American Institute of

Aeronautics and Astronautics

HISTORIC AEROSPACE SITE



Rochester

New York, USA

Declassified satellite reconnaissance photograph of a warship at berth, annotated by imagery analysts. Camera-original film from programs of this era was processed at Kodak's Hawkeye Works in Rochester, New York.

AIAA

American Institute of

Aeronautics and Astronautics

HISTORIC AEROSPACE SITE

Rochester

New York, USA

Kodak Park · Hawkeye Works · Lincoln Plant

Building 601 · Elmgrove Plant

Commemorative plaque located at the Rochester Museum & Science Center

Strasenburgh Planetarium · 663 East Avenue

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AIAA

INTRODUCTION

A century of high-resolution imagery

Rochester, New York — one historic site, five locations

Advances in aeronautics and astronautics made major improvements in aerial photography possible. During WWI, aircraft flying missions at ever-increasing altitudes with aircraft-mounted cameras began conducting reconnaissance runs. By the late 1950's, the first film-based reconnaissance satellites were launched. Specialized films, the optics, the cameras, and the chemistry to develop the film that was exposed all needed to be created and refined. For more than a century, a remarkable share of that work was done in Rochester, New York.

The broad field of remote imaging includes film-based and electronic imaging systems – cameras pointed down at the earth, ground-based telescopes imaging night skies, and space-based observatories imaging the universe. The locations recognized in this designation contributed to one or more phases of that grand venture: research and development investigations, engineering design, parts manufacturing, system integration and assembly, testing, and finally image capture and analysis.

What is imaging? The imaging chain begins with an illuminated object. From there it runs through optical image formation, image recording, latent-image transfer or transmission, image processing, and, finally, image display. Every link in that chain was at one time, or another created, refined, or manufactured within a few miles of the Genesee River. A global legacy in aerial photography, satellite reconnaissance, and space exploration was established in Rochester through the pioneering work of the Eastman Kodak Company.

Three eras

The work at these locations falls into three periods. From World War I to 1955, aerial photography relied on film exposed in cameras and then chemically processed and printed on the ground. From 1955 to 1975, rapid technological progress extended film-based cameras to higher altitudes, to Earth orbit, and even to lunar orbit. From 1975 to the present, digital electronic image sensors have increasingly replaced film, with images transmitted to Earth by telemetry, then often processed and retransmitted to end users.

Secrecy, and its unveiling

Some of this work was carried out under government security restrictions. Four programs central to the Rochester story were initially covert and later declassified: CORONA, GAMBIT, HEXAGON, and BRIDGEHEAD. Other projects — the Lunar Orbiter cameras, the space-based observatories including Chandra X-ray Observatory telescope, James Webb Space Telescope, and the Nancy Grace Roman Space Telescope; and commercial imaging satellites including IKONOS, GeoEye, and WorldView — were unclassified from the start. All the information presented in this brochure is publicly available or can be derived from public sources.

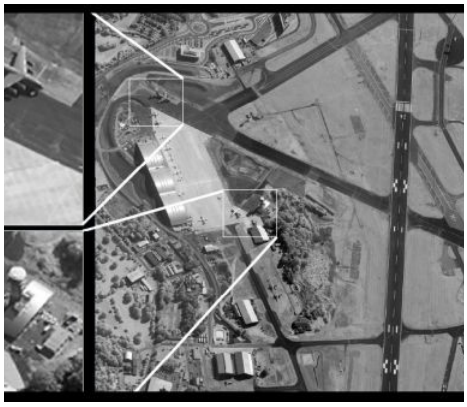
Names and ownership

Because the timeline is long, ownership of buildings and of proprietary operations has changed repeatedly, and several of the buildings have since been repurposed. This brochure uses the location names as they were commonly known to the public during each period of historical significance.

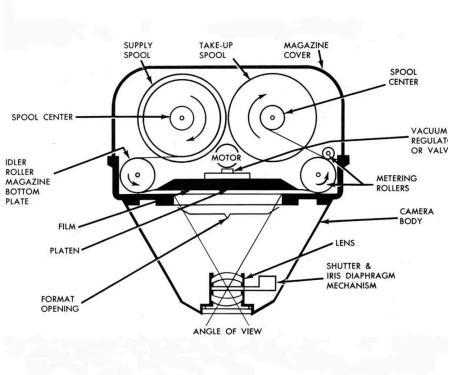
What follows is a short tour of five places — a film works, a processing laboratory, an assembly plant, an optics shop, and an engineering headquarters — whose products flew over every continent, orbited the Earth, photographed the moon, and imaged the universe.



Lockheed U-2 Dragon Lady Spy Plane[1]



U-2 Photo from the Edge of Space[2]



U-2 Film Spooling System[3]

LOCATION ONE

Kodak Park

Ridge Road West at Lake Avenue · Rochester, NY 14615

Kodak Park — KP to generations of Rochesterians, was a complex of more than 150 buildings spread across 1,300 acres on the north side of the city. Employment once exceeded 30,000 people, making it the single largest operation of the Eastman Kodak Company in the Rochester area (total employment in Rochester was over 60,000). It was the home of research, development, and manufacturing for photographic materials sold worldwide.

At its own expense, Kodak conducted the product development needed to manufacture special-order products for military and Department of Defense operations, for NASA aeronautical and scientific projects, and for covert National Reconnaissance Office programs.

Film that no store ever sold

Alongside photographic products with unusual light-sensitivity and spectral-response characteristics — black-and-white, color, and color infrared — Kodak Park manufactured film to demanding requirements that few consumer products ever approached.

Widths ran from 70 millimeters to 9.5 inches. Continuous lengths ran from several hundred feet to several thousand, and to more than a mile for the HEXAGON program. Thicknesses went as thin as two mils — about that of household plastic wrap — maximizing film carrying capacity with the capability and cost of the launch vehicle to lift the camera into orbit.

Across the Cold War era, Kodak Park delivered more than 1,500 miles of high-resolution black-and-white, color, and color infrared film for classified government programs, together with the associated special photographic chemicals required for precision processing.



Corona Film Return Capsule[5]

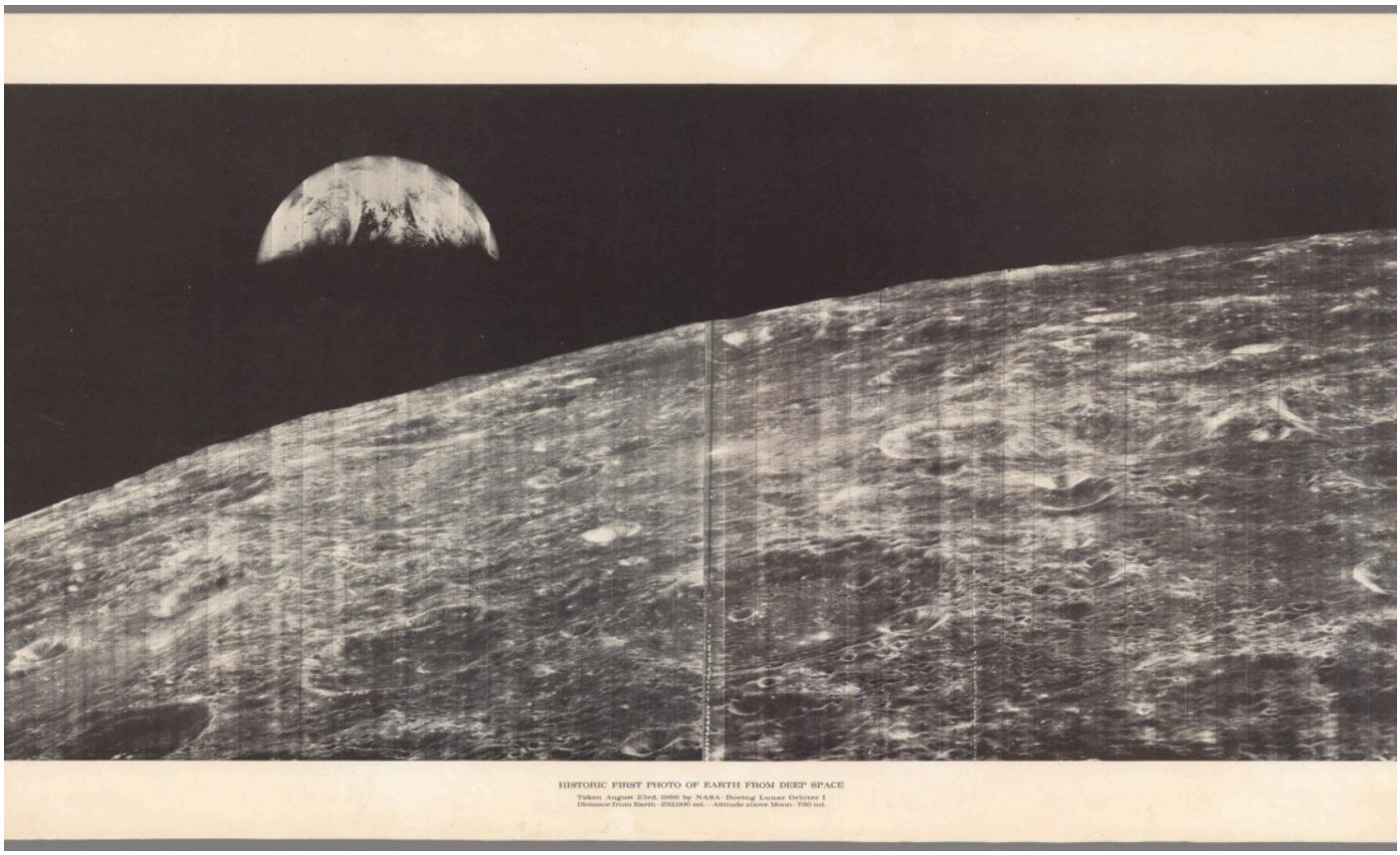
KODAK PARK AT A GLANCE

- More than 150 buildings on 1,300 acres
- Peak employment above 30,000
- Film widths from 70mm to 9.5 in.
- Roll lengths to more than one mile
- Base thickness to 2 mils
- 1,500+ miles of film for classified government programs

LOCATION ONE, CONTINUED

Kodak Park

Film for the moon · From film to photons



Earthrise from Lunar Orbiter, 1966[4]

Film for the moon

For NASA's Lunar Orbiter Program of 1966–67, Kodak Park made a special dry-processing material, Kodak Bimat film, which allowed exposed film to be developed inside the camera during flight — a quarter of a million miles from the nearest darkroom.

The combined camera and processor units were designed and manufactured at Kodak's Lincoln Plant. Once processed aboard the spacecraft, the images were scanned and returned to ground stations by telemetry.

From film to photons

Beginning in the 1970s, Rochester spearheaded the evolution from film to digital electronic sensors. Kodak introduced a 10,000 black and white pixel array in 1975, and the first color megapixel array in 1986. That transition eventually reduced overall film production from billions of feet/year to around a million feet/year, resulting in a seismic change in the workforce and footprint. While the medium evolved, the region maintained the technological and innovative leadership in imaging technology. The industry is supported today by L3Harris, local universities, and regional companies.

LOCATION TWO

Hawkeye Works and BRIDGEHEAD

St. Paul Street at Driving Park · Rochester, NY 14621

The Hawkeye Works location was home to several classified programs beginning in the 1950s and 1960s. The first was BRIDGEHEAD, a precision film processing laboratory. The second was support for the GAMBIT KH-7 and KH-8 satellite cameras.

BRIDGEHEAD was created to process the camera-original film returned from the CORONA, GAMBIT, and HEXAGON satellite cameras. It is difficult to overstate what arrived in those recovery capsules. Each roll was the end deliverable of an extraordinarily sophisticated image-acquisition system and of an enormous financial investment — and, potentially, the long-awaited answer to a critical intelligence question inside multiple agencies of the United States Government. There was no second copy and no second chance.

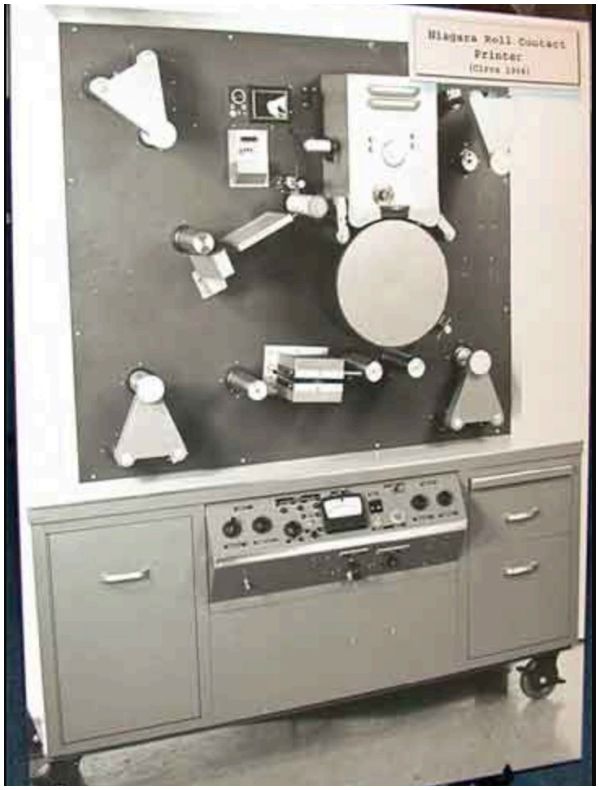
Processing therefore ran round the clock, seven days a week. After the film originals were developed, multiple duplicates were produced along with priority enlargements. These were then carefully packaged, shipped, and distributed to the analysts and agencies waiting on them.

One area of Hawkeye Works was dedicated to the development of specialized optics. Through research and development investigations, optics manufacturing, and subassembly and test functions, Hawkeye Works not only processed returned film, but also supported the GAMBIT satellite camera development in close coordination with other locations including Lincoln Plant, Building 601, and Kodak Park.

This network is the reason the single Rochester designation covers five locations rather than one. No single building tells the story; the achievements lay in the seamless movement of materials, optics, hardware, and exposed film among them.



Analyst's enlargement detail from a declassified satellite reconnaissance photograph. Priority enlargements of this kind were among the products distributed from the BRIDGEHEAD laboratory at Hawkeye Works.[6]



Niagara Printer[7]

LOCATION TWO, CONTINUED

Hawkeye Works and BRIDGEHEAD

Why Rochester



Hawkeye Works[8]

Why Rochester

The choice of location was not sentimental. Film returned from orbit is unforgiving: it has been carried through launch loads, held for days or weeks at vacuum and extreme temperatures, and subjected to radiation. Recovering the latent image from it demanded processing control far beyond commercial practice — and that expertise, along with the specialized equipment required, was concentrated within a few buildings in one city.

The imaging chain comes full circle in Rochester. The same organization that had coated and slit the film (the first link of the imaging chain) and developed camera systems to image from space delivered the finished prints (the last link) from which national decisions were made.

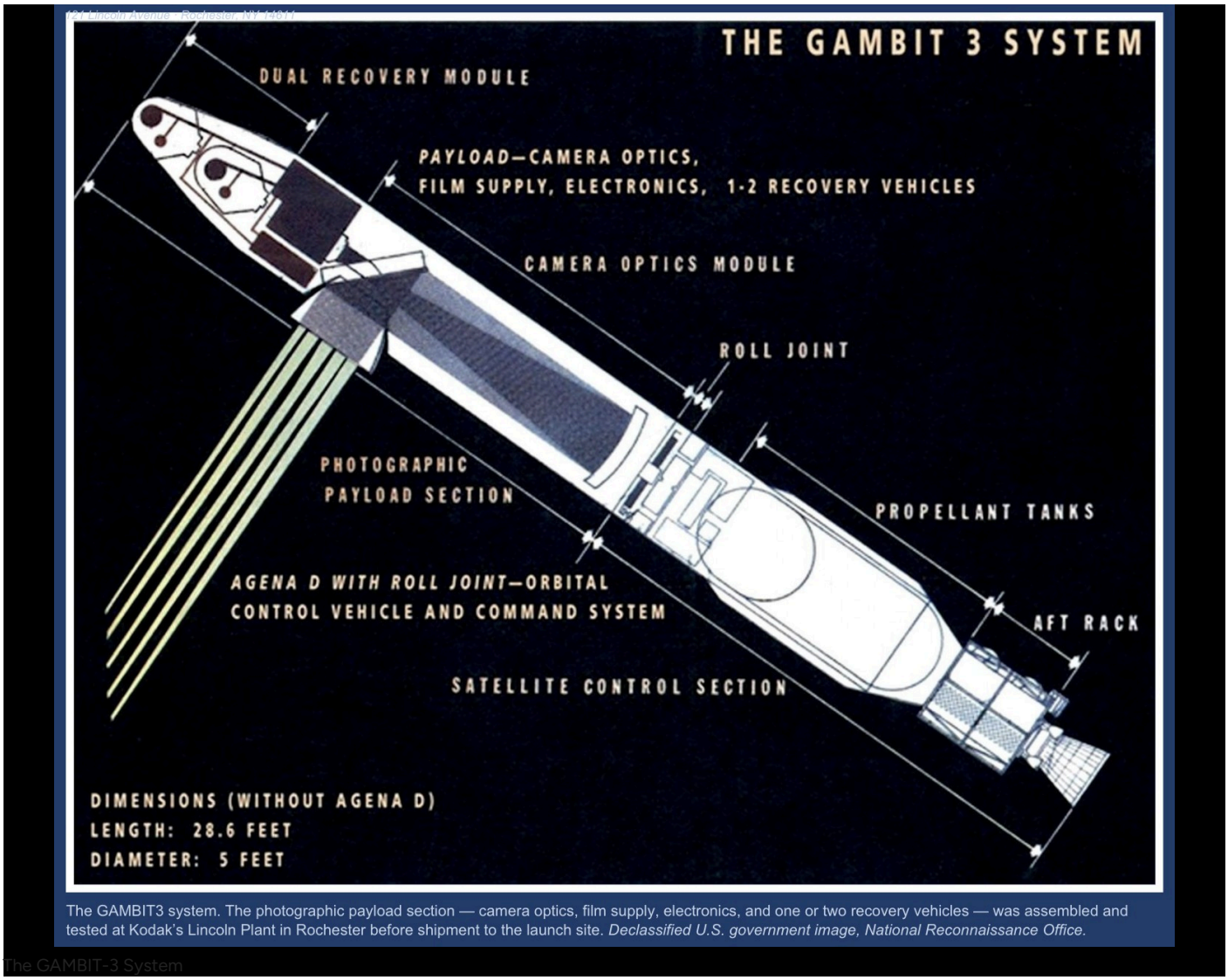
THE BRIDGEHEAD CHAIN

- Recovery capsule returned from orbit and delivered to Rochester
- Camera-original film developed under precision process control
- Duplicate negatives and positives produced
- Priority enlargements made for urgent targets
- Products distributed to analysts and agencies

LOCATION THREE

Lincoln Plant and GAMBIT

121 Lincoln Avenue · Rochester, NY 14611



The GAMBIT3 system. The photographic payload section — camera optics, film supply, electronics, and one or two recovery vehicles — was assembled and tested at Kodak's Lincoln Plant in Rochester before shipment to the launch site. *Declassified U.S. government image, National Reconnaissance Office.*

The GAMBIT-3 System

Lincoln Plant — LP — was a government-owned facility made available to Kodak for a number of programs, some of them classified and military, others unclassified and civil. The largest by far was GAMBIT[9]. At Lincoln Plant the program's research and development investigations were carried out, parts were manufactured, and KH-7 and KH-8 payloads received their final assembly and testing before shipment to the customer's launch site.

The GAMBIT system possessed a remarkable set of capabilities: nadir exposures looking straight down, forward and aft exposures forming stereo pairs, and oblique frame exposures. All of it was recorded on roll film 9.5 inches wide, five thousand feet long, and two mils thick, with individual frame lengths ranging from two inches to eighteen — followed by frame-by-frame process control back on earth.

Unofficially, GAMBIT achieved ground-resolved distances as small as half a meter. The official figure remains classified.

LOCATION THREE, CONTINUED

Lincoln Plant and GAMBIT

Lunar Orbiter · SAMOS



Lincoln Plant[10]

Lincoln Plant's other legacy is written on the moon in the research, manufacture, and assembly for the five camera and processor systems of NASA's Lunar Orbiter Program. Those systems mapped 99 percent of the lunar surface and identified the safe landing sites that the Apollo astronauts would later use. They flew with Kodak Bimat film made at Kodak Park. The system was derived from the highly classified SAMOS program, a system that was designed to develop exposed film while in low earth orbit, scan the images, and transmit them back to Earth – the first application of near real time satellite imaging. However, given lack of on-board image storage, limitations in downlinks, and unsecure data transmission, the classified program was cancelled and transferred to the National Aeronautics and Space Administration, a very successful technology transfer.

Pause for a moment and consider what that required. The spacecraft had to expose the film, develop it in flight without liquids that would boil away in vacuum, scan the developed negative line by line, and radio the result back across a quarter of a million miles — all without a human hand anywhere in the loop.

KEY PROGRAMS

- **SAMOS** – early reconnaissance program first launched in 1960 that would electronically scan its film and beam images down by radio link
- **Lunar Orbiter** — five camera/processor systems launched in 1966-1967; 99% of the lunar surface mapped

LOCATION FOUR

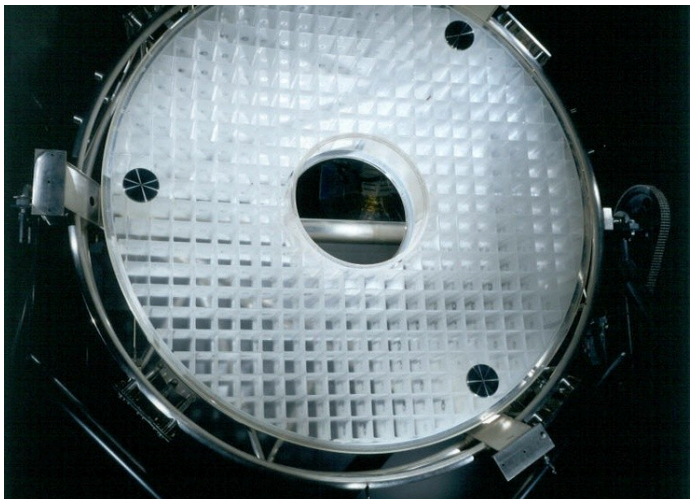
Earth Observing & Space Science Telescopes

Building 601 · 800 Lee Road · Rochester, NY 14606

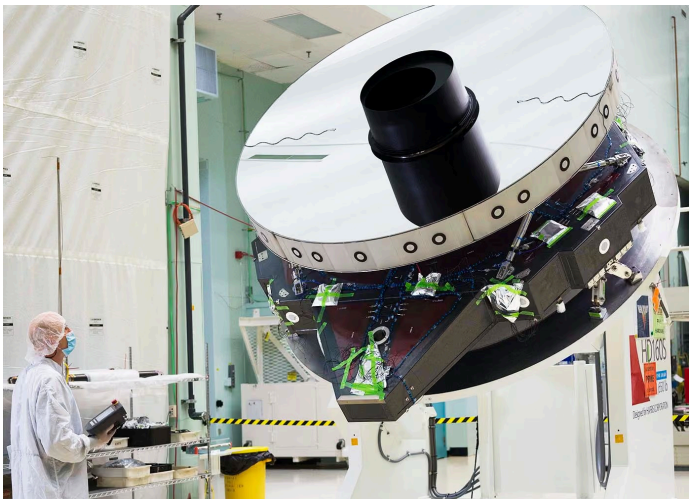
Operations at Building 601 were often integrated seamlessly with operations at Kodak's other locations. For multiple government programs, large lightweight optical components were manufactured here, and subsystems were assembled and tested.

Among the results: the optically perfect back-up mirror for the **Hubble Space Telescope**, the telescope for the **Chandra X-ray Observatory**, and critical assembly and test support provided to NASA for the **James Webb Space Telescope**. The legacy continued with the delivery of the **Nancy Grace Roman Space Telescope** program in 2024.

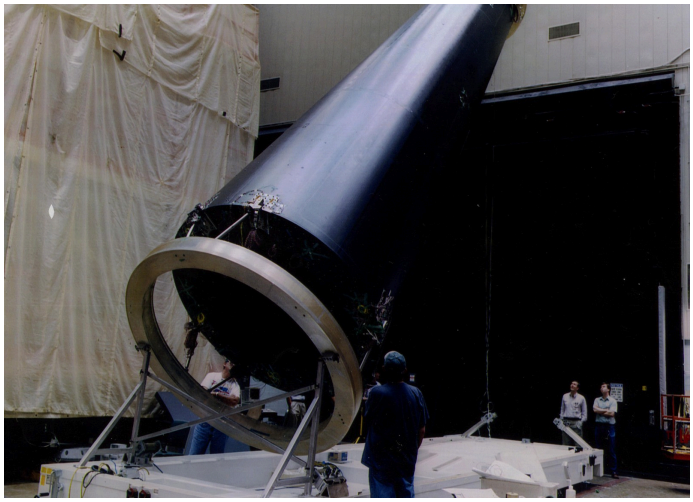
The completed 1,825 pound, 2.4m Hubble back-up mirror was tested and verified by Kodak in the 1990's to meet the strict optical tolerances prescribed by NASA. In contrast, advancements in lightweight mirror technology enabled a similarly sized finished mirror for the Roman Space Telescope delivered to Goddard Space Flight Center in 2024 that weighed only 410 pounds.



Hubble Space Telescope Backup Mirror[11]



Roman Space Telescope Primary Mirror[12]



Chandra Optical Bench[13]



Chandra X-Ray Observatory[14]

LOCATION FOUR, CONTINUED

Building 601: Webb and Beyond

800 Lee Road · Rochester, NY 14606



Pillars of Creation – Hubble and JWST imagery side-by-side[16]



James Webb Space Telescope[15]

Building 601 also manufactured the optical system for IKONOS, the first commercial earth visible imaging satellite, making high-resolution (80 cm), visible-light imagery accessible to the public and private sector for mapping, environmental monitoring, and other applications. Later commercial systems including GeoEye and WorldView, providing higher resolution (30 cm), were assembled and tested at Building 601 and other Kodak facilities.

The same advanced technical capabilities — figuring large mirrors, holding tolerances over long optical paths, testing in vacuum and extreme temperature environments, and keeping mass low enough to successfully launch — served a reconnaissance satellite looking down and science observatory looking out. Rochester's legacy is the ability to successfully apply these unique skills to numerous programs over multiple decades.

FROM ROCHESTER TO ORBIT

- **Chandra X-ray Observatory** — the telescope launched in 1999
- **IKONOS** — the commercial imaging camera system launched in 1999, followed by **GeoEye** (2008) and **WorldView** (2009, 2014, 2016) camera systems
- **James Webb Space Telescope** — the telescope launched in 2021
- **Nancy Grace Roman** — the telescope launched in 2026

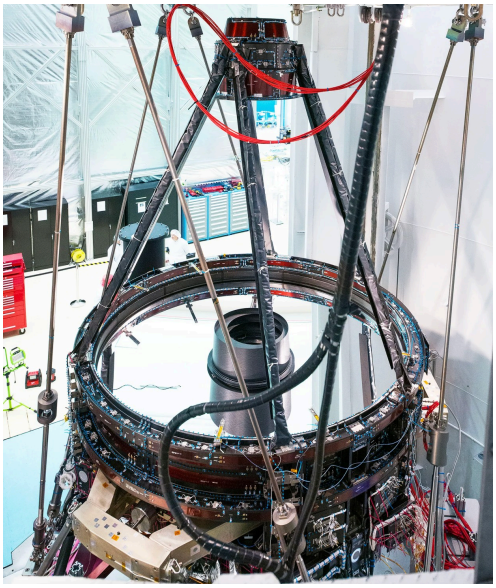
LOCATION FIVE

Elmgrove Plant

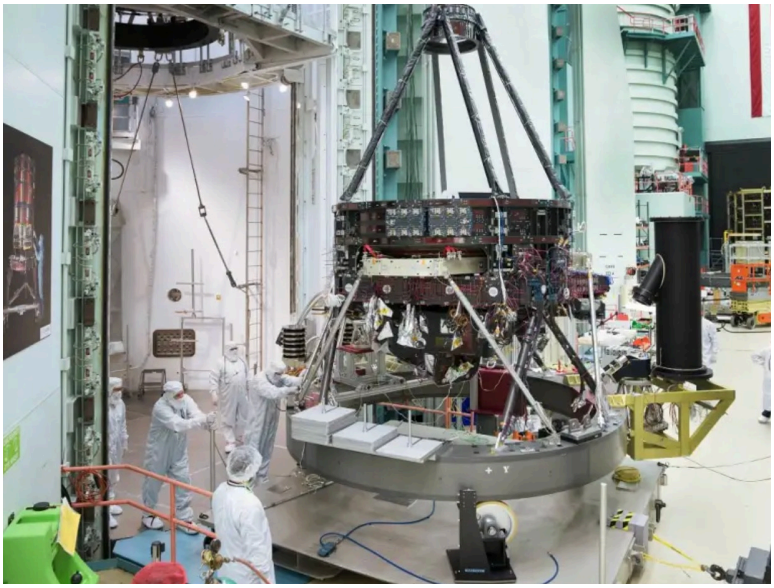
789 Elmgrove Road · Rochester, NY 14624

Construction of the Elmgrove Plant began in 1967, and the plant became the headquarters of Kodak's apparatus division, including the government focused Research & Engineering Group. Senior management for aerial photography equipment eventually moved to Elmgrove, as did much of the research and design engineering workforce. L3Harris Technologies currently owns and leases several buildings on the Elmgrove campus, along with other Rochester locations including Building 601.

Satellites must be tested for compatibility with space and to ensure they can endure violent launches and extreme temperature and pressure excursions. The facilities required to perform these tests include large vacuum chambers and large thermal vacuum chambers, capabilities that are available within the Elmgrove Plant campus. In addition to the imaging satellites already mentioned, NOAA weather satellites and GPS satellites now under the control of the U.S. Space Force were tested to ensure that once launched they would meet the demanding requirements to deliver accurate, comprehensive data to national users.



Roman Space Telescope – completing optical tests[17]



Roman Space Telescope – completing optical tests[18]

More than a picture – what the systems provided

Aerial and space imagery serves ends far beyond intelligence. The general categories include military planning, surveillance, and post-action assessment; intelligence documentation and reporting; science exploration; photogrammetry and cartography; agricultural and forestry assessment; urban planning and development; law enforcement; civil disaster analysis; highway planning and construction; traffic monitoring; real estate marketing; local government documentation; construction planning and progress reporting; news and weather reporting; and satellite-based travel monitoring and navigation. Nearly every one of those uses depends on a chain of materials, optics, and processes that was developed and assembled, over a century, in one mid-sized city in western New York.

SUPPORTING UNIVERSITIES AND COMPANIES

University of Rochester, Rochester Institute of Technology, and Tropel

Employees trained in specialized fields that support aeronautical and aerospace systems, including engineering, optics, image science, and dynamics are a vital resource for these five locations. It's no coincidence that local universities offer all the required fields of expertise, and that uncountable students have graduated and worked at these locations contributing their expertise to the programs described.

University of Rochester

The University of Rochester (U of R) is recognized as one of America's leading institutions for research, teaching, and innovation. Founded in 1929, U of R's Institute of Optics is the first optics education program in the United States and has awarded more than half of all optics degrees in the country. Numerous Alumni from the Institute of Optics, as well as the Department of Physics and Astronomy and the Engineering and Applied Sciences schools have leveraged foundational knowledge and hands-on research and contributed to the design, build, and testing of the telescopes and cameras described in this booklet.

Rochester Institute of Technology

Rochester Institute of Technology (RIT) is recognized for leadership in innovation, hands-on career preparation, and in specific fields supporting aeronautics and aerospace such as engineering (all disciplines) and imaging science. RIT is the only U.S. university offering an undergraduate Bachelor of Science in Imaging Science, which studies how images are generated, processed, and interpreted. Combining physics, math, computer science, and engineering, cutting-edge film-based and digital imaging systems are developed for planes, satellites, drones, and more. RIT's Aerospace Engineering Option focuses on all engineering aspects of design, development, and testing of aircraft, spacecraft, and related systems. Advanced coursework in the dynamics of aerospace systems is also offered, the understanding of which is critical to successfully surviving violent launch loads and stability for imaging once spaceborne.

Tropel Corporation

Founded in 1953 by University of Rochester scientists, the Tropel Corporation — now Corning Tropel, in Fairport — specializes in custom lens design, opto-mechanical alignment, and high-precision metrology. They produced optimized lens design and material specifications for camera lenses used in both high-altitude and space applications. Companies like Tropel were an important part of the regional capability that supported many important research and development programs.



University of Rochester Rush Rhees Library[19]



RIT Chester F. Carlson Center for Imaging Science[20]

REFERENCES

Photo Credits

Numbers correspond to the superscripts in the captions

1 **Lockheed U-2 Dragon Lady Spy Plane.** Image credit: https://lyonairmuseum.org/blog/brief-history-u-2-spy-plane-program/

2 **U-2 Photo from the Edge of Space.** Image credit: https://kinja-img.com/img/cjyacfggb2zcmlcsjgqa.jpg

3 **U-2 Film Spooling System.** Image credit: https://media.defense.gov/2007/Jul/12/2000471926/2000/2000/0/070712-F-1234P-011.JPG

4 **Earthrise from Lunar Orbiter.** Image credit: NASA, David Rumsey Map Collection, David Rumsey Map Center, Stanford Libraries.

5 **Corona Film Return Capsule.** Image credit: Smithsonian National Air and Space Museum, NASM Original Photography, NASM Acc. 2012-0026.

6 **Analyst's enlargement detail from a declassified satellite reconnaissance photograph. Priority enlargements of this kind were among the products distributed from the BRIDGEHEAD laboratory at Hawkeye Works.** Image credit: Declassified U.S. Government imagery.

7 **Niagara Printer – Early U-2 Film Processing Equipment.** Image credit: Photo taken at U-2 CIA Conference 1998.

8 **Hawkeye Works.** Image credit: Image sourced from the cover of *Bridgehead: The Story of Its Role in the Early Overhead Programs of the National Reconnaissance Office 1955-2000*, distributed by ITT Geospatial Systems for the NRO's 50th Anniversary (2011).

9 **GAMBIT-3 System.** Image credit: Declassified U.S. Government Imagery, National Reconnaissance Office.

10 **Lincoln Plant.** Image credit: https://rochesterentertainer.net/site-3

11 **Hubble Space Telescope Back-up Mirror.** Image credit: airandspace.si.edu/collection-media/NASM-A20010288000-NASM2017-10014

12 **Roman Space Telescope Primary Mirror.** Image credit: NASA/GSFC – svs.gsfc.nasa.gov/vis/a010000/a014400/a014461/Primary.jpg

13 **Chandra Optical Bench.** Image credit: NASA/chandra.si.edu/graphics/resources/illustrations/optical-bench5_300.jpg

14 **Chandra X-Ray Observatory.** Image credit: NASA – chandra.harvard.edu/press/cxcfact.html

15 **James Webb Space Telescope.** Image credit: NASA/GSFC – science.nasa.gov/mission/webb/webbs-mirrors/

16 **Pillars of Creation – Hubble and Webb images side by side.** Image credit: NASA – science.nasa.gov/asset/webb/pillars-of-creation-hubble-and-webb-images-side-by-side/

17 **Roman Space Telescope – completing optical tests.** Image credit: NASA – www.nasa.gov/wp-content/uploads/2024/04/ota-harris-240402-004-copyrevb.jpg

18 **Roman Space Telescope – completing optical tests.** Image credit: NASA – www.spacepage.be/nieuws/sterrenkunde/maak-kennis-met-de-nancy-grace-roman-space-telescope.html

19 **University of Rochester Rush Rhees Library.** Image credit: "RushRheesLibraryInWinterObliqueFromLeft" by Daniel Penfield is licensed under CC BY-SA 4.0.

20 **RIT Chester F. Carlson Center for Imaging Science.** Image credit: Chester F. Carlson Center for Imaging Science by Matthew D. Wilson (LtPowers), licensed under CC BY-SA 2.5.

– **Cover photograph.** Declassified U.S. Government imagery.

– **Plaque.** Photograph: AIAA. **Location map.** Map data © Google.

THE DESIGNATION

The Plaque

Rochester Museum & Science Center · Strasenburgh Planetarium · 663 East Avenue · Rochester, NY 14607



The AIAA Historic Aerospace Sites program recognizes places where events of enduring significance to aeronautics and astronautics took place. The Rochester designation covers five locations as a single site.

The plaque is publicly accessible at the Rochester Museum & Science Center, 663 East Avenue. The five recognized locations themselves are working industrial properties in private hands; the map on the back cover shows their locations, and several are readily visible from public roads.

HISTORIC AEROSPACE SITE

Rochester, New York

Five locations that imaged the Earth, the Moon and the universe



The five recognized locations, together with the Rochester Museum & Science Center, where the commemorative plaque is sited. Map data © Google.

1 Kodak Park
Ridge Road West at Lake Avenue, 14615
Film and photographic materials R&D and manufacturing

2 Hawkeye Works
St. Paul Street at Driving Park, 14621
BRIDGEHEAD precision processing; KH-7 / KH-8 support

3 Lincoln Plant
121 Lincoln Avenue, 14611
GAMBIT assembly and test; Lunar Orbiter camera systems

4 Building 601
800 Lee Road, 14606
Large lightweight optics; Chandra, JWST, Roman, IKONOS

5 Elmgrove Plant
789 Elmgrove Road, 14624
Research & Engineering division headquarters

★ **Plaque location**
Rochester Museum & Science Center
Strasenburgh Planetarium · 663 East Avenue, 14607
Open to the public

> The five recognized locations are working industrial properties in private hands; several are readily visible from public roads. The commemorative plaque is publicly accessible at the Rochester Museum & Science Center.

The AIAA Historic Aerospace Sites program commemorates places of enduring significance to aeronautics and astronautics. Presented by the AIAA Niagara Frontier Section.
aiaahistorycommittee.com/has · nf-aiaa.org

AIAA