



Geog 126: Maps in Science and Society

Mapping Denied Territory: Secret Maps of the Cold War

Fall of Berlin in May 1945



Post war Europe

- Soviet Union occupied Bulgaria, Romania, Hungary, Poland and eastern Germany.
- Great Britain, the United States, France, and the Soviet Union divided Germany and Berlin into four occupation zones to be administered by the four countries

Occupation Zones in Germany 1945



The Iron Curtain

- Prime Minister Winston Churchill
- “From Stettin in the Baltic to Trieste in the Adriatic, an iron curtain has descended across the continent.”
- Berlin Airlift (1945-48)



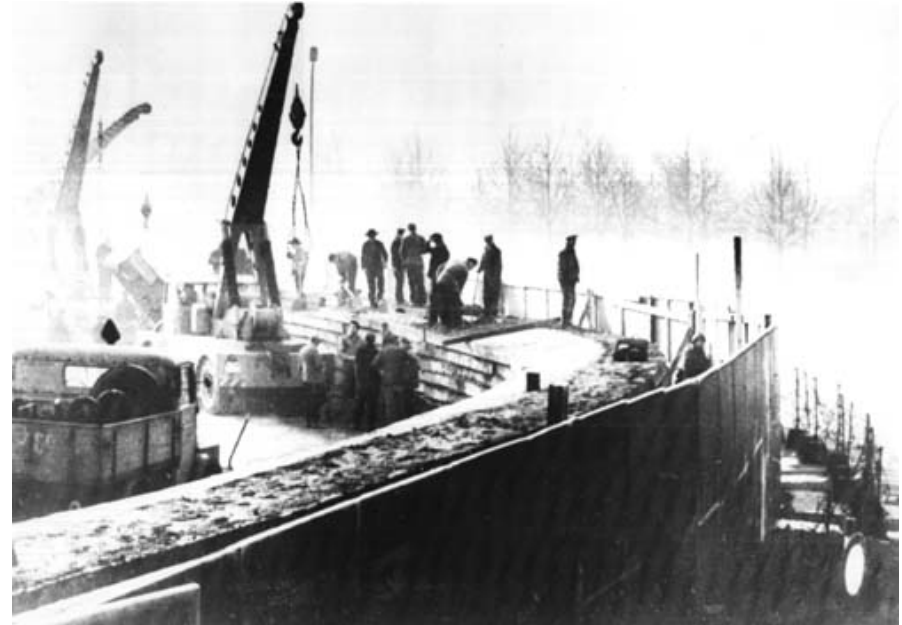
The Cold War Context

- Soviet post war expansionism: Hungary 1956
- Rise of nuclear weapons (Hydrogen bomb 1952)
- Berlin Wall 1961
- Denied territory
- “Open Skies” proposal via UN
- Khrushchev (1956) "We will bury you!" (Russian: "Мы вас похороним!")
- SAC moved to 24/7, Bomber then Missile Gap
- Culminates in Cuban Missile Crisis 1963

Berlin Wall 1961-1989

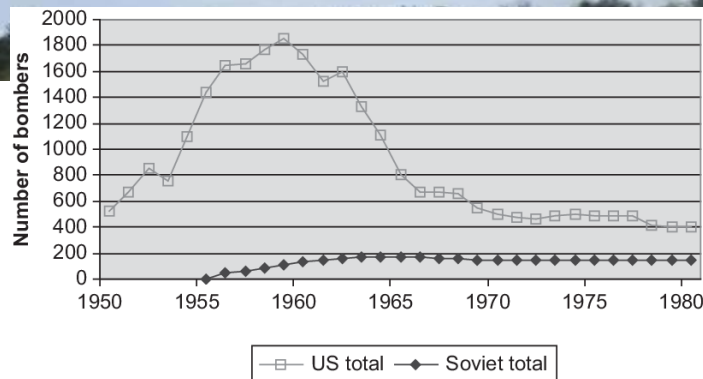


The Berlin Wall (1961-89)

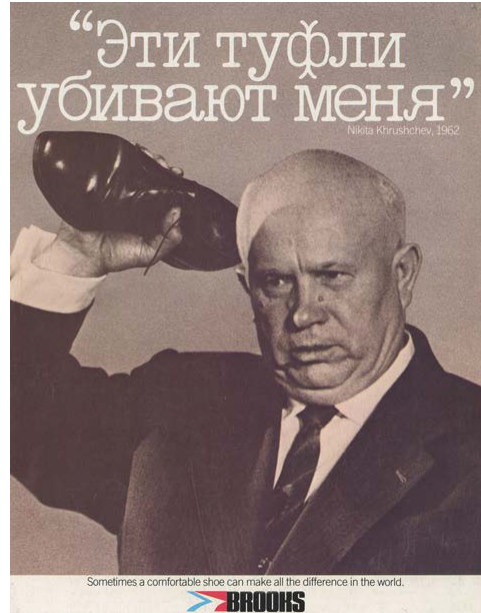
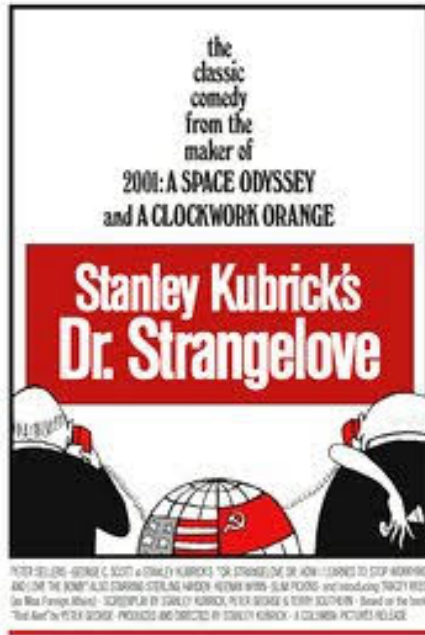


The Bomber Gap

B-52 and Tupolev Tu-95



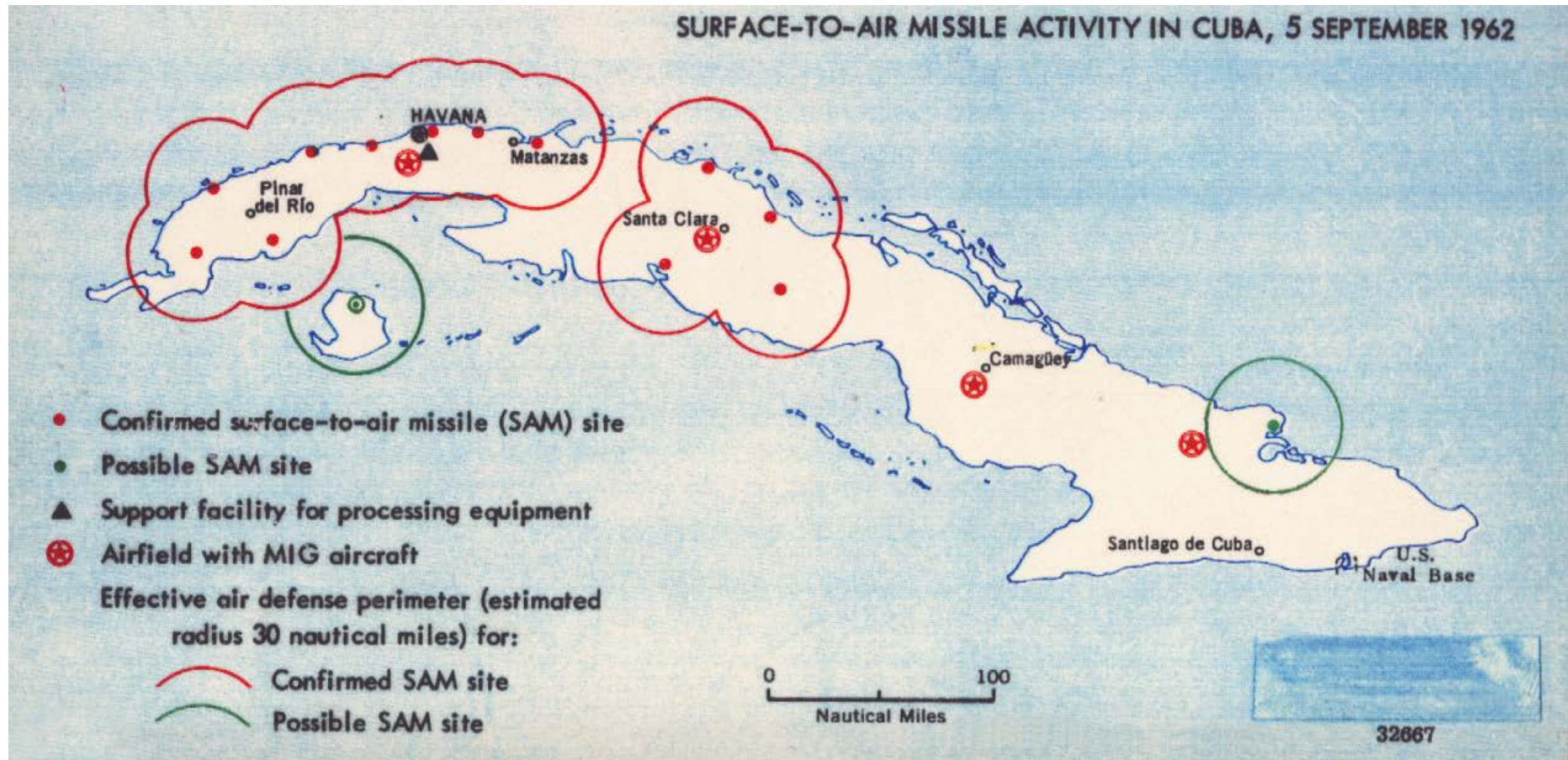
The Cold War



The 1962 Missile Crisis



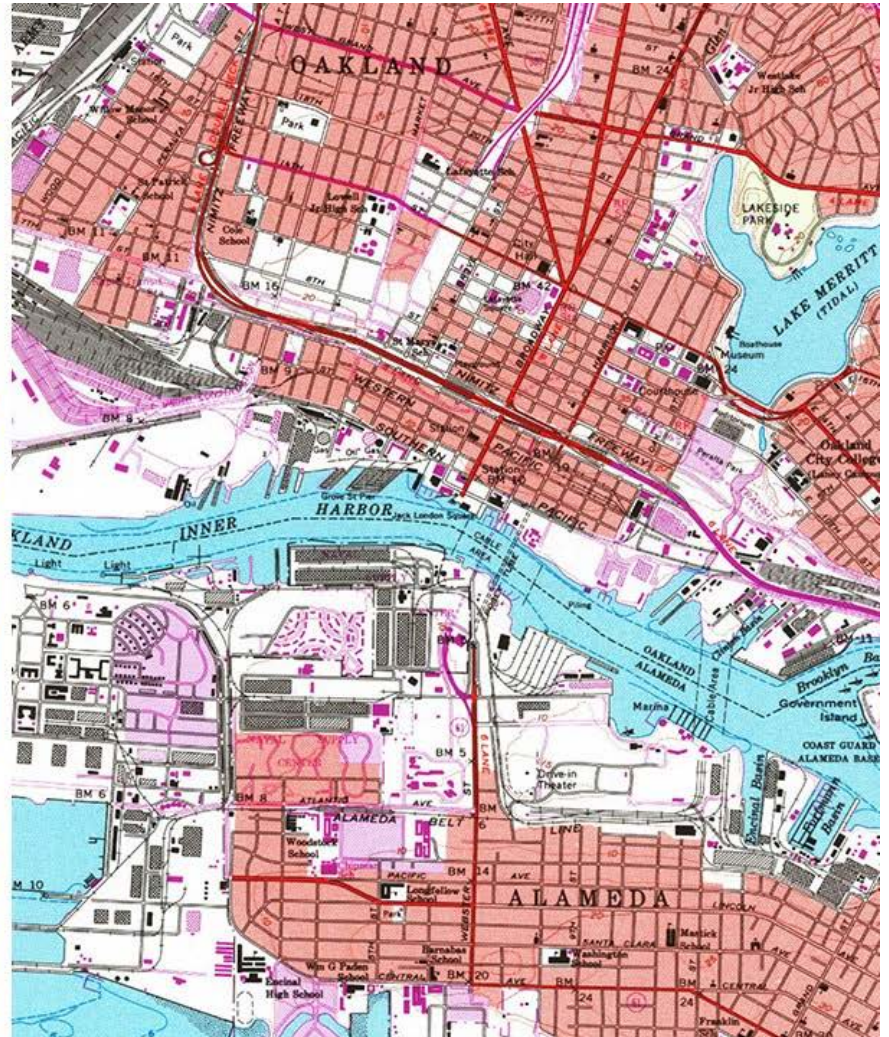
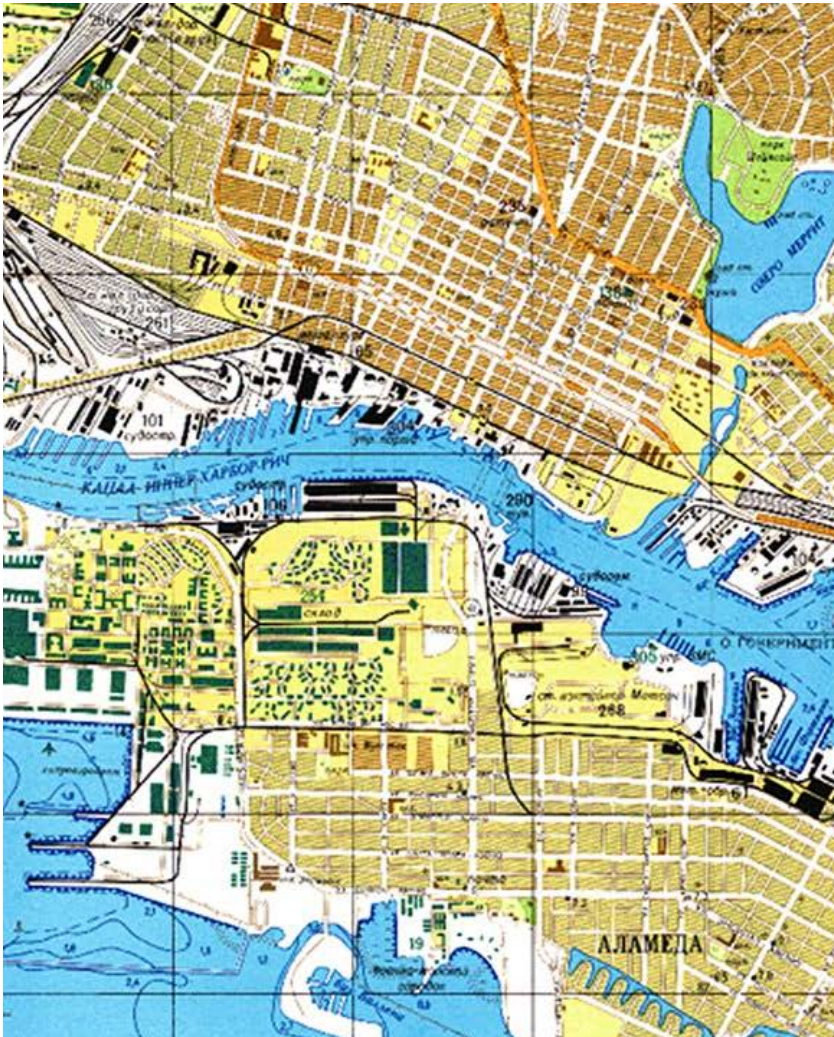
SURFACE-TO-AIR MISSILE ACTIVITY IN CUBA, 5 SEPTEMBER 1962



The Need for Maps

- US committed to Open Source mapping, free availability
- All of Russia, especially Asian part “Denied Territory”
- Russian and Soviet maps rare and inaccurate, subject to Maskirovka
- Need to locate targets, but also wide surveillance of strategic assets

Soviet Invasion Maps: Highly Detailed



Genetrix

- WS-119L program to launch surveillance balloons over Communist China, Eastern Europe and the Soviet Union
- Cover story was weather balloons
- Altitudes of 50,000–100,000' Jan and Feb 1956, 516 balloons launched from 5 different launch sites
- Recovery by air capture
- 54 were recovered but only 31 provided usable photographs
- Used first generation Itek panoramic camera



Early Talent-Keyhole

U2 Incident May 1, 1960

BUT Corona's first mission only 6 weeks later



Secure Compartmentalized Information

- Project code words in UPPER CASE
- TALENT: All imagery and intelligence from aircraft, included U-2, SR-71 and low altitude oblique
- KEYHOLE: All space-based reconnaissance
- Eventually space based got its own agency, the NRO

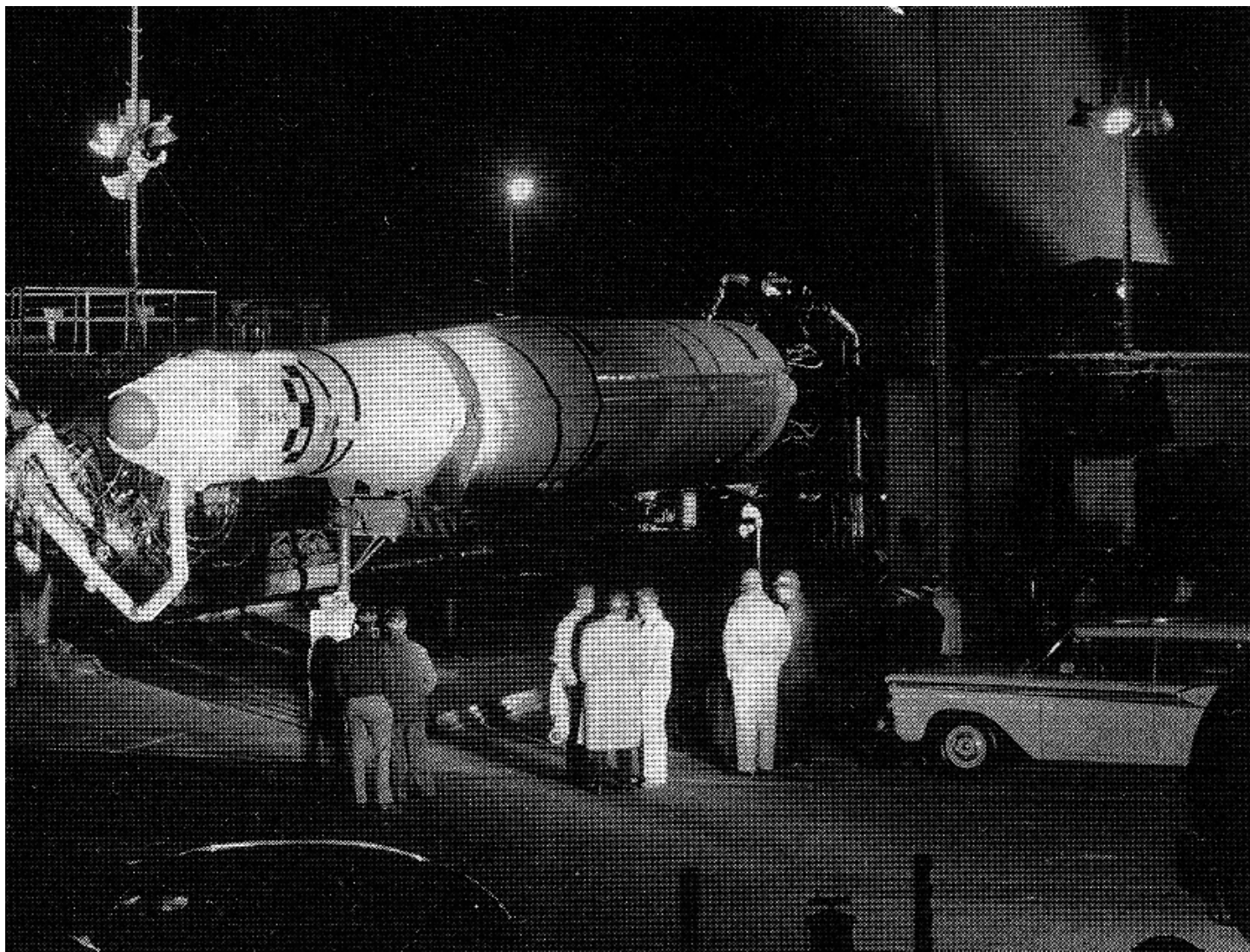
How CORONA worked

- The Space Segment: Thor/Atlas/Agena
- The Payload: Itek cameras, film return, aerial recovery
- Camera series: Keyhole, Argon, Lanyard Films: spectral suites, spatial coverage, resolutions etc.
- CORONA's overlapping successors: SAMOS, GAMBIT (KH-7 41 missions, KH-8 53 mission), HEXAGON (KH-9 20 missions, 1971-86), DORIAN (KH-10) MOL, KENNAN/CRYSTAL (9 missions 1976-88)

CORONA:Space Segment

- Cover story (Discoverer)
- Thor/Agena
- KH-4 lift required THORAD
- Film Recovery system
- Failure history

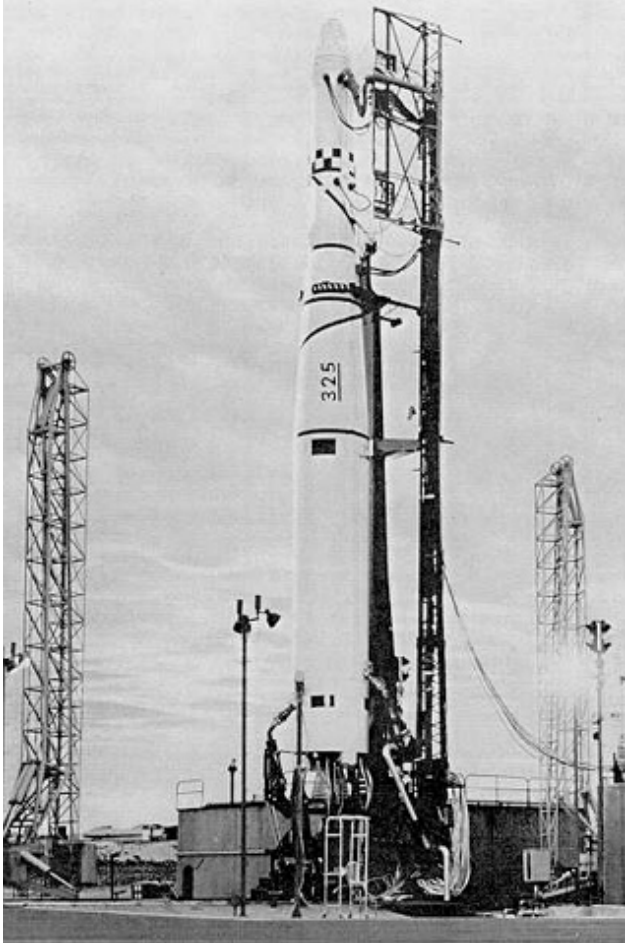
Discoverer at Vandenberg



A Point in Time (1972)



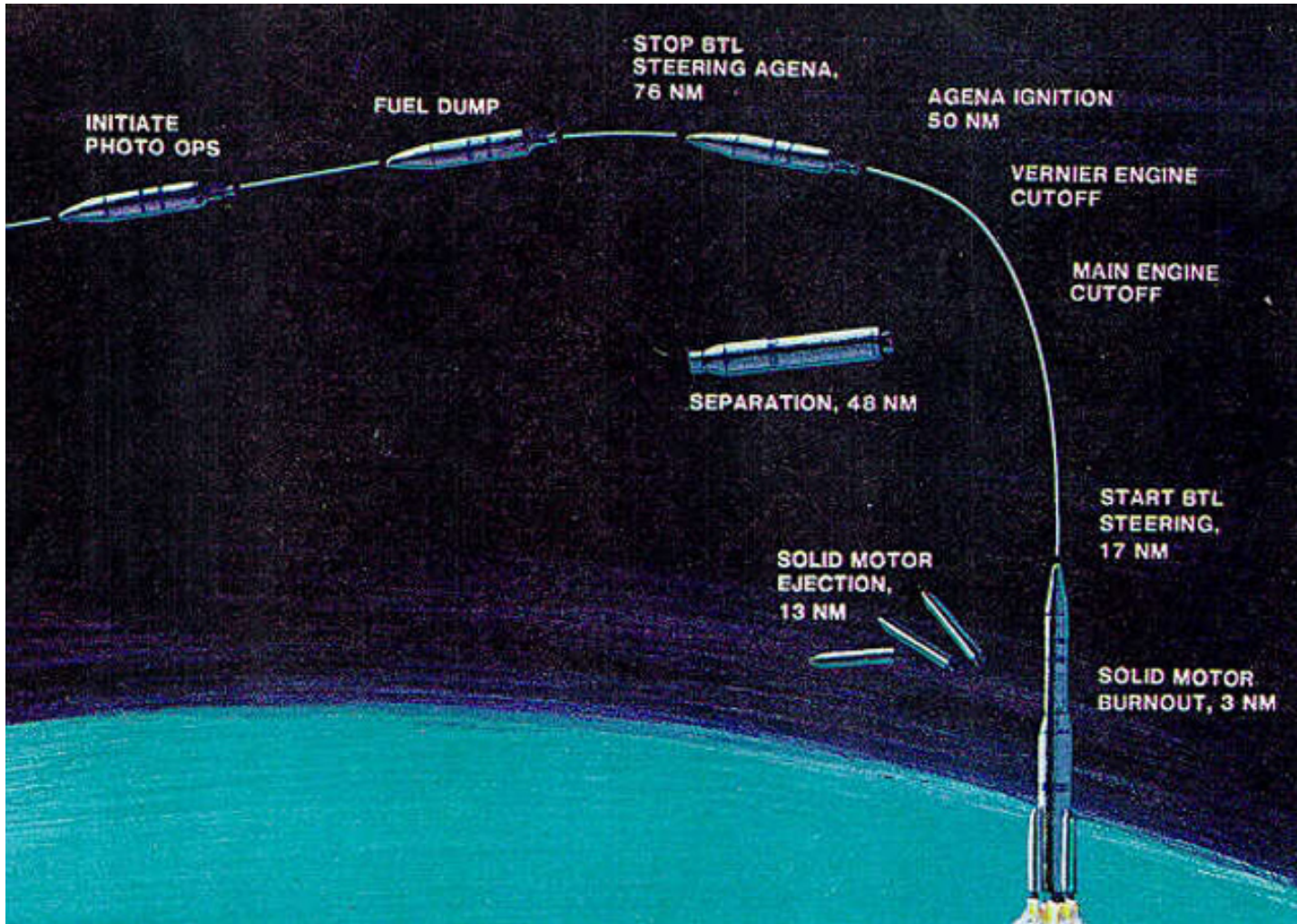
Launch: Vandenberg AFB



Thor launch pad



Launch sequence



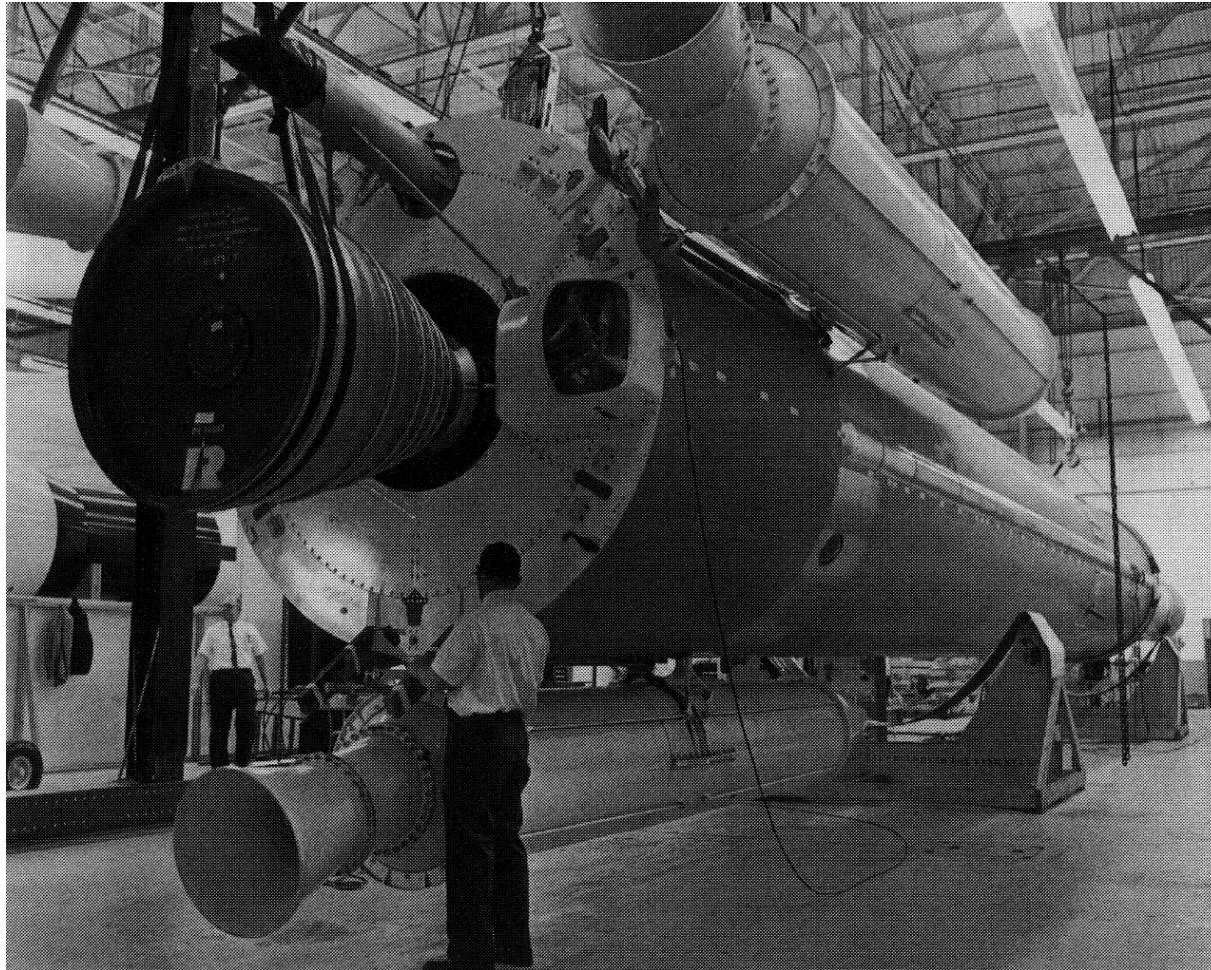
Thirteen failures



Unanticipated Circumstances

- “We were all operating in those days in a field in which we didn’t really believe it could be done, we were just going to try.” John Wolfe, Itek camera program manager (A Point in Time)
- “Overnight, we went from famine to feast” Richard M. Bissell, Jr.
- “By 1965, the rate of success was phenomenal. On the average three or four recoveries were made every month. The seven years of frustration and effort were paying off.” (A Point in Time)

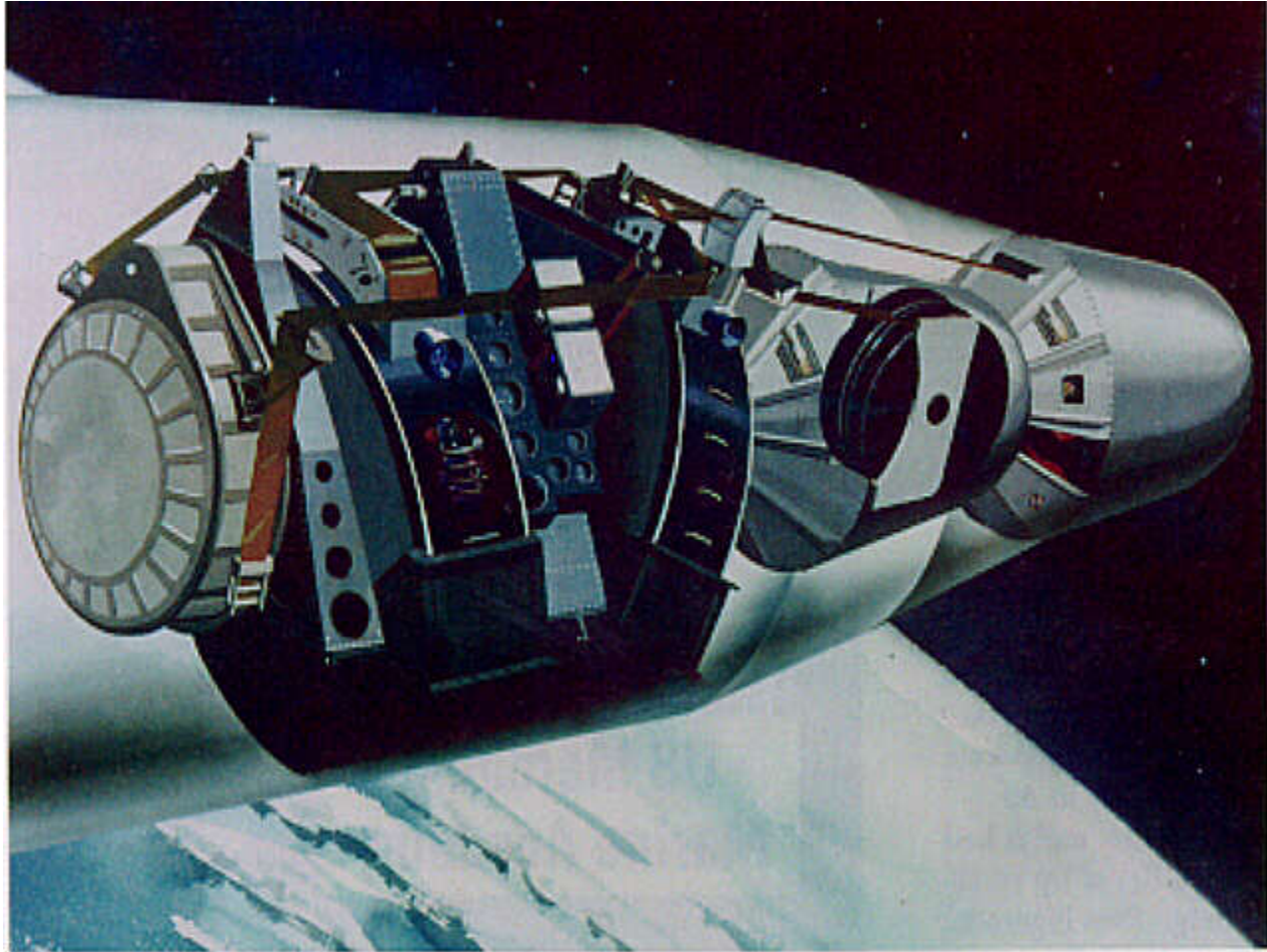
Thorad in Production

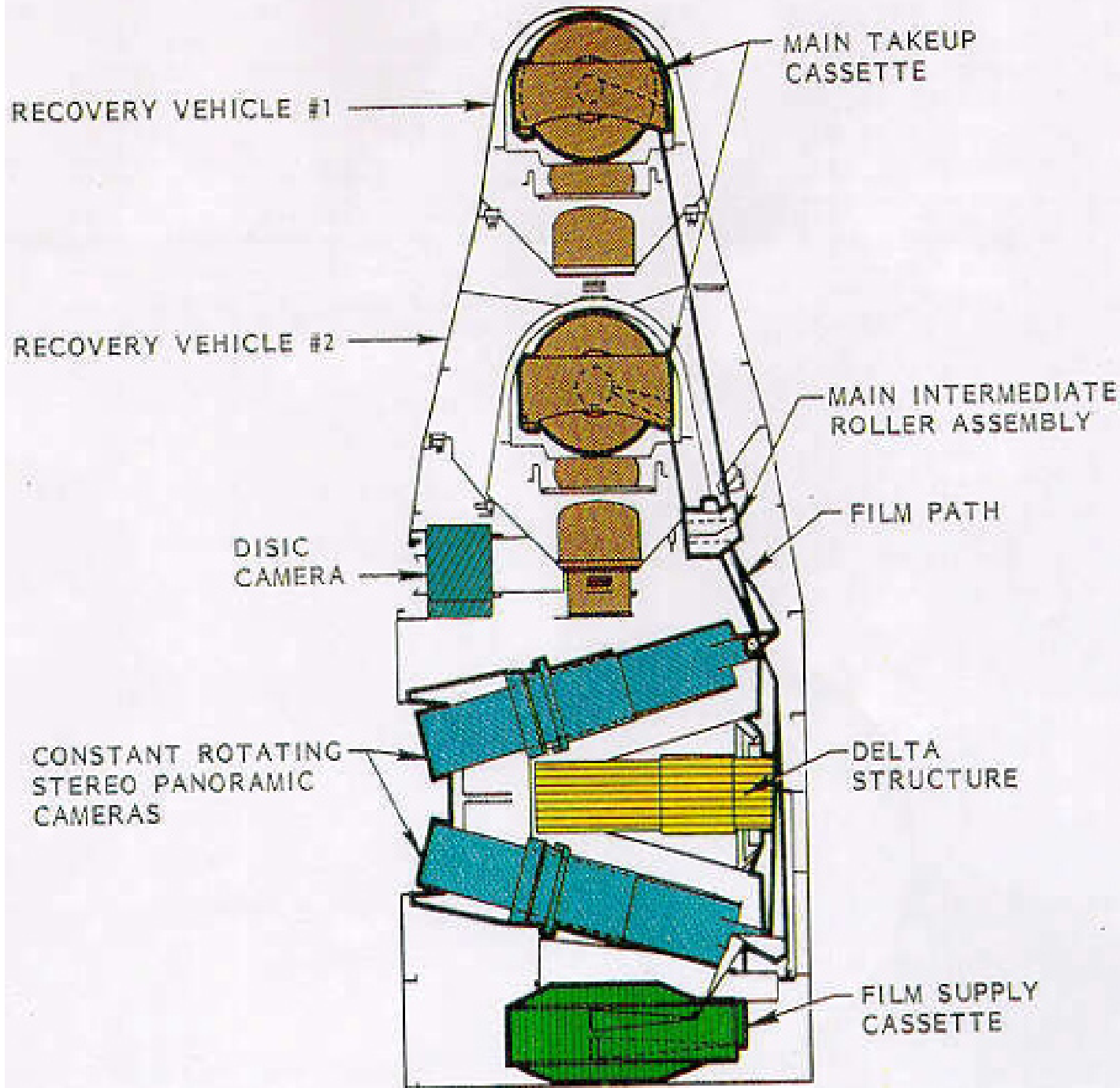


Thorad/Agena

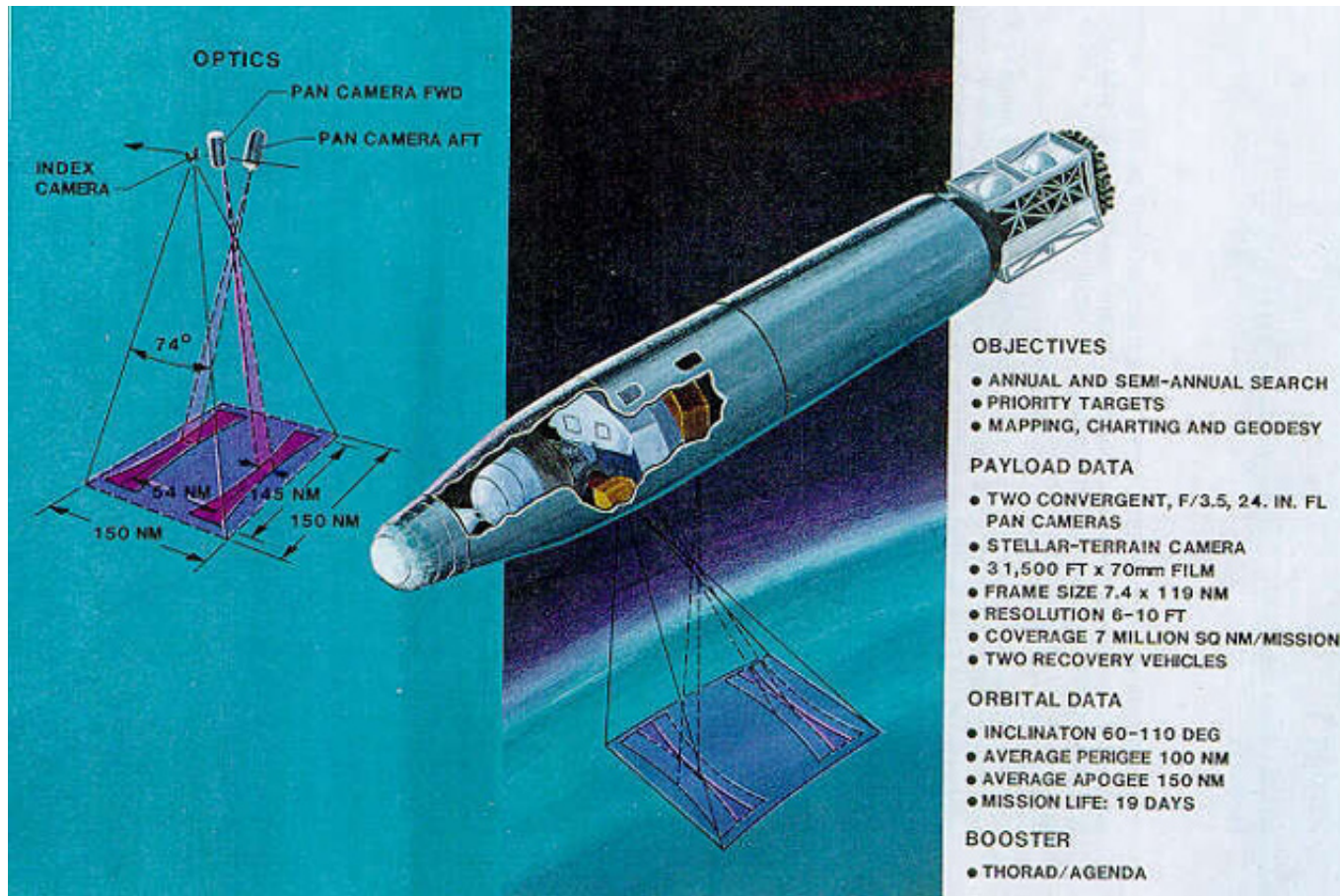


Operational schematic

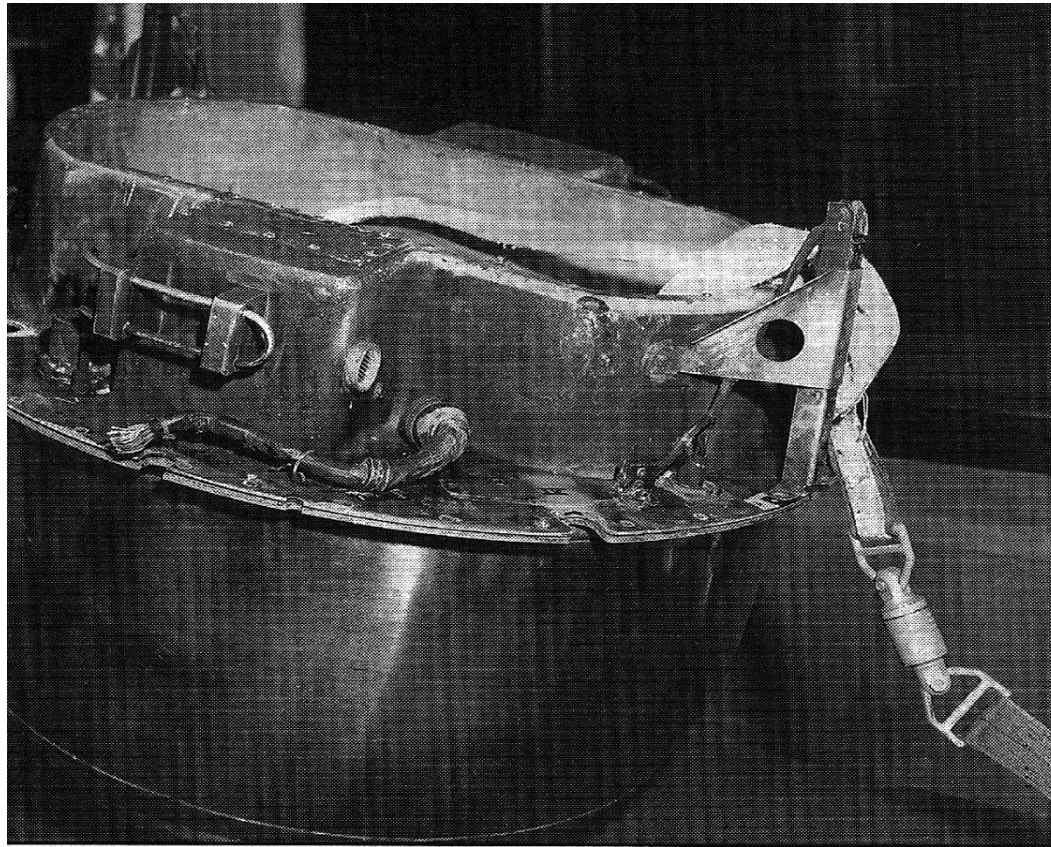




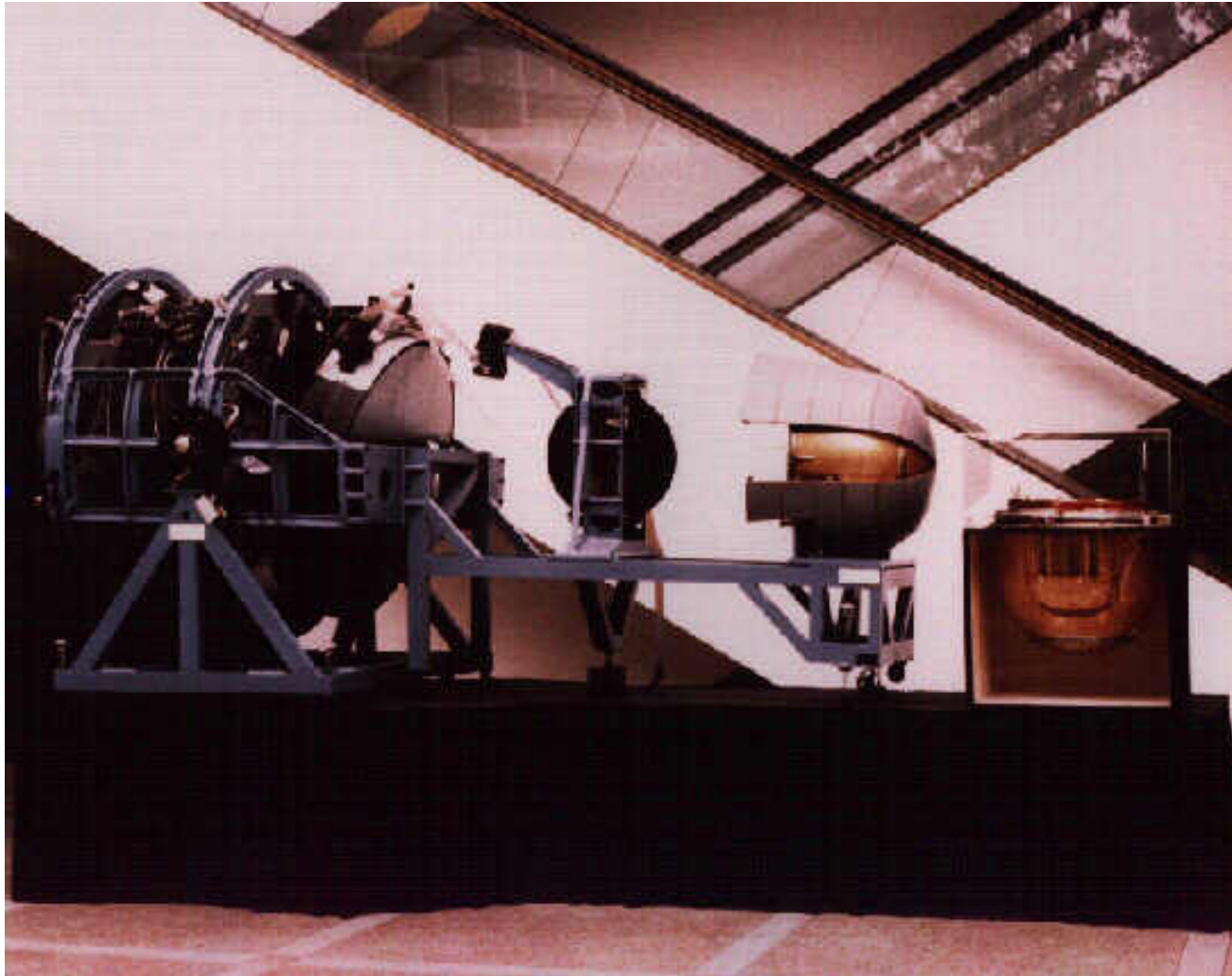
Operations



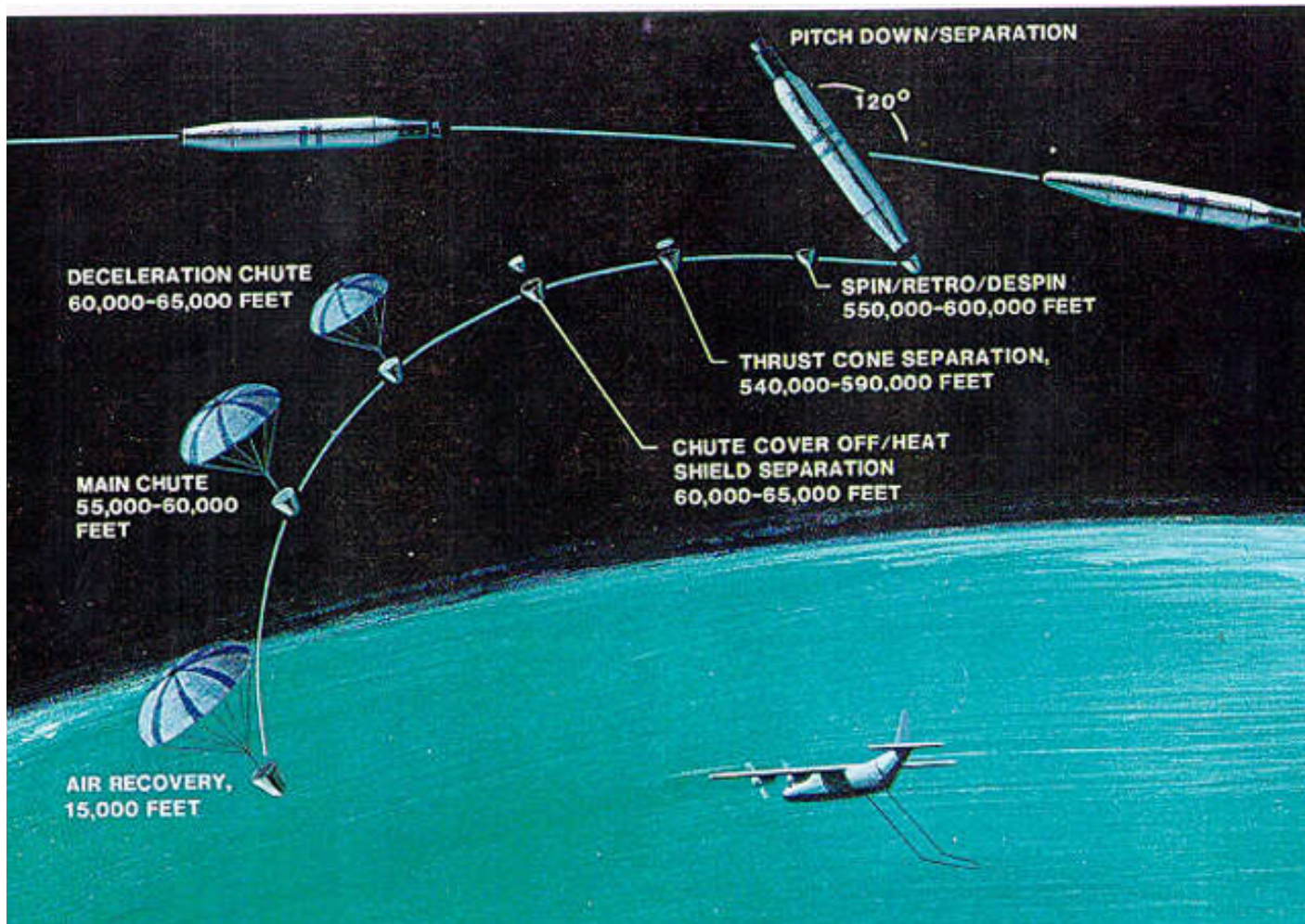
CORONA “Bucket”



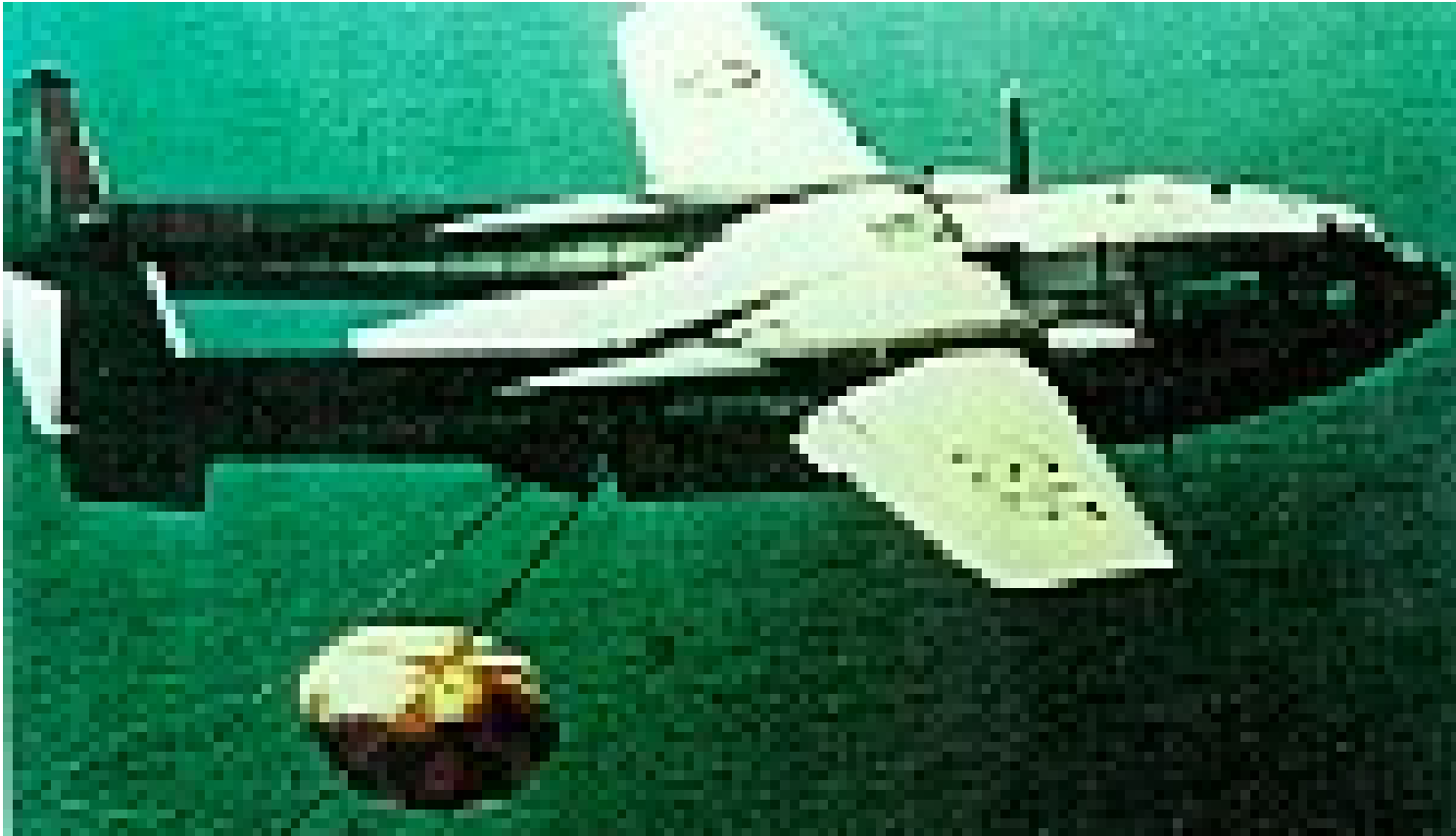
NRO HQ Exhibit



Recovery



Film capsule recovery



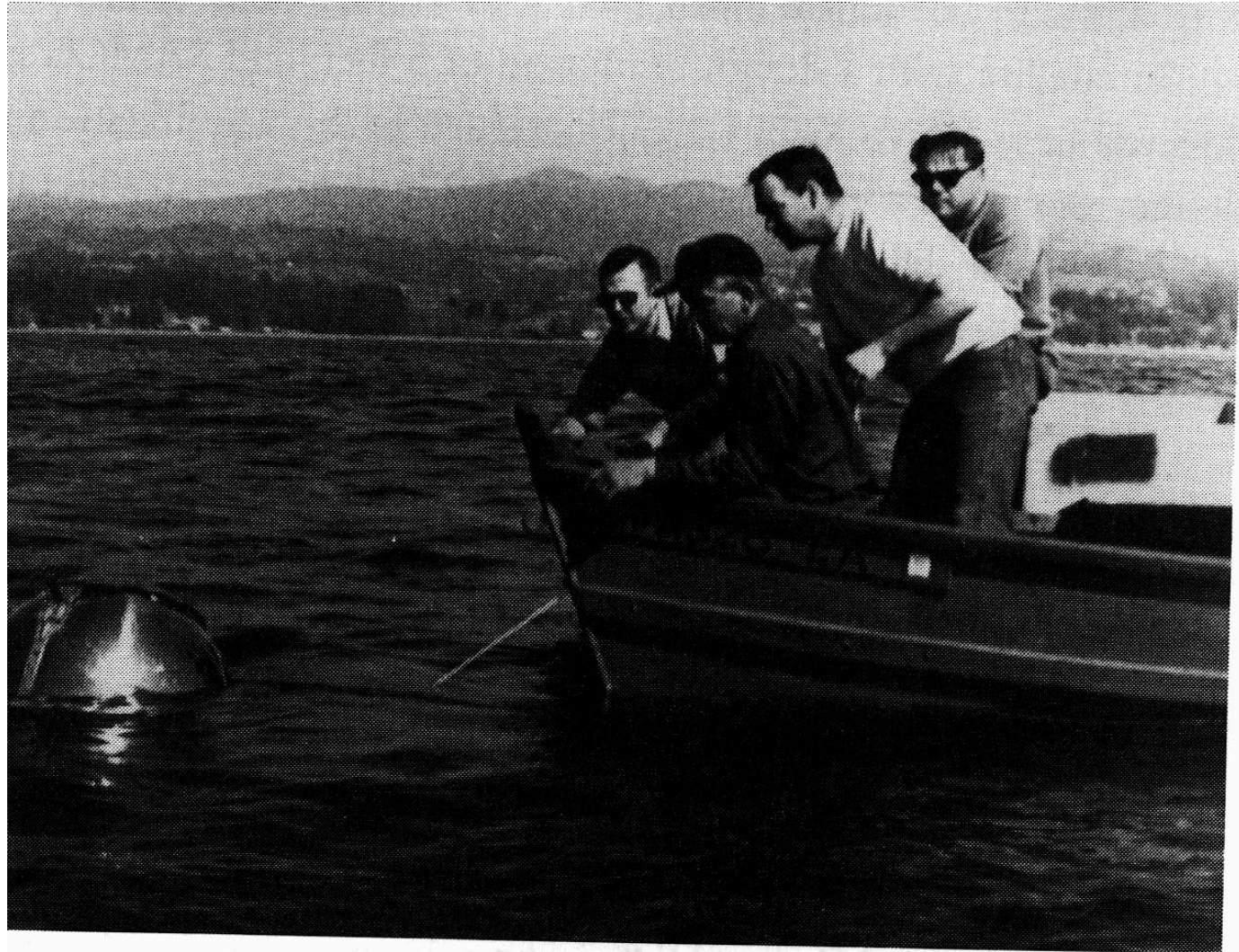
C-130 Air Catch: 6594th Squadron



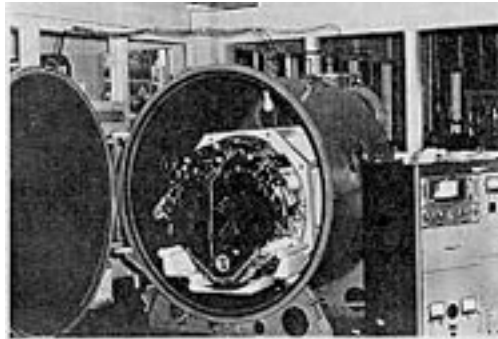
Capture Hooks



Testing the salt plugs (Santa Barbara?)



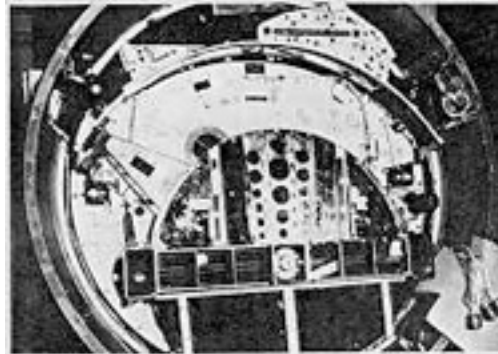
CORONA's Cameras: KEYHOLE



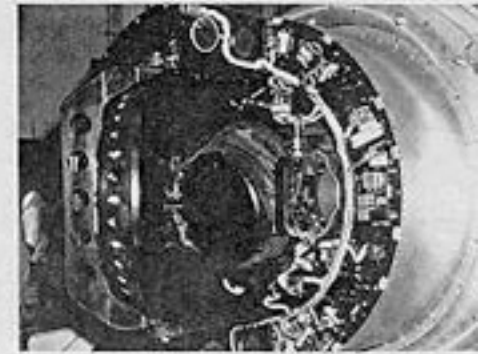
The Original CORONA (C)



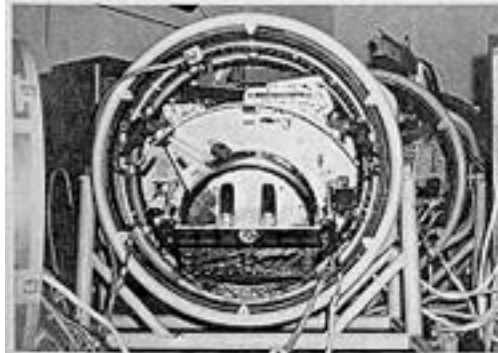
The ARGON (A)



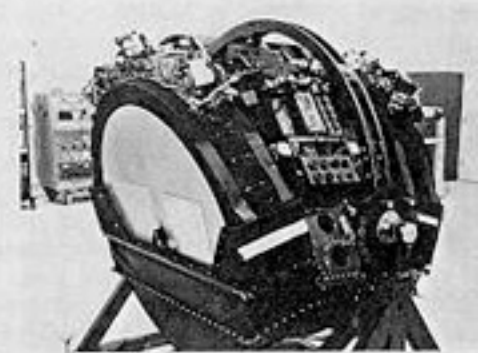
The Mural (M)



The LANYARD (L)



The J-1



The Constant Rotator or J-3

KEYHOLE Camera Evolution

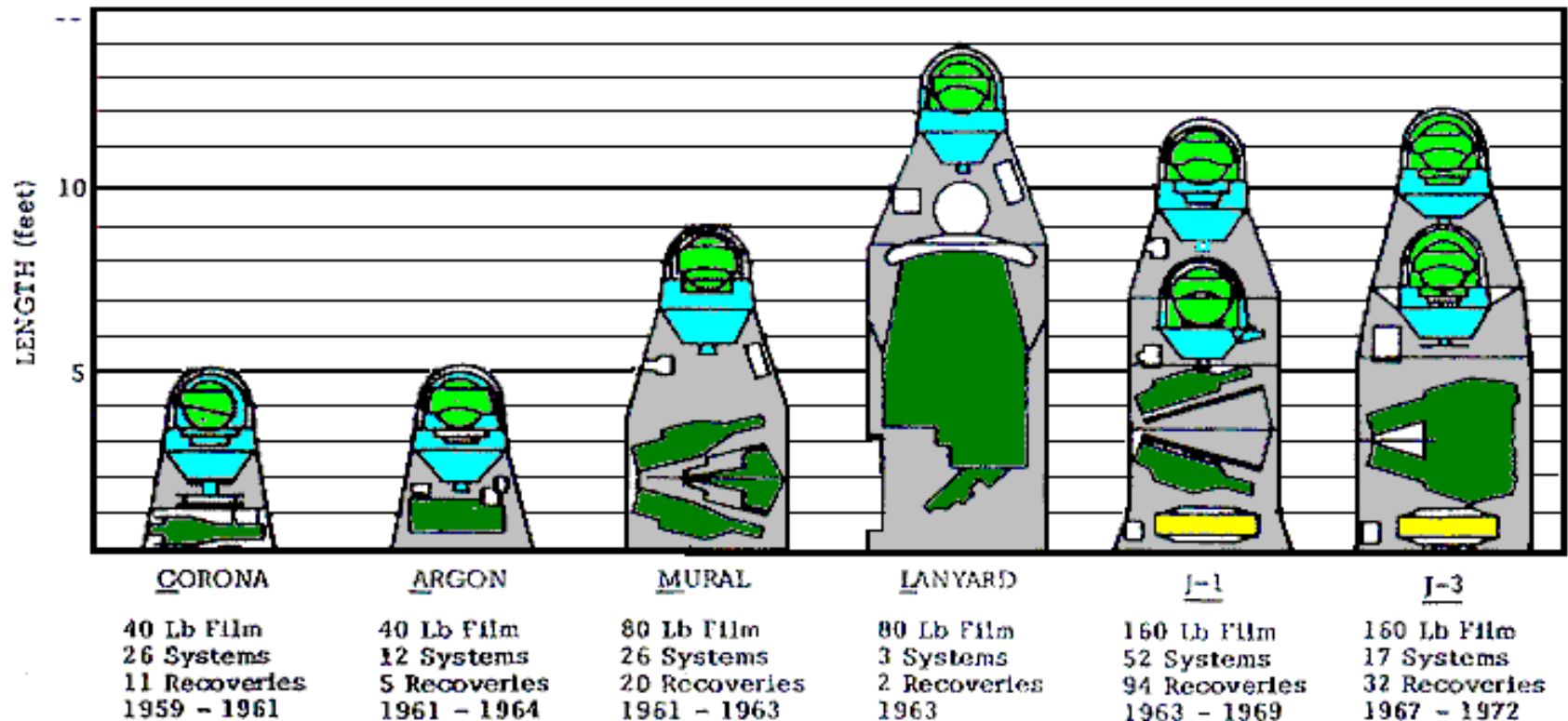
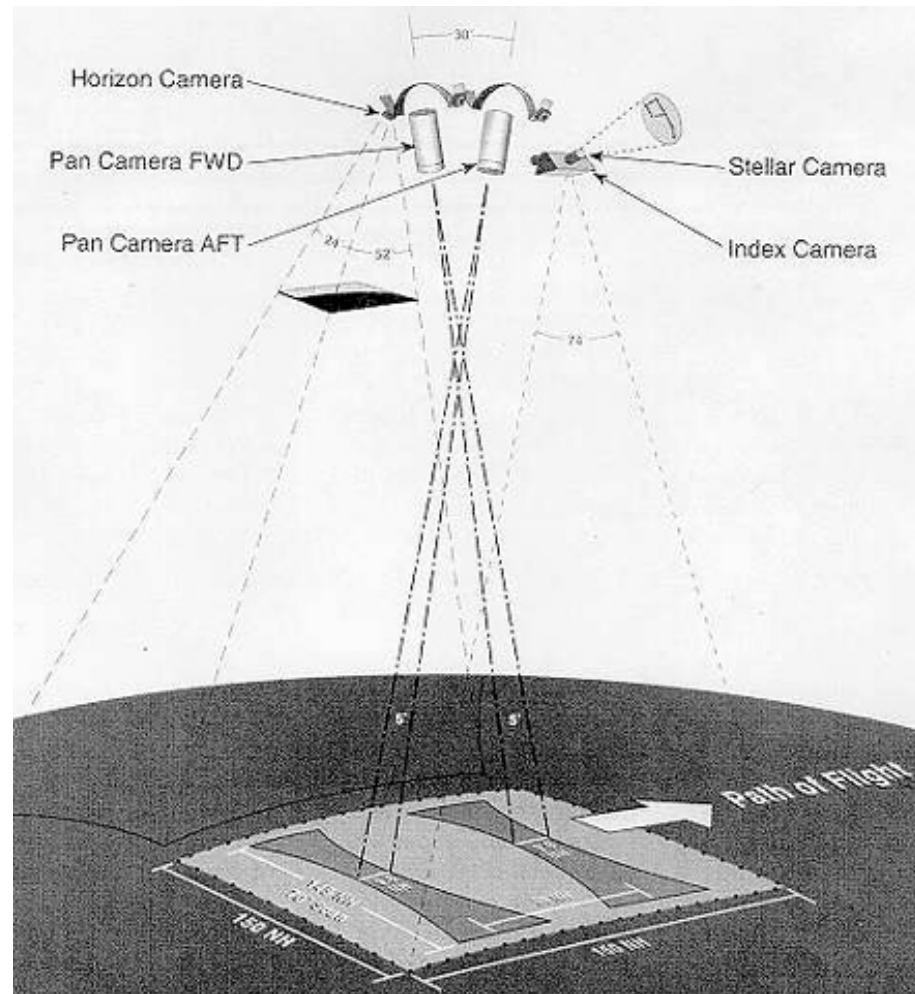


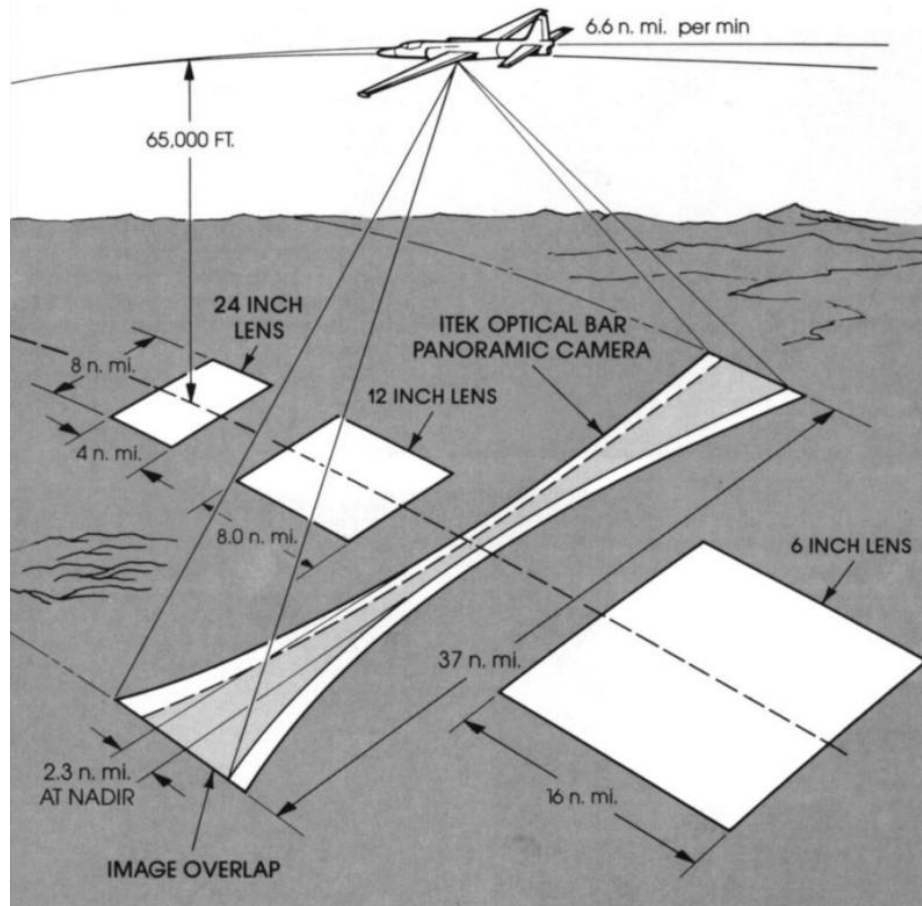
Image resolution

System	Dates	Best resolution	# Missions	Film footage
KH-1	Aug 60	40 ft	1	3,548
KH-2	Dec60-Jul61	30 ft	3	17,949
KH-3	Aug61-Dec61	25 ft	5	24,676
KH-4	Feb62-Dec63	25 ft	20	239,299
KH-4A	Aug63-Oct69	9 ft	92	1,293,025
KH-4B	Sep67-May72	6 ft	32	505,970
KH-5 ARGON	May62-Jul64	460 ft	7	22,503
KH-6 LANYARD	Jul63-Aug63	2 ft	1	2,251

A platform and a system



Imagery types



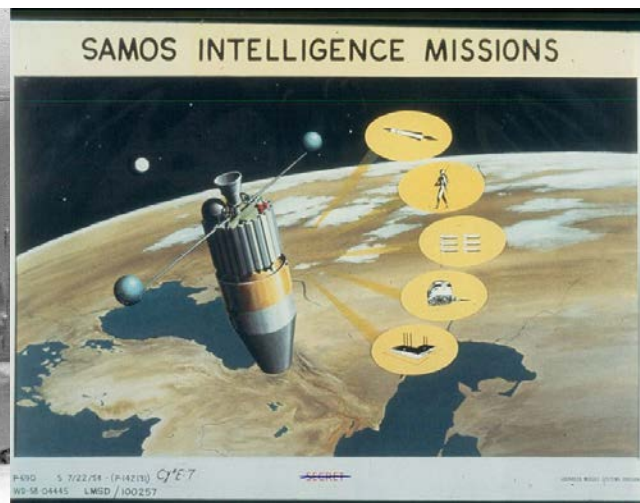
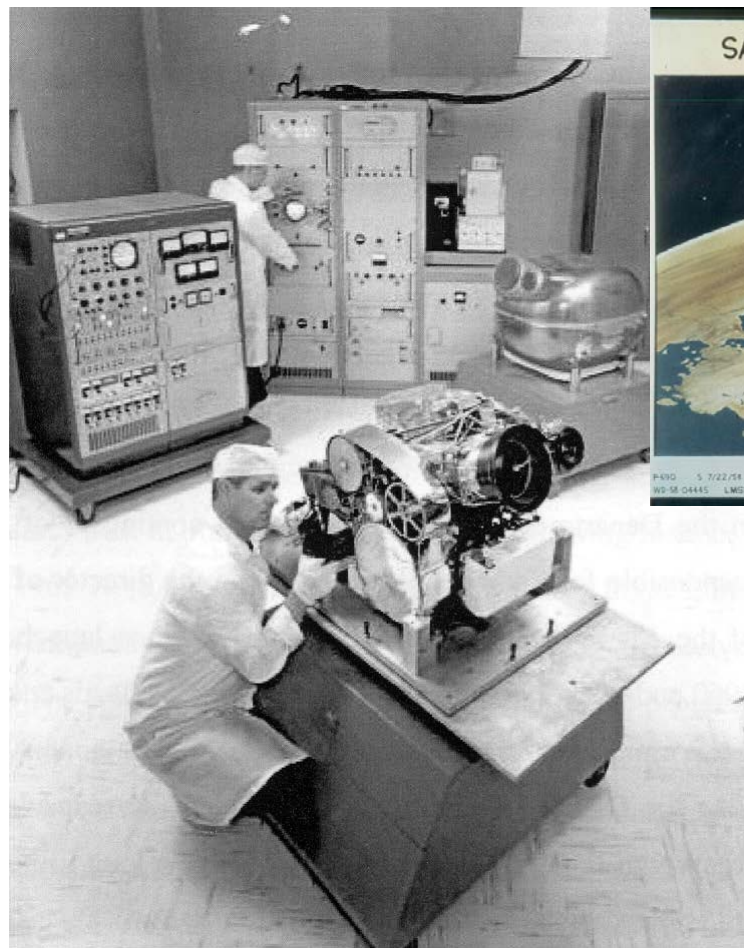
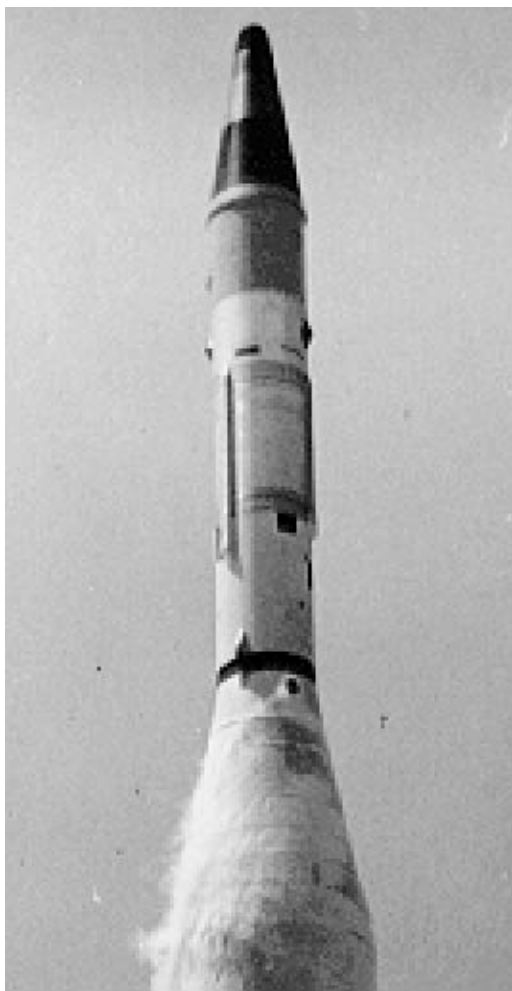
CORONA 1959-72

- 145 total flights
- At Vandenberg
 - Pad 75-1-1 -> SLC 2E
 - Pad 75-3-4 -> SLC 1W
 - Pad 75-3-5 -> SLC 1E
 - Pad 75-1-2 -> SLC 2W
 - Point Arguello Launch Complex -> SLC 3W
- First Launch 28 Feb 1959 Failed to orbit
- 10 Aug 1960 Discoverer 13 Operations # 1035
 - Separation on orbit 17
 - Water recovery on 11 Aug
- Last flight 25 May 1972 (2 RVs)

CORONA by the numbers

- Length of program in years: 12
- Number of successful missions: 103
- Number of images taken: 800,000
- Mapped image coverage in sq. nm: 750 million
- Number of film canisters in the archive: 39,000
- Length of film strips in feet: 2.1 million

SAMOS 1960-62 (Source: Harvard)



Photograph courtesy of EKC

SAMOS

- 12 launches, 3 readout 9 recovery
- Resolutions 100, 20, 5 and 8 feet
- Film developed and scan converted
- 5 days-4 months missions
- 1958-1961 then cancelled
- 1966-7 went to the Moon as the Apollo Lunar Mapping Camera

GAMBIT and HEXAGON

- High resolution KH-7 (and KH-8) system flown July 1963 to June 1967
- Used for large scale mapping of specific targets 0.46 m and 0.5 m resolution, 2 SRVs, 50 days missions.
- KH-9 was a low resolution system specifically for cartography
- “Big Bird” 2 x 1.52 m focal length cameras with 0.6 m resolution. Four capsules. Final mission life of 275 days.
- Declassified in 2002

GAMBIT (Source: www.skyrocket.de)

KH-7



KH-8



Atlas/Agna -> Titan3B/Agna-D



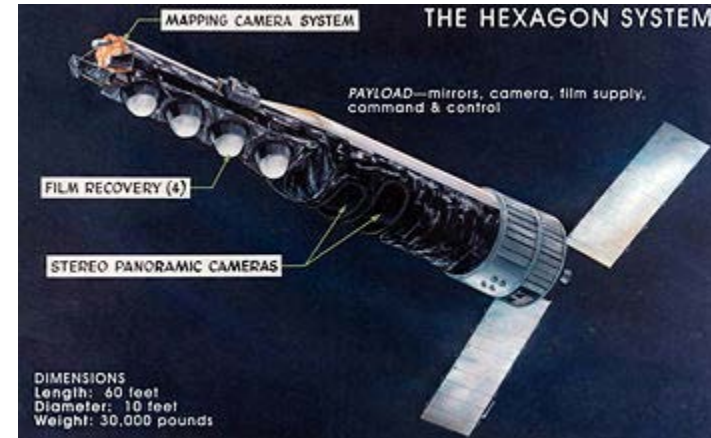
HEXAGON 1971 to 1986

BIG BIRD

Weight 11,400kg

Used TITAN 3-D

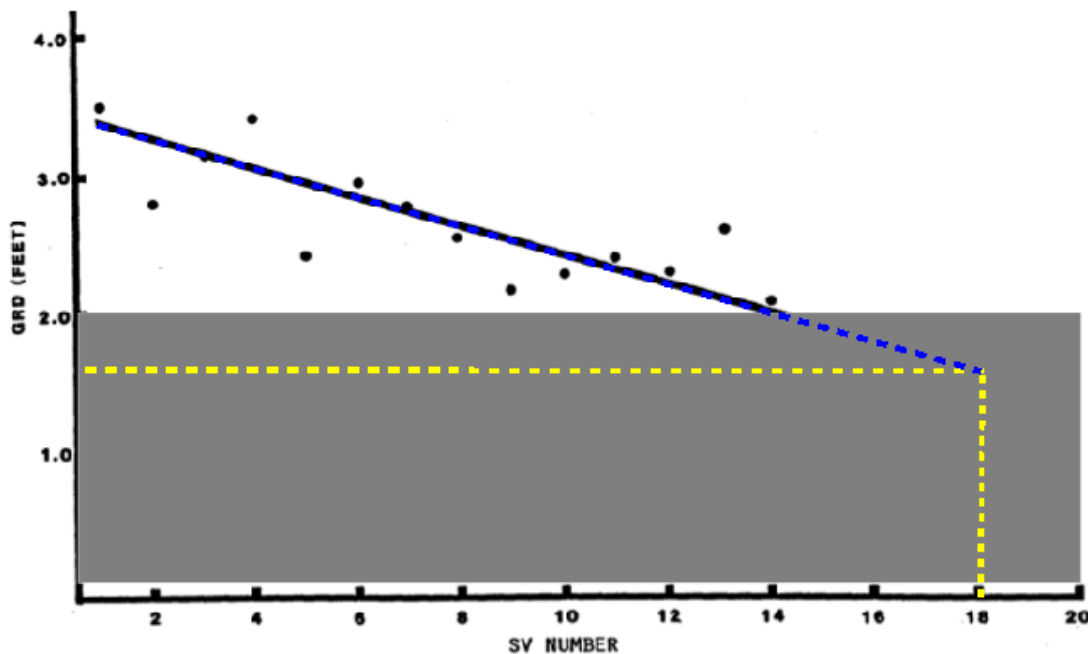
Perkin-Elmer cameras



Hexagon Resolution

29,000 images, each covering 3400 square km, declassified in 2002

APPENDIX E
SYSTEM PERFORMANCE TRENDS



NRC APPROVED FOR
RELEASE 1 / September 2011

~~TOP SECRET~~

~~TOP SECRET~~

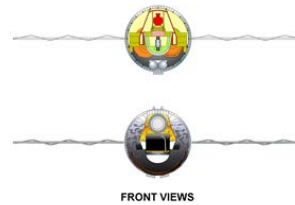
196

RIP 007-0253-85
HANDLE VIA BYEMAN
CONTROL SYSTEM ONLY

KH-9 Recovery



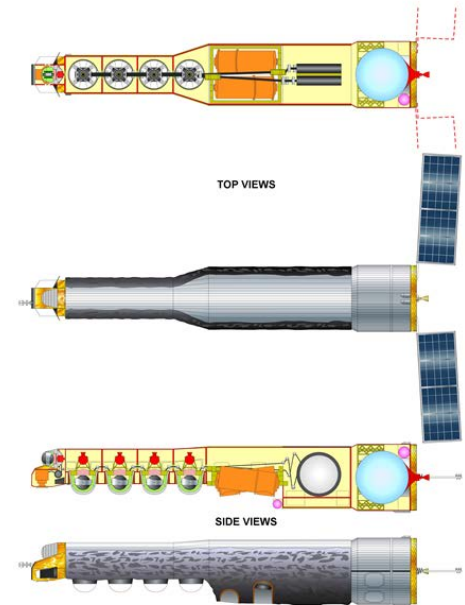
KH-9 HEXAGON



FRONT VIEWS



Human Figure
(76 Scale)




TOP VIEWS

SIDE VIEWS

TALENT/ KEYHOLE

TOP SECRET

HANDLE VIA TALENT-KEYHOLE CONTROLS ONLY



**TALENT
KEYHOLE**

WARNING

"This document contains information affecting the National Defense of the United States within the meaning of the espionage laws, Title 18, U.S.C., Secs. 793 and 794, the transmission or revelation of which in any manner to an unauthorized person is prohibited by law"

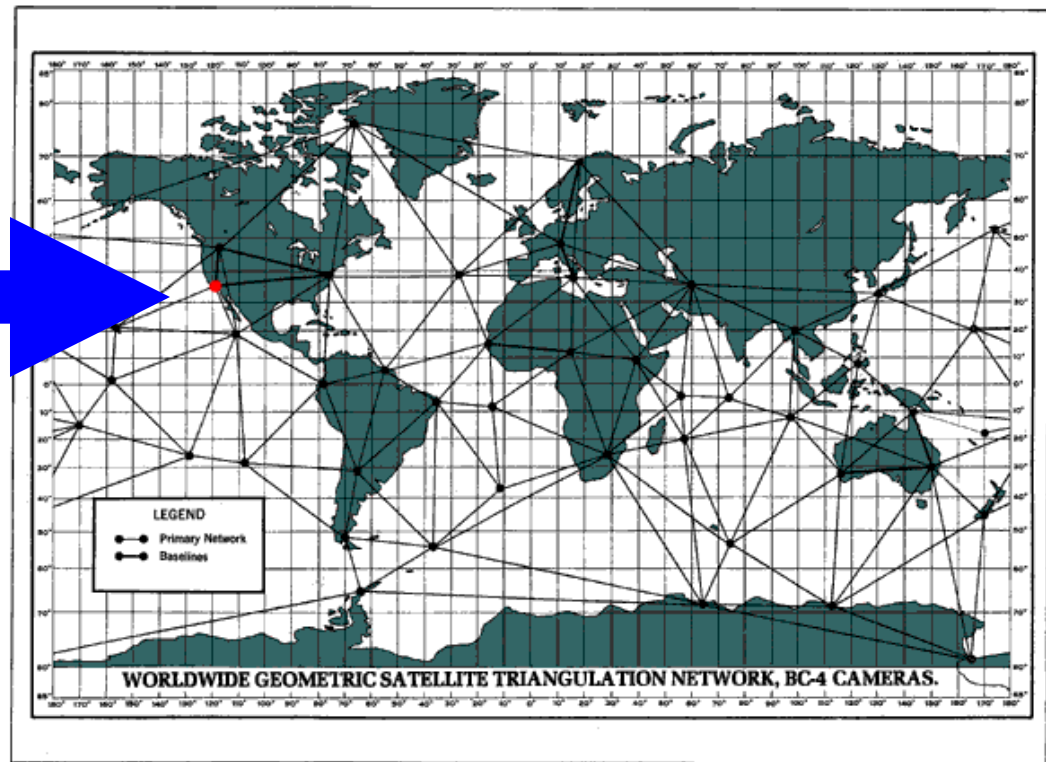
It is to be seen only by U. S. PERSONNEL especially indoctrinated and authorized to receive TALENT-KEYHOLE information. Its security must be maintained in accordance with KEYHOLE and TALENT regulations.

TOP SECRET

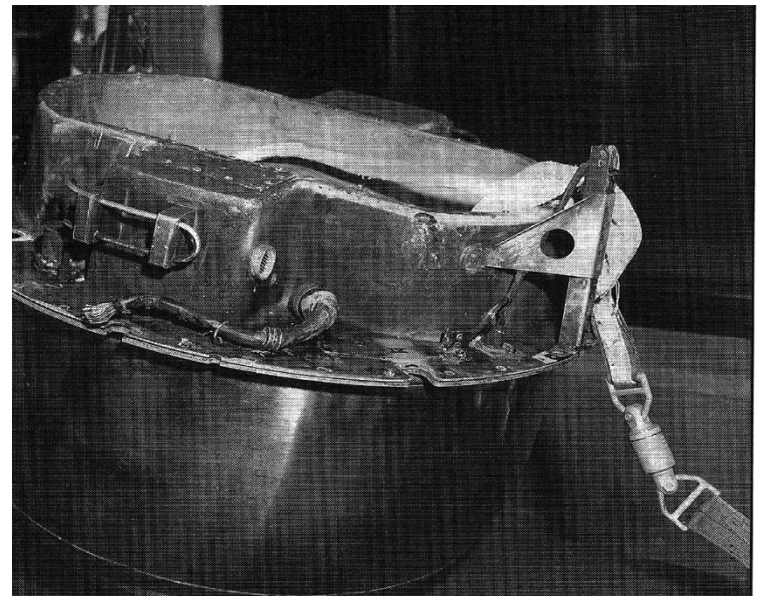
Mapping vs. Intelligence

- ARGON (KH-5) “frame camera” had reseaus for mapping
- Necessary for registering KH-1...4B strips
- Competition at first between CIA and Air Force (SAC targeting)
- Later KH-5 replaced by DISIC mapping camera

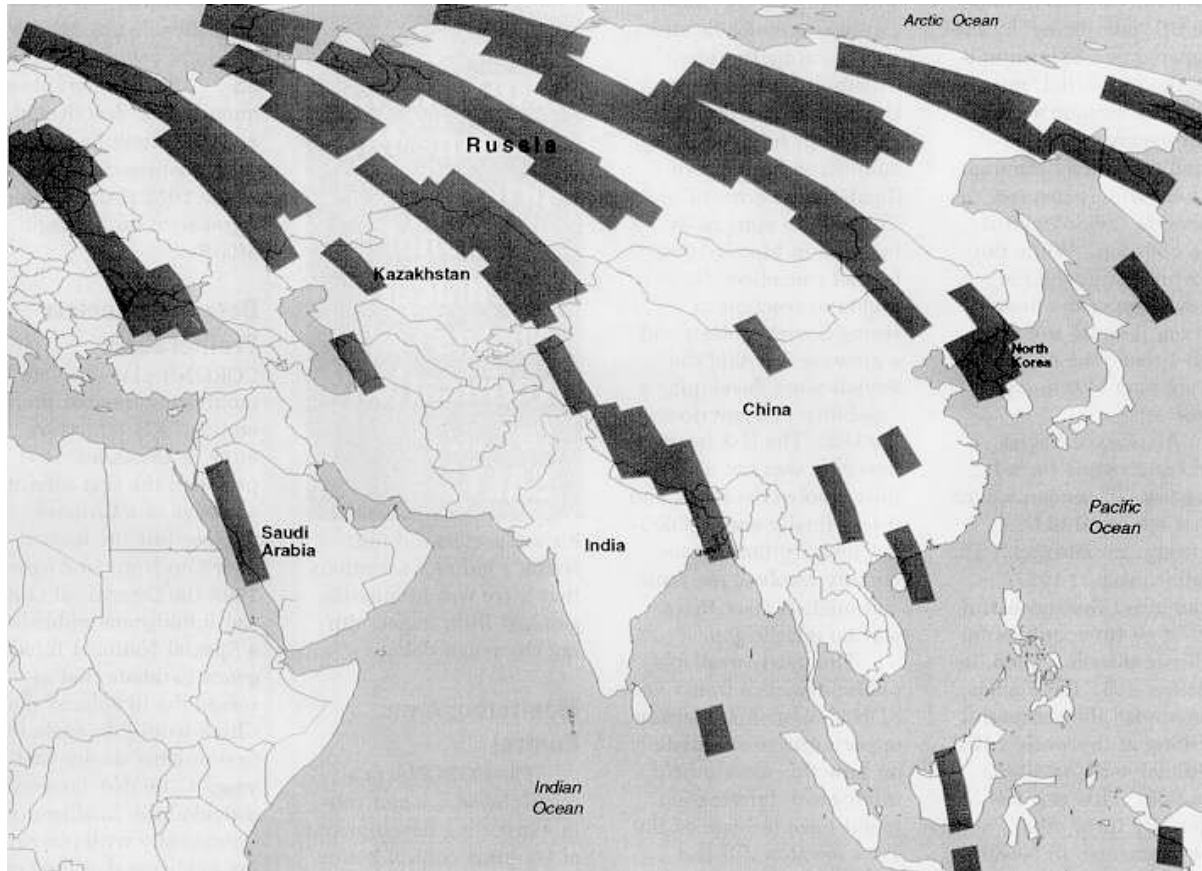
Geodesy and WGS70



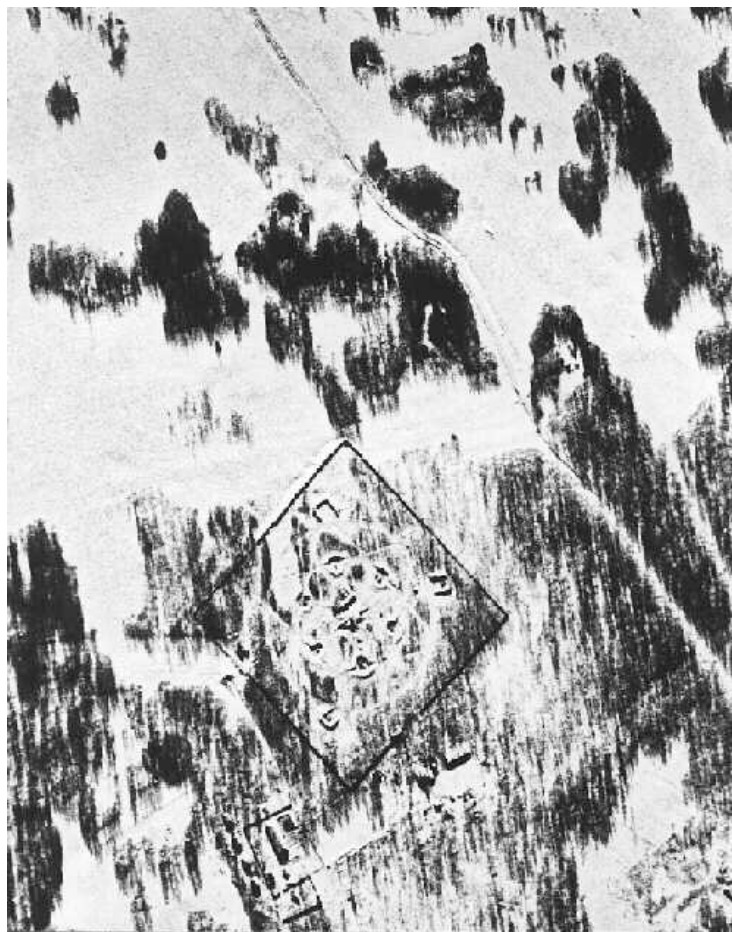
Mission 9009: 18 August 1960



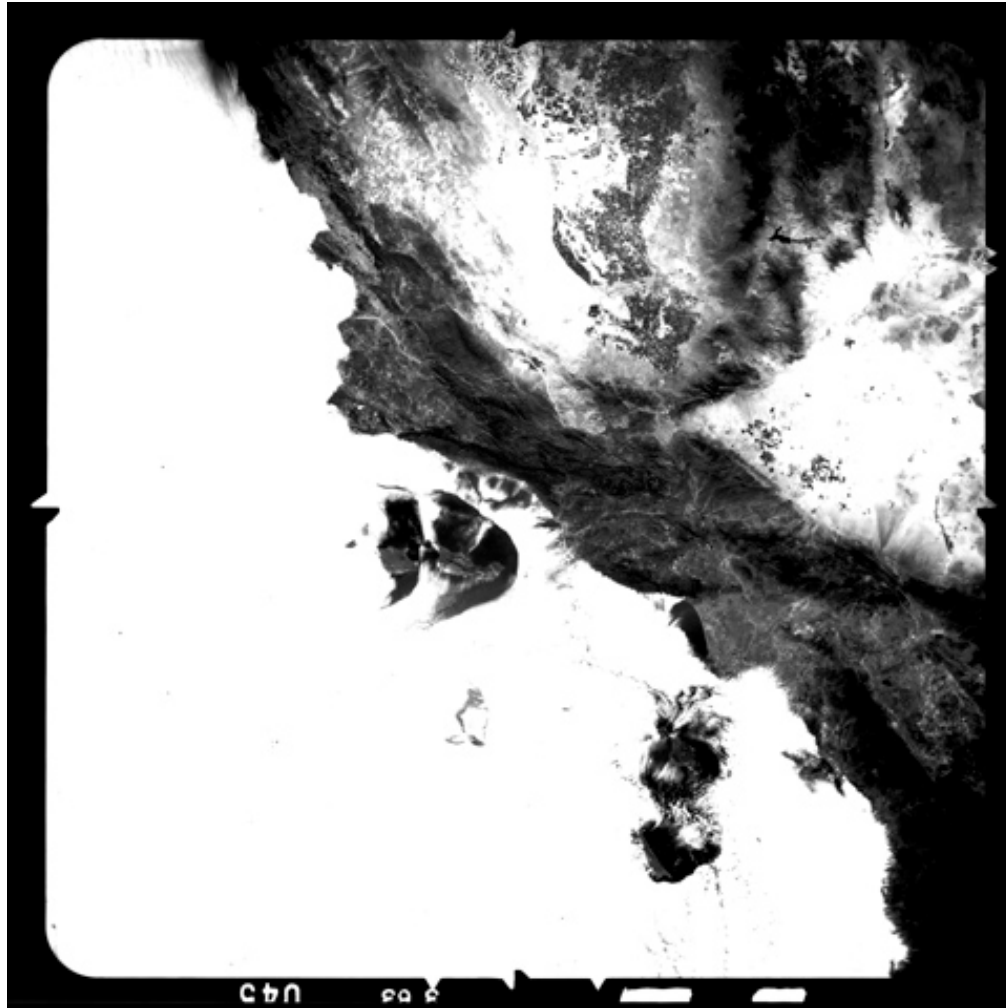
Coverage: Denied territory, but...



Soviet SA-2 Launch Site



KH-5 Argon Santa Barbara Channel



Santa Rosa Island in 1967



Early KH Pentagon



CORONA/SPOT Pan comparison



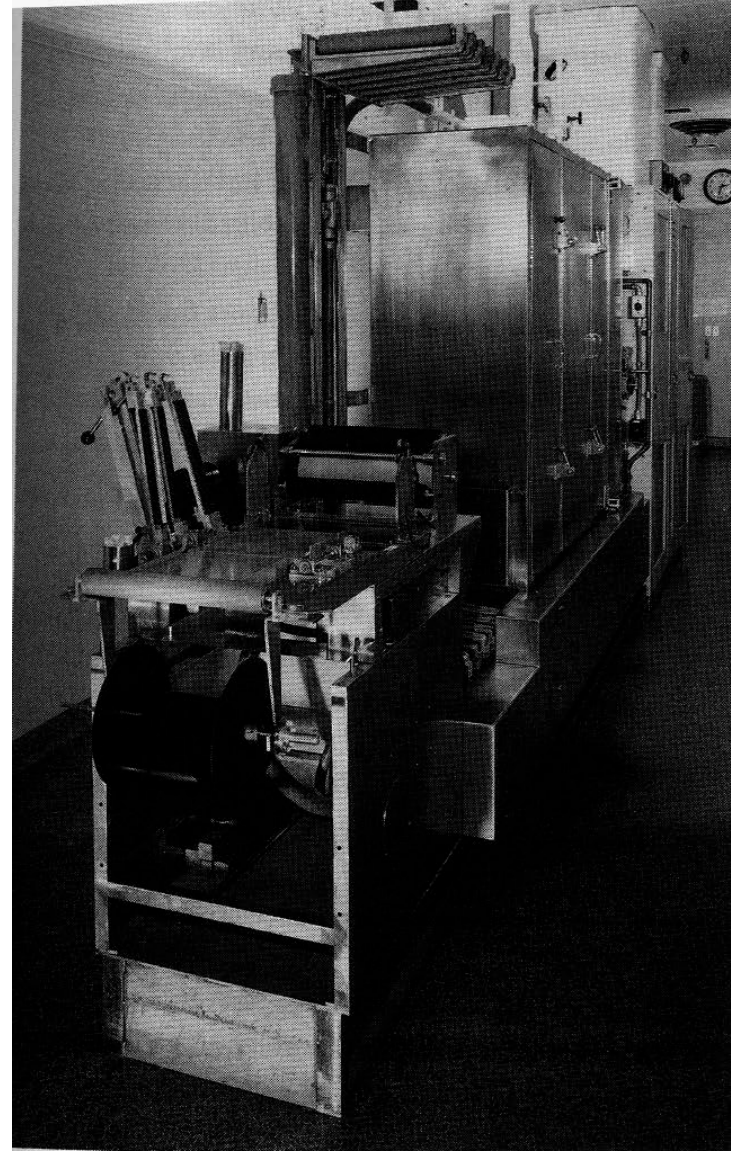
Mass imagery

- Georegistration
- Multiple copies
- Mosaicing
- Revisit and change detection
- All needed new hardware, training, methods etc

PIC (Steuart Bldg) 5th and K Sts., NW (Navy Yard Bldg
213 in January 1963)



Kodak Film Processor



Budget Pressure

- NRO/CIA budget also deep black
- OMB and congress seek to make use of money already spent as mission became less critical
- 1973 OMB report acknowledges civil role
- Civil backs up intelligence/military (e.g. Gulf War I)

New Uses

- USGS Building E-1 “Special Mapping Centers”
- “The USGS became the largest civil agency user of the CORONA imagery” (Baclawski, 1997)
- EPA, Forest Service, FEMA: Civil Applications Committee 1975, Medea
- Technology for cartography, UPDRAMS, UNAMACE, AS-11
- Birth of GIS and remote sensing
- “A Pandora’s box of potential applications”

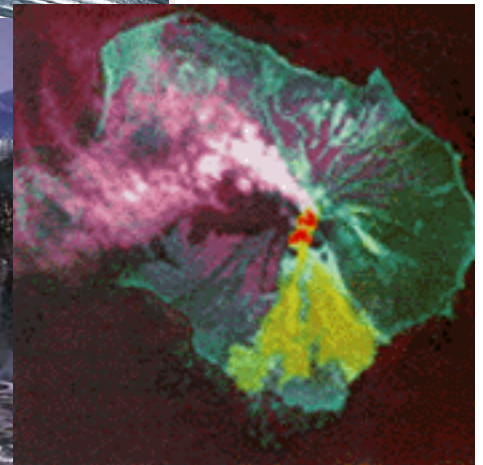
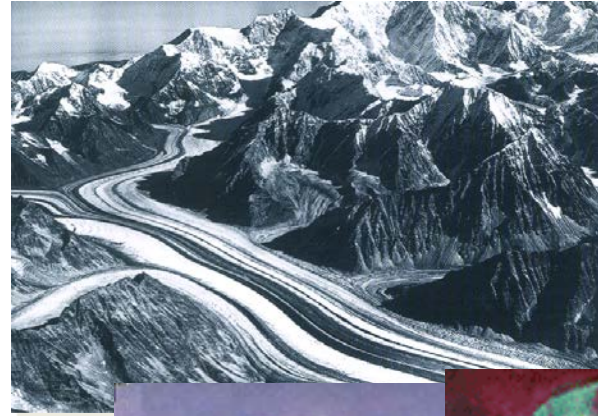
White, Gray and Black

- Leaks A and B
 - *Secret sentries in Space* 1971
 - *Deep Black* 1986
 - *Photogrammetric Engineering*
- Eugene Fubini: DISIC, mapping and multiuse
- Gemini: Control and reuse of components
- Apollo Lunar Mapping Camera: SAMOS
- Geodetic mapping: DMA 1972
- ERTS 1972: NRO/Air Force vs NASA (Landsat 7 and stereo)

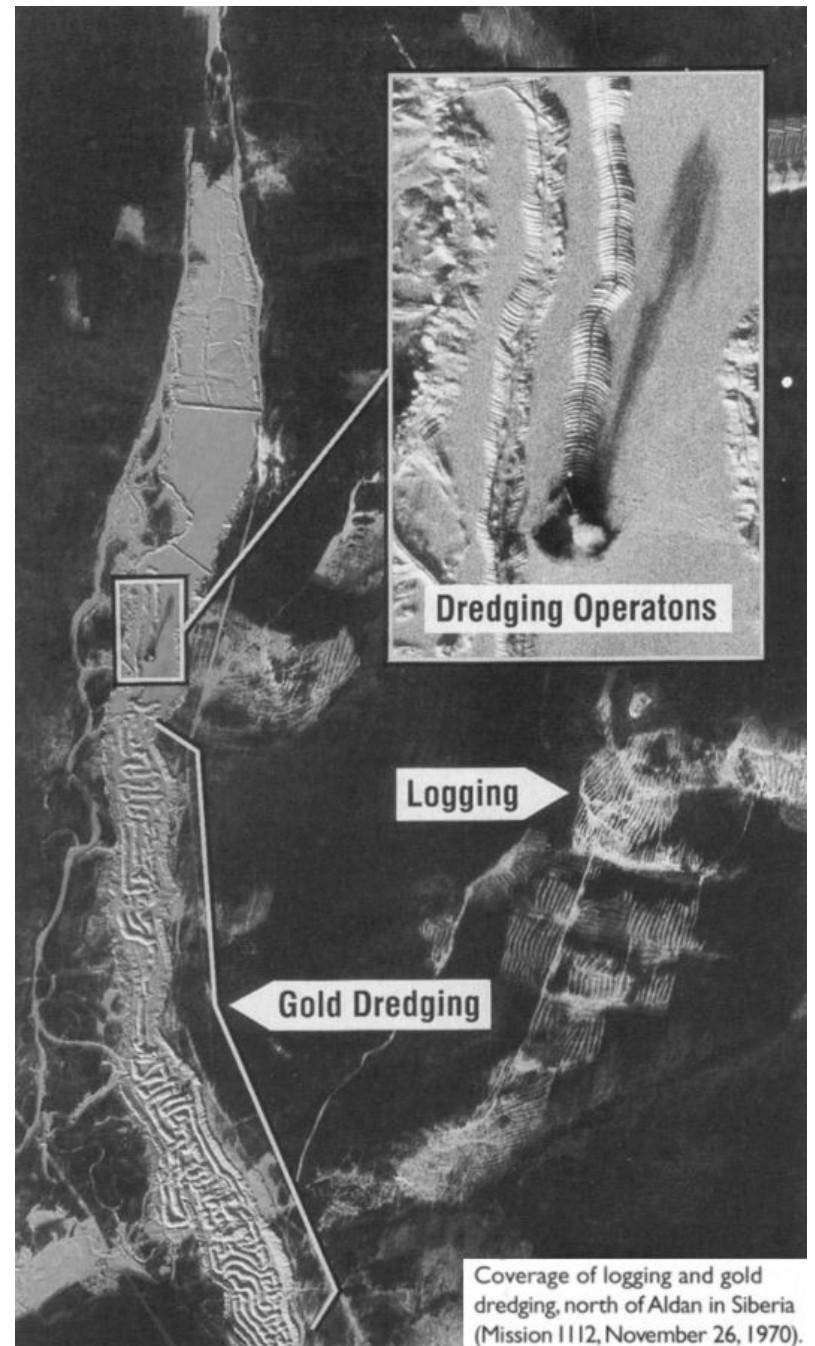


CAC Charter

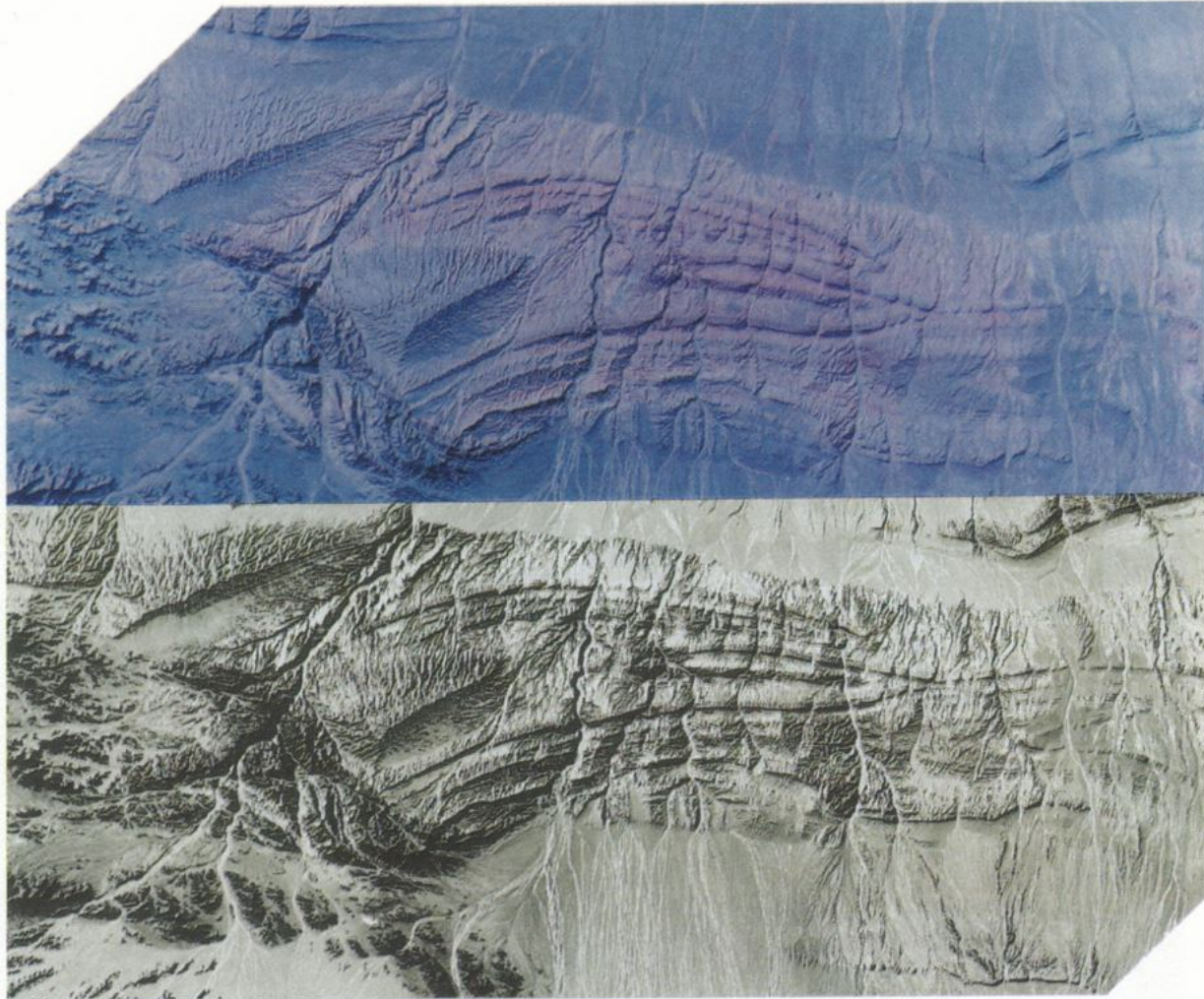
“...facilitate civilian agencies’ use of classified systems and coordinate the incorporation of photography, derived data, and technology in performance of domestic civilian functions...”



Dredging and gold extraction



Tsaidam Basin China: RED DOT



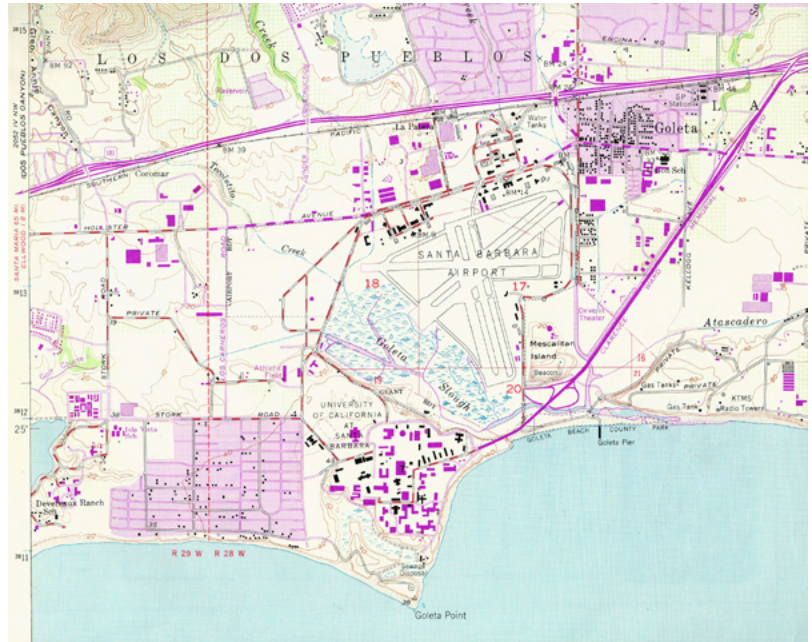
Autometrics: Africa Mosaic



CORONA and archaeology



Goleta, CA: 24K Revision



Today

- CORONA archives open, images at Sioux Falls and in National Archives 1995
- NRO acknowledged 1992
- KH-7/8/9 Declassified 2011
- All since KH-9, most of SAMOS etc. still T-K
- Executive Order 12951 in 1995, five year promise completed in 2002
- Many uses of CORONA in environmental and historical work

CORONA and GLIS

Netscape: Detailed Information about: Entity Id: DS1012-2063DF031

File Edit View Go Communicator Help

Back Forward Reload Home Search Netscape Print Security Shop Stop

Bookmarks Location: <http://edcwww.cr.usgs.gov/Webglis/glisbin/detail.pl?1> What's Related

Google "Melvyl Homepage" Santa Barbara MTD UCSB Dept of Geograpy Discussion Board

USGS
science for a changing world

Detailed Information about: Entity Id: DS1012-2063DF031

[Map Information](#) NEW

Instructions for drawing on map:
To Pan, click on the Pan radio button, then click on any spot within the map.
To Zoom, select the Zoom factor and whether you want to Zoom In or Zoom Out, then click on your area of interest.
To Add or subtract map layers, click the on/off buttons provided for each layer. Grid Increment and map size can also be changed to your preferences.

Pan

Zoom In

Zoom Out

2X

Political Boundaries Populated Places Lakes/Rivers Roads Railroads
NAPP Flightline/Station NHAP B&W NHAP CIR LANDSAT WRS 1 LANDSAT WRS 2

Grid Increment: Auto Grid Labeling: Off On

Now in Earth Explorer

The screenshot displays the Earth Explorer website interface. The browser's address bar shows the URL earthexplorer.usgs.gov. The page title is "Earth Explorer - Home". The main navigation bar includes "Home", "Login", "Register", "RSS", "Feedback", and "Help".

The interface is divided into several sections:

- Search Criteria Summary (Show):** Located at the top right of the main content area, it displays the current search coordinates: $(43^{\circ} 22' 51'' \text{ N}, 100^{\circ} 45' 59'' \text{ W})$. There is a "Clear Search Criteria" button and a "Options" menu.
- Search Criteria:** A tabbed interface with "Data Sets" selected. It contains the following text: "2. Select Your Data Set(s). Check the boxes for the data set(s) you want to search. When done selecting data set(s), click the *Additional Criteria* or *Results* buttons below. Click the plus sign next to the category name to show a list of data sets." Below this text is a checkbox for "Use Data Set Prefilter (What's This?)".
- Data Set Search:** A search input field.
- Data Set Categories:** A list of categories with expandable arrows. The "Declassified Data" category is expanded, showing three sub-items: "Declass 1 (1996)", "Declass 2 (2002)", and "Declass 3 (2013)". These three items are circled in red.
- Map:** A satellite-style map of the central United States, showing parts of South Dakota, Nebraska, Iowa, and Minnesota. Major cities like Aberdeen, Wilmar, Watertown, Minneapolis, St. Paul, Pierre, Sioux Falls, Sioux City, Norfolk, Mason City, Rochester, Albert Lea, Austin, Waterloo, and Des Moines are labeled. The map includes a "Stack" icon in the top left and zoom controls in the top right.

The Windows taskbar at the bottom shows the system tray with the time 2:08 PM and date 2/10/2020.

KH-7 Hanoi 6/11/67



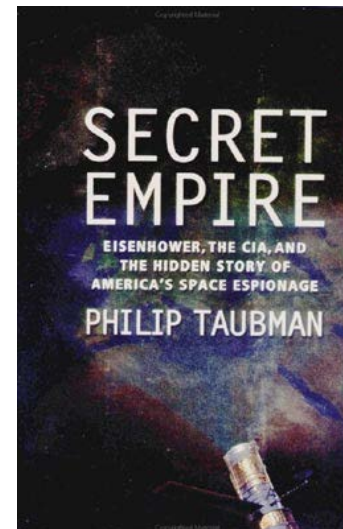
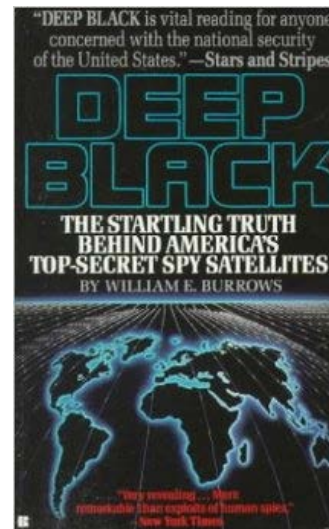
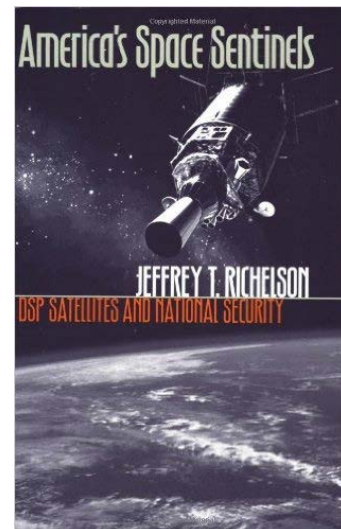
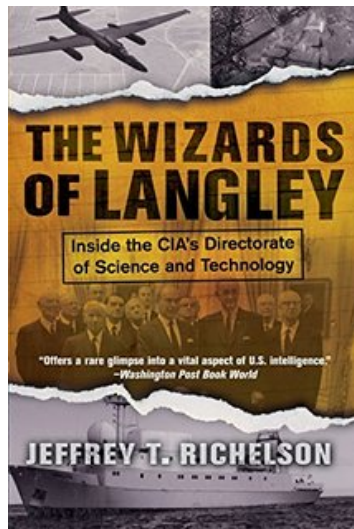
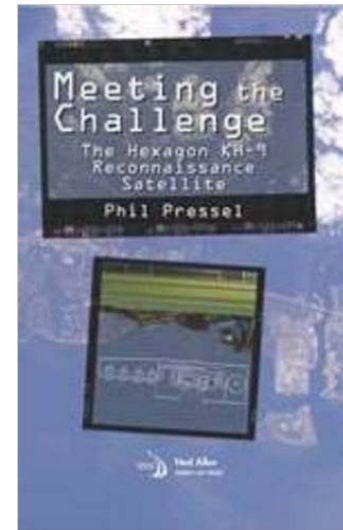
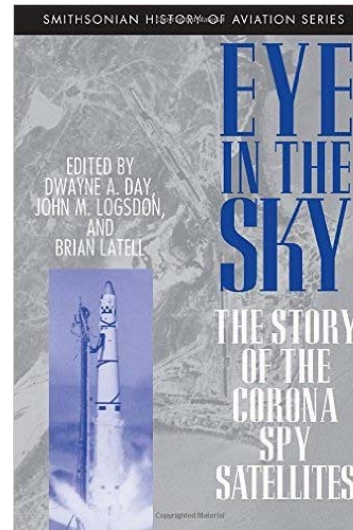
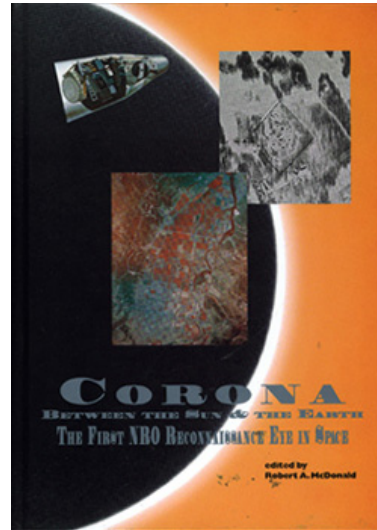
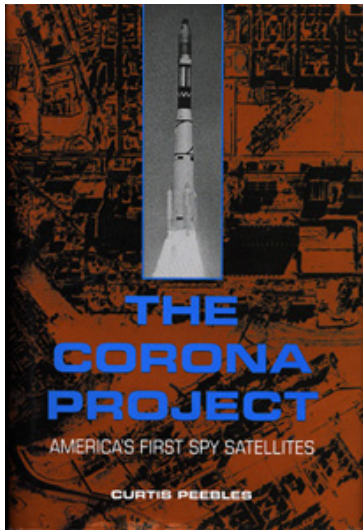
KH-7 Moscow 4/6/79



KH-9 Severodvinsk Shipyards



Many Books



Summary

- Cold war and denied territory led to new mapping solutions
- Precursors: Genetrix, Samos, Panoramic camera, return capture
- Crisis in 1960 with U-2, but first success after 13 tries with CORONA 6 weeks later
- Became main source of intelligence information, and used for CAC applications
- Successor systems mechanical, then digital
- Invented remote sensing and GIS!