORWARDED TO SAFSS FOR REVIEW. IT WAS AGREED THAT MAC'S DESIRE IS TO PROVIDE SAFSS WITH WHATEVER IS REQUIRED. MAC RECOMMENDS FOOTAGE OF OTHER 15 THOR LAUNCH FAILURE SEQUENCES ONLY BE PROVIDED AS EXPEDITIOUSLY AS POSSIBLE. SUGGEST AAVS VERBALLY CONTACT SAFSS [redacted] TO DISCUSS REQUIREMENT. PLEASE ADVISE THIS HEADQUARTERS OF SATISFACTORY COMPLETION OF REQUEST.
BT
#4744
PTCUZFDY RUCIMAA4704 2172114 0021-UUUU 2180036 N

PRIORITY

SS-5 (Capt Peyton)

HIS-B 7 Sec B

DE DE 2142006 RR RR UUUU 1450 022006Z AUG 74

FM OSAF/SAFSS

TO MAC,CC, SCOTT AFB

INFO HQ AVVS, CC [redacted]

UNCLAS

REFERENCE SAFSS MSG 141914Z MAY 74.

SAFSS MSG 211924Z JUL 74.

THE TWO REFERENCED MESSAGES SENT TO HQ AVVS ASKED FOR SIXTEEN DIFFERENT STOCKED FOOTAGES OF EARLY THOR (DISCOVERED) LAUNCH FAILURES TO BE FORWARDED TO SAFSS FOR REVIEW. THIS IS IN CONJUNCTION WITH A PROJECT HAVING THE PERSONAL INTEREST AND SUPPORT OF THE UNDER SECRETARY OF THE AIR FORCE. TO DATE ONE FILM HAS ARRIVED. IT WAS REVIEWED AND FOUND UNSUITABLE. THE OTHER FILMS HAVE NOT BEEN RECEIVED. WE WOULD APPRECIATE YOUR GOOD OFFICES IN EXPEDITING THE RELEASE OF THESE FILMS TO SAFSS.

[redacted]

16

DEPARTMENT OF THE AIR FORCE
HEADQUARTERS AEROSPACE AUDIO-VISUAL SERVICE (MAC)
NORTON AIR FORCE BASE, CALIFORNIA 92409

REPLY TO ATTN OF: DOSDV [redacted] 22 August 1974

SUBJECT: **Delinquent Return of Loaned Material**

TO: SAF/SS
Room 4 C 1000
Pentagon
Washington DC 20330 Attn: Capt K. S. Peyton

1. **The following motion picture film was forwarded to you on a loan basis and has not been returned as of this date:**

ID NO.	SIZE	MEDIA	REEL NO.	DATE OF SHIPMENT
USAF-34224	16mm	Comp	1	25 July 74

2. **Request the above listed motion picture film be returned to Hq AAVS (DOSDV), Norton AFB, California 92409, marked "RETURN OF LOAN", Project No.** 74/E-1007 .

3. **Your cooperation is solicited in order that this organization may expedite to you and our customers our service upon request.**

B. M. MCKEWEN
Deputy Director of Services

WES Van

REPRODUCTION REQUEST

Please supply 16 MM master positives of the following films:

" THOR INTERMEDITATE RANGE PROGRESS REPORT # 4 "
USAF 34224,
from 000 to 036 ft.
438 to 475 ft.
690 to 750 ft.

✓ USAF 29208, reel 1 of 1, print all the reel.

" PHOTOGRAPHY IN THE AIR FORCE "
✓ SFP 1028, color comp. print, print all the reel.

USAF 33263, color 35MM, silent. Print all the reel.

The 16 MM master pos. should have the same emulsion position as original ECO, 7252.

Thanks

Roy Banks

H12-B-7 Sm

DEPARTMENT OF THE AIR FORCE
WASHINGTON 20330

OFFICE OF THE SECRETARY

16 September 1974

MEMORANDUM FOR HQS AEROSPACE AUDIO-VISUAL SERVICE (DOSDV)

SUBJECT: Return of Loaned Material

The four films which this office has received on loan from your organization, are being returned to you with the following request for duplication. Please send the reproduced material to this office in care of Captain Peyton. The films are:

USAF-34224 - please reproduce the following footages: from 0 to 36 feet, from 438 to 475 feet, from 690 to 750 feet. This film report has been identified as being declassified; however, it is the opinion of this office that the material contained in the film still requires classification at the SECRET XGDS-3 level. Request you make the necessary change in classification on this film.

USAF-29208 - please reproduce the entire reel.

SFP-1028 - please reproduce the entire reel.

USAF-33263 (35 mm) - please reproduce this in color size 16 mm film.

For the above reprint request, please supply 16 mm master positives having the same emulsion position as original ECO, 7252. We appreciate the assistance your organization has provided in this project.

Keith S Peyton

KEITH S. PEYTON
Captain, USAF
Assistant Deputy Director
for Plans and Policy
Office of Space Systems

Astronautics - Satellites - Discoverer XV

Film Only - Confidential ~~SECRET~~

USAF 29208. LAUNCHINGS OF DISCOVERER XV, XVI AND XVII, VANDENBERG AFB, CALIFORNIA, 13 SEPTEMBER, 26 OCTOBER AND 12 NOVEMBER 1960.

1 reel,16mm,color,silent,unedited,592 feet,quality: Good (Basic: Mas color)

Documentary coverage of Discoverer XV, XVI and XVII launches, including scenes of prelaunch activities; animation depicting comparison of Agena A and Agena B; Discoverer's orbiting path and recovery of Discoverer XVII capsule by C-119. (Photo'd by Aerospace Corp)

Scenes of prelaunch activities and a man in bucket of crane near gantry.

54' LS from stationary camera showing lift-off of Thor-Agena A (Discoverer XV), 13 September 1960.

135' Stationary and tracking camera footage of Thor-Agena A (Discoverer XV), launch and programmed climb. (Fair).

211' MLS & MS pan left to Agena A and Agena B on carts at consoles in hangar.

232' Animation showing the comparison of sizes of Agena A and Agena B.

241' MS of Agena B (Discoverer XVI) in horizontal position as transport trailer is removed.

252' LS stationary camera showing Thor-Agena B (Discoverer XVI) lift-off. 26 October 1960.

274' High-speed and tracking camera footage of Thor-Agena B programmed climb showing main engine burnout -- second stage failed to separate.

380' Tracking and high-speed camera footage of Thor-Agena B (Discoverer XVII) launch and programmed climb and a short clip of prelaunch activites. 12 November 1960.

USAF MOTION PICTURE FILM DEPOSITORY [redacted] Film only ~~Confidential~~ ~~SECRET~~

Guided Missiles - US- Thor-Agena -Malfunctions Film Only - Confidential-3 ~~SECRET~~

USAF 33263. AERIALS OF DISCOVERER X LAUNCH, VANDENBERG AFB, CALIFORNIA, 19 FEBRUARY 1960.

1 reel,35mm,color,silent,unedited,206 feet,quality: Fair (Basic: Orig color)

(Photo'd by 1369th)

Aerial coverage of Thor-Agena/Discoverer X launch and programmed flight -- Thor-Agena fishtails during flight showing engine gimbaling from side to side.

THE END

Ribbon only Confidential-3 ~~SECRET~~

USAF MOTION PICTURE FILM DEPOSITORY CARD 1 OF 1

Thor Agena A&B

DISCOVERER	DATE		
1	28 F 59	orbit	
2	13 Apr 59	orbit	
3	3 Jun 59	no orbit	
4	25 Jun 59	no orbit	
5	13 aug 59	orbit	
6	19 aug 59	orbit	
7	7 nov 59	orbit	
8	20 nov 59	orbit	
9	4 Feb 60	first stage malfunction	
10	19 Feb 60	" " "	
11	15 apr 60	orbit	
12	29 Jun 60	second stage malfunction	
13	10 aug 60	orbit	
14	18 aug 60	orbit	
15	13 Sep 60	orbit	
16	26 oct 60	first and second stage failed to separate	
17	12 nov 60	~~orbit~~	
18	7 Dec 60	orbit	
19	20 Dec 60	orbit	
20	17 Feb 61	orbit	
21	18 Feb 61	orbit	
22	30 mar 61	second stage malfunction	
23	8 apr 61	orbit	
24	8 June 61	second stage malfunction	
25	16 June 61	orbit	
26	7 July 61	orbit	
27	21 July 61	malfunction	
28	3 aug 61	second stage malfunction	orbit
29	30 aug 61	orbit	
30	12 Sep 61	orbit	
31	17 Sep 61	orbit	
32	13 oct 61	orbit	
33	23 oct 61	first stage malfunction	27 Feb 62
34	5 nov 61	orbit	
35	15 nov 61	orbit	
36	12 Dec 61	orbit	
37	13 Jan 62	second stage malfunction	38