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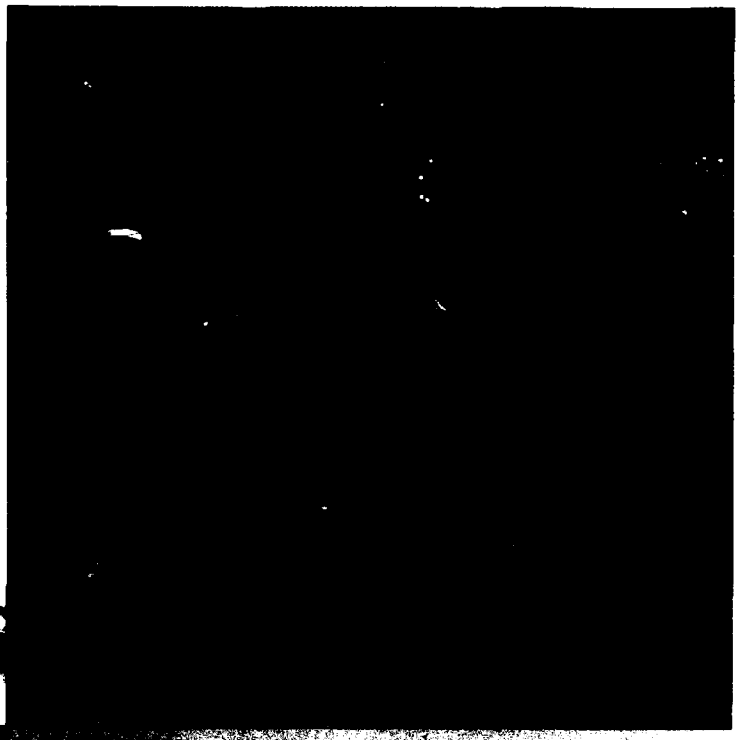
In-House Report

(2)

FORTY YEARS OF RESEARCH AND DEVELOPMENT AT GRIFFISS AIR FORCE BASE



June 1951 - June 1991

"Where Visions Become Reality"

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This historical monograph describes the accomplishments of the Rome Air Development Center and Rome Laboratory from its inception in June 1951 through June 1991. Information contained in the report includes facts on RADC/RL technical achievements, administrative policies, and miscellaneous points of interest.

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FOREWORD

Nineteen ninety-one saw both the fortieth anniversary of the establishment of a major Air Force Laboratory at Griffiss Air Force Base, the Rome Air Development Center (RADC), and the first anniversary of the redesignation of RADC as Rome Laboratory. The year was eventful in many other ways as well. Rome Lab technologies played a vital part in the stunning coalition victory in the Persian Gulf. The most profound restructuring of the organization in its history was accomplished smoothly and ahead of schedule, as Rome Lab received formal designation as the Air Force "superlab" for Command, Control, Communications, and Intelligence (C3I). The continuing collapse of Soviet Communism, and the resulting retrenchment in the United States defense establishment, presented Rome Lab, and, indeed, the entire Science and Technology community, with radically new challenges and significantly decreased resources.

Yet, as readers of this volume will observe, change is not new to this organization. In the final analysis, changes in structures and programs are less important than the continuing commitment of the Laboratory to advancing the state-of-the-art in the technologies which give commanders the means to understand a battlefield and employ their forces victoriously. While those technologies have undergone repeated revolutionary advances, the original RADC charter holds remarkably true after four decades, calling for the organization "to accomplish applied research, development, and test" in the use of electronics in such areas as "detection, control, identification and countermeasures, navigation, communications, and data transmission systems."

Many awards attest to the quality and productivity of the Laboratory and to the dedication of its people. But the ultimate proof lies in the hundreds of systems and other products delivered to the fighting forces over the years which have been vital elements in a technically superior Air Force and thereby helped preserve the nation's security and the world's peace. The pages which follow are full of examples of the talent, hard work, and solid achievement of the men and women who have shaped Rome Lab's proud heritage of excellence.

JOHN M. BORRY
Colonel, USAF
Commander

PREFACE

When portraying the history of any organization with an ongoing mission, the selection of chronological boundaries might seem somewhat arbitrary. Even so, the completion of forty years of research and development at Griffiss AFB under the Rome Air Development Center (RADC)/Rome Laboratory was an especially noteworthy landmark. Although RADC had just recently been renamed the Rome Laboratory and was implementing a structural reorganization, the ongoing work at the Laboratory continued to reflect the excellence that its staff had always demonstrated. In preparing this brief account, the Office of History seeks to recognize some of the many notable achievements of the Rome Laboratory throughout its existence.

The purpose and format of this study did not lend itself to the use of footnotes and a formal bibliography, so a brief note on the primary sources is in order here. The bulk of the information came from the official organizational histories. Also valuable were the annual RADC Accomplishments which were published by the Center for many years. In addition to this material, historical data was gleaned from a variety of documents on file in the Laboratory archives.

This volume was the result of the contributions of many individuals. Dr Thomas W. Thompson, the previous Historian, passed on to his successor the idea of preparing a "forty-year history." Staff members from every directorate assisted in tracking down some of the more recent information, in particular many of the details on the Laboratory's support to Operation Desert Shield/Desert Storm. Mr Mark Lomery and his Technical Resources Division, especially the personnel in the Technical Photo Branch and the Technical Illustration Branch, provided valuable, prompt support. I am also indebted to those who reviewed the work in draft, especially Dr Fred I. Diamond, Rome Laboratory Chief Scientist, and Colonel John M. Borky, Rome Laboratory Commander. Colonel Borky also provided the foreword. A special word of thanks goes to SSgt David A. Byrd of the Office of History, who co-authored this history and did the entire layout.

JOHN Q. SMITH
Historian

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FRONT COVER: (top left) An RADC-developed askania-theodolite tower built in support of guided missile development circa 1956; (top right) A recent photonics experiment in action. Photonics is the optical equivalent of electronics; instead of utilizing electrons, however, photonic devices employ photons; (bottom right) The entrance to Building 106 in the mid-1970's. Prior to installation of the card key entrance system, all RADC buildings were fenced in, with a 24-hour guard at the gate; (bottom left) The same view of a snow-capped Building 106 and Rome Laboratory sign today.

Approximately three years before the formal establishment of the Rome Air Development Center (RADC), Griffiss AFB officially received responsibilities from Headquarters, Air Materiel Command, in the area of electronics research and development. The resources would come from Watson Laboratories and the Middletown testing units at Middletown, Pennsylvania. Personnel from Middletown arrived at Griffiss AFB as early as 1948. On 6 July 1950, the Senate Committee on Armed Services recommended the establishment of an "Air Force Electronics Center" at Griffiss AFB, New York. President Truman signed the resulting bill on 26 September 1950, and the transfer of Watson Laboratories to Griffiss AFB, beginning on 29 November of the same year, was completed on 14 February 1951. Griffiss AFB was assigned to the Air Research and Development Command on 2 April 1951. On 12 June 1951, RADC was officially established.

SENIOR LEADERSHIP

As of 12 June, Colonel Paul E. Burrows, Griffiss AFB Base Commander, became the first RADC Commanding Officer. On 29 August, Brigadier General Daniel C. Doubleday -- whose fourth cousin, General Abner Doubleday, was said to have created the game of baseball -- assumed command. Early in General Doubleday's career, while he was Group Communications Officer for the historic 1st Pursuit Group at Selfridge Field, Michigan, he constructed and equipped a structure that was probably the first modern control tower to be used at an Army Air Field.

Colonel Alvin L. Pachynski was named the first Deputy Commanding Officer. Colonel Robert C. Sexton replaced Colonel Pachynski as Deputy Commanding Officer on 27 August. Mr Ralph Cole was named as the first Technical Director -- the senior civilian position -- of RADC.

ORGANIZATION

Mission

The mission of RADC was "to accomplish applied research, development and test of electronic air-ground systems such as detection, control, identification and countermeasures, navigation, communications, and data transmission systems, associated components, and related automatic flight equipment, in support of the mission of the Air Research and Development Command." As the host organization at Griffiss AFB, RADC also was tasked with providing logistical and administrative support to tenant units and organizations.

Personnel and Facilities

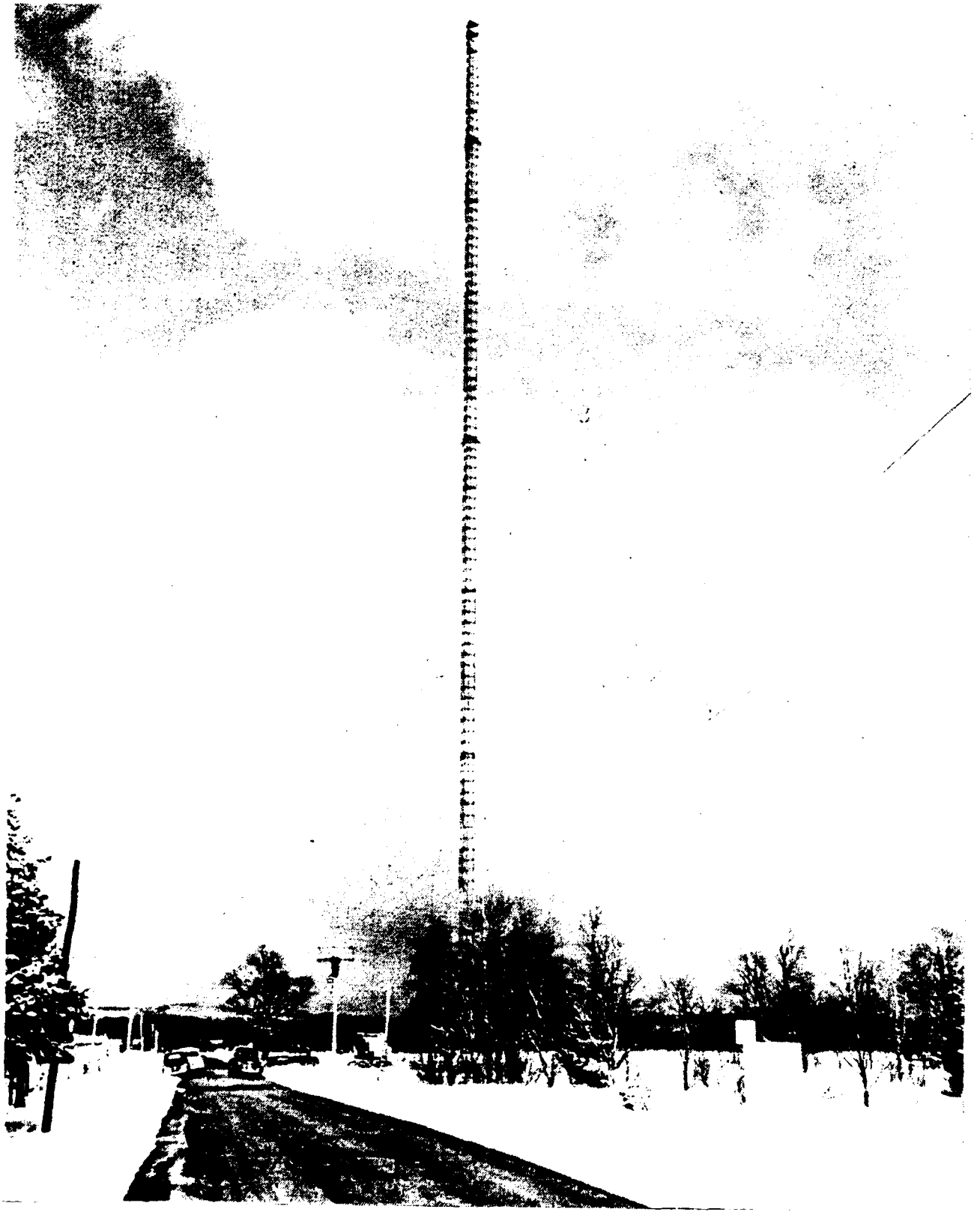
Personnel Military personnel assigned to HQ RADC, as of 1 November, included 117 officers, no airmen, and one WAF. The top civilian annual salary was under $9,500 (earned by only one employee). The average (mode) annual income for civilian employees at Griffiss AFB was between $3000 and $3500.

Off-Base Locations The District Engineer opened bidding for the construction of off-base facilities at Verona and Floyd, New York. The recently acquired tract of land at Verona covered 325 acres. The Floyd site would consist of a single building designed to test communications equipment.

Forestport Tower The Forestport tower, a transmission antenna used by RADC for low-frequency communications experiments, was constructed. Depicted on the opposite page, the tower was 1205 feet high, compared to the Eiffel Tower at 984.25 feet and the Empire State Building at 1250 feet.

Structure

RADC Headquarters Organizationally, HQ ARDC provided RADC with a headquarters. The Center was to operate as a command reporting directly to HQ ARDC. On 12 June, HQ ARDC had discontinued the Headquarters 2751st Experimental Wing, Headquarters 3171st Electronics Research and Development Group, and the Headquarters 3151st Electronics Group. All personnel assigned to those units were subsequently reassigned to HQ RADC.



Tower at Forestport

RESEARCH AND DEVELOPMENT ACTIVITIES

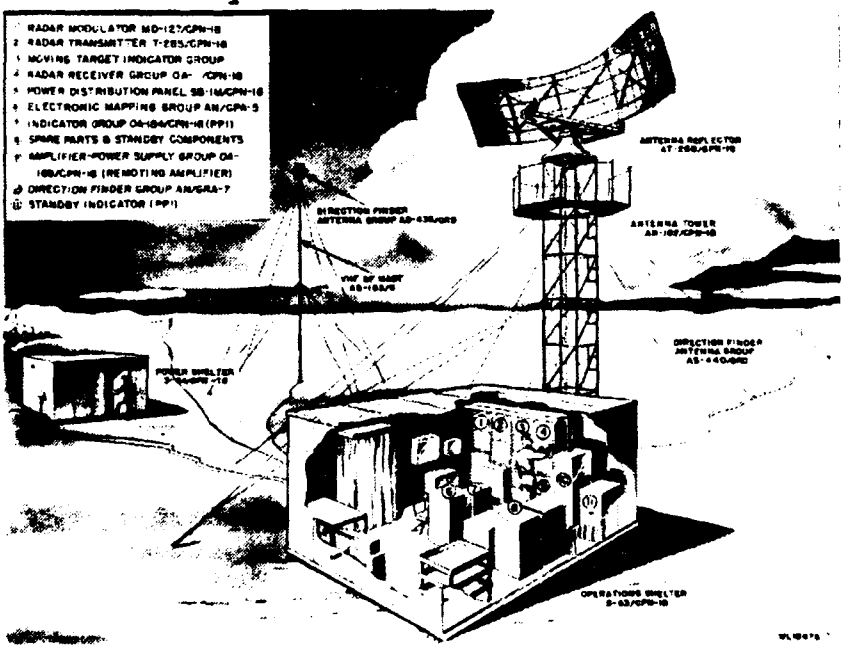
Surveillance

AN/FPS-6 Long-Range Height Finder Radar The AN/FPS-6 radar, developed at RADC, was the first long-range height finder radar employed at all Semi-Automatic Ground Environment (SAGE) locations. This system had a maximum range of 200 nautical miles and a height-finding capacity of 75,000 feet within an angle limit of minus 2 to plus 32 degrees.

AN/FPS-7 Radar The AN/FPS-7 radar system was one of the first stacked-beam systems to combine both the search and the height-finding capabilities. Operating in the "L" band, this long-range search radar was designed to perform ground-controlled intercept functions.

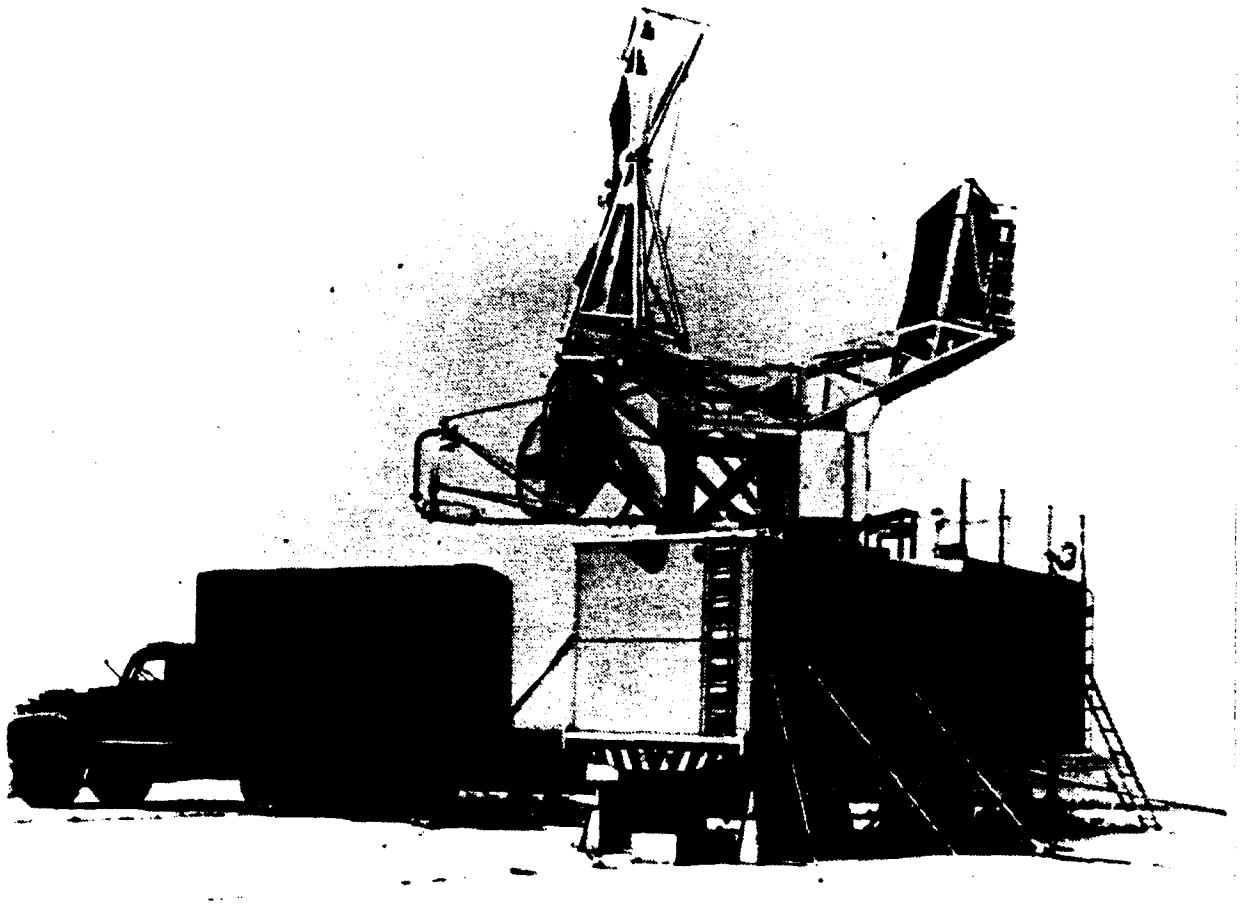
Interference Blankers RADC provided interference blankers for Moving Target Indicator (MTI) radar equipment. These blankers furnished simultaneous rejection of ground clutter and pulse interference signals when tracking moving targets.

Ground Surveillance Radar Set (AN/CPN-18) Acceptance of the last remaining items for the AN/CPN-18 ground surveillance radar set took place. This system included an S-band search system, an



Drawing of Radar Set AN/CPN-18

automatic direction-finding system, moving-target indication, video mapping, a land line remoting system which could handle up to four indicators at two miles, and a 30 nautical-mile range installed on an F-80 aircraft. An actual AN/CPN-18 is shown on page 5.



Operational AN/CPN-18

Communications

Vehicular Applications of Forward Area UHF & HF Radios One project involved the engineering application of forward area ultra-high frequency (UHF) and high frequency (HF) radio sets with provisions for a very high frequency (VHF) kit to be installed in an air transportable 1/4 to 3/4-ton vehicle. The system would have an eight-channel HF transmission capacity and an eighteen-channel UHF capacity with voice and tone emission. Northeastern Engineering, Incorporated, the primary contractor, completed the construction of an experimental model for RADC in 1951.

Omni-Directional VHF Radio Range RADC completed a program to provide a VHF radio range which would supply azimuth bearings to aircraft in all directions within range of the ground station.

UHF Intermediate and Rear-Area Ground-to-Air Radio Flight tests of the AN/GRC-27 radio sets, designed for communication with airborne sets, were completed. Testers concluded that it could replace intermediate and rear-area sets now using VHF.

Intelligence

Film Viewing Table RADC developed a viewing table designed to enable analysts to view aerial reconnaissance imagery in roll film transparency form.

Other

Microwave Broadband Tee Sections Sperry Gyroscope Co. developed and constructed tees for all standard waveguide sizes for the frequency range 2600 to 40,000 megacycles. RADC accepted the Sperry tees, while the tee for the 1120 to 1700 megacycle per second range were returned to contractor Sherron Electronics Co. for rework, since it did not conform to Air Force specifications.

Broadband Transmission Line Adapters RADC accepted delivery of two waveguide-to-type "N" adapters from Microwave Development Laboratory. The broadband transmission line adapter series developed under this program would cover the frequency range from 100 to 40,000 megacycles and would be designed to cover all waveguide and coaxial sizes of lines in this frequency band.

Low-Power Dummy Loads Contracts were completed for 3/8 inch, 7/8 inch, and 1 5/8 inch coaxial dummy loads and for waveguide dummy loads for frequency ranges 1120-1700, 1700-2600, and 2600-3950 megacycles per second. All dummy loads had a voltage standing wave ratio of less than 1.05.

Broadband Cavity-Type Frequency Meters RADC accepted experimental models of broadband cavity-type frequency meters covering ranges 550 to 1000 and 3950 to 5850 megacycles and final models with ranges from 550 to 3950 megacycles from Polytechnic Research & Development Co.

Command and Control

Unattended Ground X-Band Beacon Utilizing a receiver with an 80 megacycle bandwidth and a crystal-controlled transmitter, an X-band ground radar beacon capable of handling high traffic was developed. A production contract with Webster-Chicago Corporation called for the procurement of 45 units.

Ground-Controlled Approach Radar An AN/CPN-4 radar set capable of performing ground-controlled approach functions was delivered to RADC for evaluation. In a somewhat related development, Craig Machine, Incorporated was producing shelters for the AN/FPN-16 ground-controlled approach radar.

AN/CPN-4 at Armed Forces Day Exhibit

During the first six months of 1952, the current RADC historian commented that the Center had moved into "high gear." It was predictable that unsettled times would follow the transfer of Watson Laboratories to Griffiss AFB and the establishment of RADC, undoubtedly due in part to the need to fill so many personnel actions and set up the necessary administrative functions of a headquarters. By 1952, a degree of personnel stability and the existence of the necessary foundation contributed to the Center's increased efficiency.

On a different note, the annual snowfall for the area during FY 1952 was 32.2 inches. This showed a significant reduction from both the previous year's figure of 69.6 and the even higher annual average (119.78 inches) for the past ten years. Even the relatively low snowfall for the current year might have been an adjustment for some of the employees of Watson Laboratories who had relocated to Griffiss AFB following the transfer.

SENIOR LEADERSHIP

On 21 February, Colonel Alvin L. Pachynski became Vice Commander, the first such position established at RADC. Concurrently, Colonel Robert C. Sexton, who had been Deputy Commanding Officer, was named Chief of Staff. On 27 July, Colonel Franklin K. Paul became Vice Commander, replacing Colonel Pachynski, who moved to a new duty station. Colonel Paul assumed the position of Chief of Staff, in addition to his other duties.

On 8 July, Mr Harry Davis replaced Mr Ralph Cole as the Technical Director of RADC'S Electronic Development Division. Mr Cole resigned to accept a position with a private firm. General Doubleday continued to command the Center throughout the year.

ORGANIZATION

Personnel and Facilities

Recruiting Advertisements To help alleviate a serious shortage of civilian engineering employees, RADC contacted forty radio and television stations to set up recruiting announcements as part of a publicity program.

Manpower Statistics Total RADC personnel strength on 31 December was 3,020. As of 31 August, the total number of personnel assigned to HQ RADC included 93 officers, 91 enlisted, 932 graded civilians, and 248 ungraded civilians. Totals for RADC (including subordinate support units) were 197 officers, 753 enlisted, 1585 graded civilians, and 1396 ungraded civilians.

Watson Laboratory Sites Accountability for all Watson Laboratories sites in New Jersey was transferred from Griffiss AFB during the first six months, with the exception of the Adamston location.

B-17 Crash On 17 January, a B-17 aircraft, preparing to land at Griffiss AFB, crashed about a half mile from the base. Two of the crew were killed and five others were injured. A much more serious disaster was narrowly avoided, since the site of the crash was only a few hundred yards from the Rome Hospital and even closer to an apartment complex.

Joint Use Agreement With Eastern Air Defense Force Unit In February, the Commanding General, RADC, signed a Joint Use Agreement between RADC and the Eastern Air Defense Force Unit.

Officers' Club Fire On 12 March, the Griffiss AFB Officers' Club was destroyed by a fire. One officer, Captain John F. Gietl, died in the blaze from asphyxiation.

Joint Use Agreement With Air Materiel Command Units On 19 June, General Doubleday signed a new Joint Use Agreement with Air Materiel Command units on the use of facilities located at Griffiss AFB.

New Runway Extension On 15 September, General Doubleday officially opened a new runway extension, Runway 15-33, on base. Colonel Franklin K. Paul, who had been the first pilot to land at Griffiss AFB (when it was known as Rome Army Air Field), was the first pilot to take off and land on the extended runway.

Verona and Floyd Test Sites Three radar sets (AN/CPS-3, AN/CPS-4, and AN/CPS-5) were installed at the Verona site. RADC also acquired the radar test site at Floyd, located seven miles east of Griffiss AFB.

Building 102 Elements of the Electronic Warfare Laboratory moved into Building 102 in December.

Structure

Subordinate Unit Discontinuations Effective 1 August, HQ ARDC discontinued the HQ 6530th Air Base Wing, the 6530th Motor Vehicle Squadron, the 6530th Communications Squadron, the 6530th Supply Squadron, the 6530th Base Service Squadron, the 6530th Maintenance Squadron, and the 6530th Installations Squadron.

Effective 10 November, the following units were discontinued: HQ 6530th Maintenance and Supply Group, HQ 6530th Air Base Group, 6530th Air Police Squadron, 6530th Food Service Squadron.

Effective 10 December, the 6530th Flight Test Squadron was discontinued. A Flight Test Division under the Deputy for Operations assumed responsibility for flight operations.

RESEARCH AND DEVELOPMENT ACTIVITIES

Surveillance

Radar Operations Remoting System Motorola, Incorporated provided a developmental model of this radar operations remoting system to RADC, and it was installed as part of the Radar Data Remoting Installation at Griffiss AFB. The equipment was developed to accept data from a radar and convert it to a modulated radio-frequency wave which could be transmitted by radio or cable.

Automatic Antenna Pattern Recorder Electronic Associates delivered all contract items called for. Contract was for an antenna pattern recorder to include a broadband superheterodyne type receiver, a slow-sweep-speed, long-persistence cathode-ray oscillograph, and a camera, for permanent recording of signal.

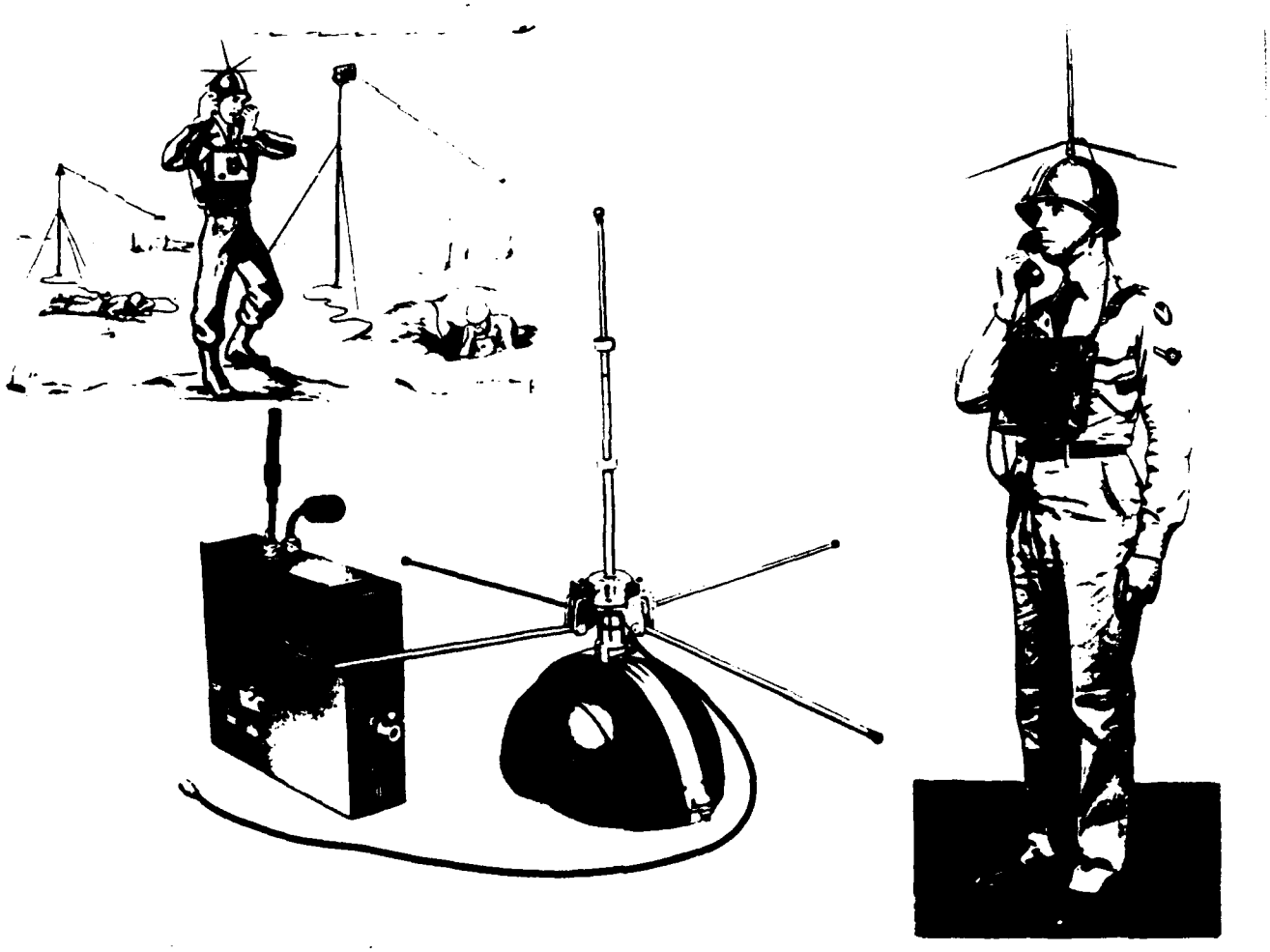
AN/MPX-7 Radar Identification Set RADC developed the AN/MPX-7 radar set. This equipment provided Mark X Identification Friend or Foe (IFF) capability for bomb-directing radar systems.

Communications

Ground VHF-UHF GCA Communications Equipment In January, Lavoie Laboratories delivered an experimental model and four service test models of a VHF-UHF ground radio set for ground-controlled approach (GCA) operations.

Communications Zone Indicator (COZI) Raytheon delivered the first Communications Zone Indicator (COZI) propagation frequency evaluation set to RADC. The equipment utilized backscatter of transmitted pulses obliquely incident on the ionosphere to determine the best operating frequency for a communications link.

Ground-to-Air UHF Pack Set RADC conducted flight testing of the AN/PRC-14 ground-to-air UHF pack set, developed for ground use during amphibious and airborne operations with aircraft equipped with the AN/ARC-19, AN/ARC-33, and AN/ARC-27 radios.



Radio Set AN/PRC-14

Propagation Frequency Evaluation Set Raytheon Manufacturing Company produced and completed a Propagation Frequency Evaluation Set (AN/GPQ-3) for the Air Force. The purpose of this equipment was to enhance reliability of high frequency communications circuits.

Navigation

Automatic Precision Approach Radar Gifillan Brothers, Inc. constructed an automatic ground controlled approach system able to handle six aircraft simultaneously. A flight test of the equipment took place on 26 February.

Radio Direction Finder Federal Telecommunications Laboratories delivered the first production model of the AN/CRD-6 direction finder to RADC in April. The objective of the program was the development of a radio direction finder which would operate on any one of ten predetermined channels in the 225 to 400 megacycle band. The contractor completed seven more production models in June.

Electronic Long-Range Navigation System A signal generator SG-28/U produced by Browning Laboratories successfully passed all service condition testing. The overall project was for the development of three-station long-distance Loran navigation system and two monitor stations.

Airport Surface Detection Equipment An airport surface detection device, commonly referred to as taxi radar, was moved to Idlewild International Airport, New York City, where it became operational on 16 September. It was designed to aid controllers in determining the location of aircraft in relation to stationary objects on the ground.

Long Distance Radio Navigation (NAVAGLOBE) System RADC accepted ten long-distance radio navigation (NAVAGLOBE) systems from Federal Telecommunication Laboratories, Inc. This equipment enabled pilots to determine position relative to the station by a direct reading indicator installed on the aircraft.

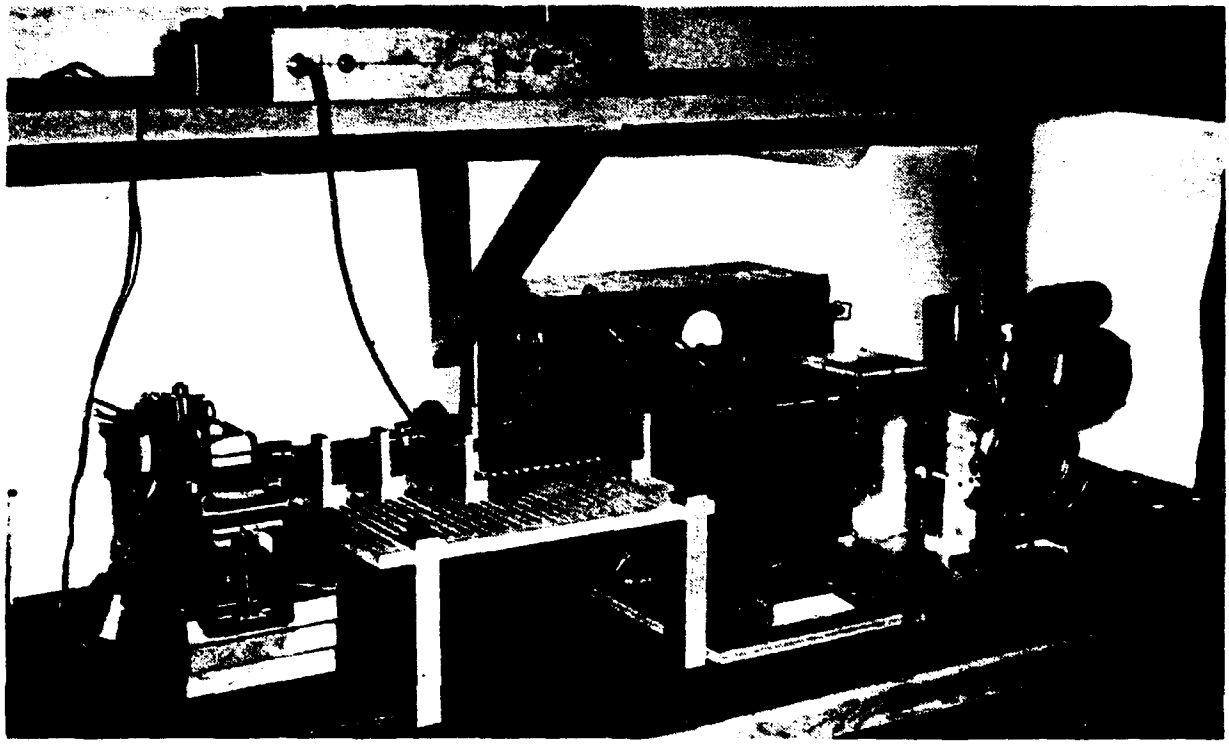
Command and Control

Direction Finder Signal-to-Noise Improvement Kit In March, Engineering Research Associates delivered a unit to be attached to existing radio direction finders which would permit operation of the equipment on signals obscured by noise. The equipment was installed at RADC's Floyd site.

Reliability and Maintainability

Automatic Power Measuring Equipment Polytechnic Research and Development Company delivered three field-type automatic power monitoring devices to RADC for testing. Under another contract Rutgers University constructed several power monitoring devices.

Broadband Automatic Test Equipment A breadboard model of a recording echo box was assembled. The ultimate goal of this project was to study the instrumentation requirements of the entire field of test equipment to determine the feasibility of making the test equipment automatic.



Automatic Recording Echo Box

Other

AN/MSQ-1 and AN/MSQ-2 RADC developed the AN/MSQ-1 and the AN/MSQ-2, which provided the first system designed for both bomb scoring and bomb directing functions. The MSQ mobile Close Support Control Set was able to guide and record missile flights, in addition to its directing and scoring capabilities.

Just as this year brought great changes to the United States as a nation -- with the inauguration of a new Republican president and the end of the Korean conflict, so it brought significant changes in the mission and the internal organization of RADC. Despite the fact that the senior leadership of the Center remained stable during 1953, RADC added areas of mission responsibility and underwent an internal reorganization of its research and development functions.

Senior Leadership

Brigadier General Daniel C. Doubleday, Colonel Franklin K. Paul, and Mr Harry Davis continued to fill the positions of Commander, Vice Commander, and Technical Director respectively throughout the year.

Organization

Mission

Mission Statement The following responsibilities were added to the RADC official mission statement: "1) Exercise responsibility for systems planning and appropriate engineering coordination in the field of USAF intelligence and reconnaissance. 2) Conduct applied research and development on ground based intelligence systems as directed. 3) Conduct applied research and development on those components of airborne and ground based reconnaissance systems that fall within RADC's technical areas of research and development."

Facilities

New Ground Electronics Equipment Building On 5 February, General Doubleday announced that work had begun to prepare for the construction of a ground electronics equipment storage and overhaul building at Griffiss AFB. Stock Construction Co., of Utica, was contracted for the construction of the $1,413,000 facility.

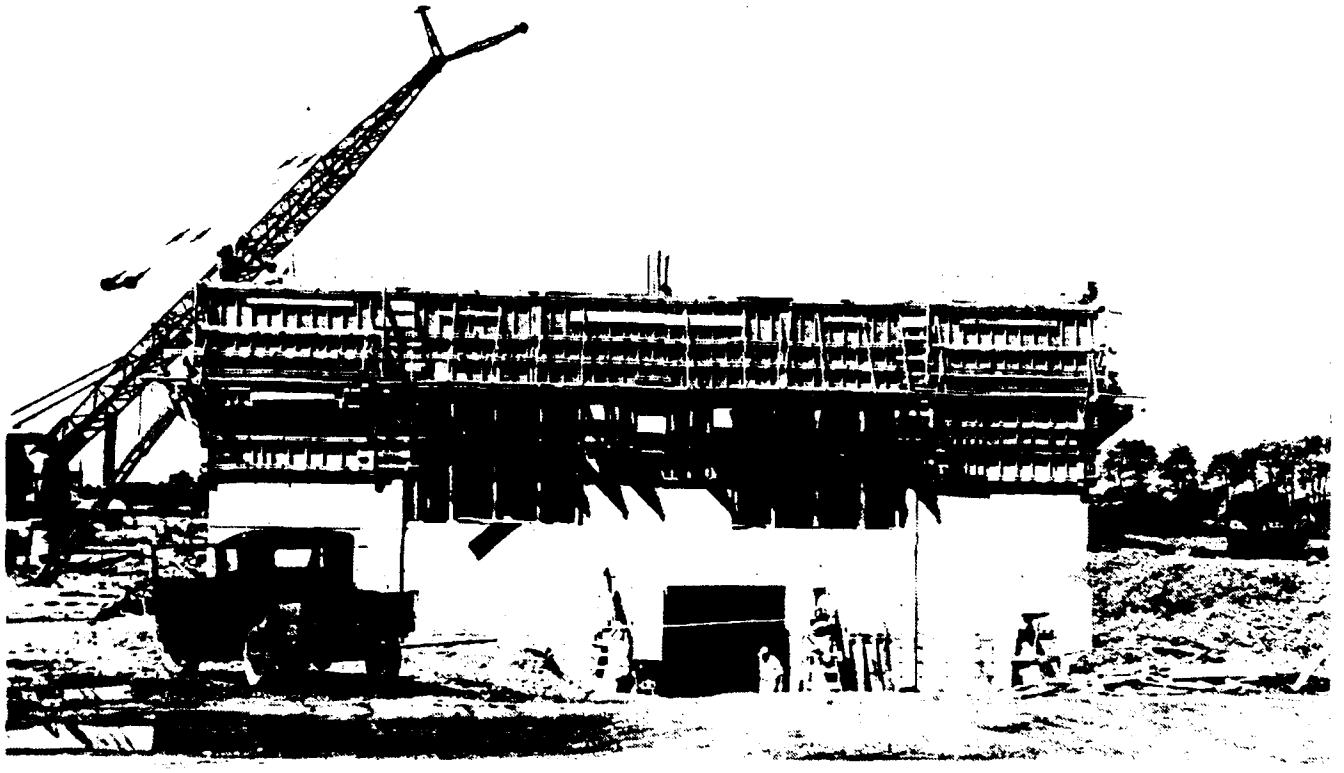
Jervis Avenue Site RADC leased 955 acres, located about 2.5 miles west of Griffiss AFB where Gifford Road and the Rome-Taberg highway intersected, at $3,870 per year for a new project known as the Jervis Avenue site. The Center would use this site to test the TRN-6, the FRN-12, and equipment for systems compatibility testing.

Newport Site The facility at Newport to be used for antenna pattern mensuration was acquired. This site was located approximately 18 miles northeast of Griffiss AFB.

Logistical Support Agreements A Logistical Support Agreement with Pope AFB, North Carolina, specifying logistical support to the RADC Experimental Station at Cape Fear, Wilmington, North Carolina was approved on 17 March, with ARDC approval on 8 April. A Logist-

ical Support Agreement with Tyndall AFB, Florida, specifying logistical support to the RADC Experimental Station at Carrabelle, Florida, was approved on 15 May, subject to final approval by the parent commands.

Aerial Reconnaissance Laboratory Groundbreaking A groundbreaking ceremony for a new Aerial Reconnaissance Laboratory took place on 10 March. Stock Construction Co. was the construction contractor for the three-story facility, with an estimated cost of approximately $2,355,000.



Construction of Aerial Reconnaissance Building

Structure

Internal Reorganization Along Divisional Lines On 1 January, a new internal organization went into effect. Four divisions were established: 1) Engineering Support Division, 2) Electronic Warfare and Techniques Division, 3) Equipment Development Division, and 4) Systems Division. A Plans and Operations Office provided overall plans and policy guidance. A Human Factors Office oversaw human engineering aspects of the RADC program. A Technical Direction Office and an Administration Office both provided the services implied by their names.

RESEARCH AND DEVELOPMENT ACTIVITIES

Surveillance

Moving Target Indicator Radar Two out of four equipment items for the moving target indicator radar system were delivered and accepted. They included a Video Pulse Generator and a Pulse Jitter Tester.

Communications

Radio Noise Meter Converter RADC tested and accepted four models of a Radio Noise Meter Converter. The Air Force approved an extension of the developmental contract to include an integral calibrator and an instruction booklet describing use of the converter with standard commercial and military receivers operating at ranges of 150 kilocycles to 1000 megacycles.

Telescopic Mast During the first half of the year, RADC developed a telescopic antenna mast, to be carried on a vehicle, for the AN/MRC radio set. The mast, shown on the following page, could be extended to a height of 30 feet.

AN/GRC-47 Air Rescue Radio RADC developed the AN/GRC-47 air rescue radio.

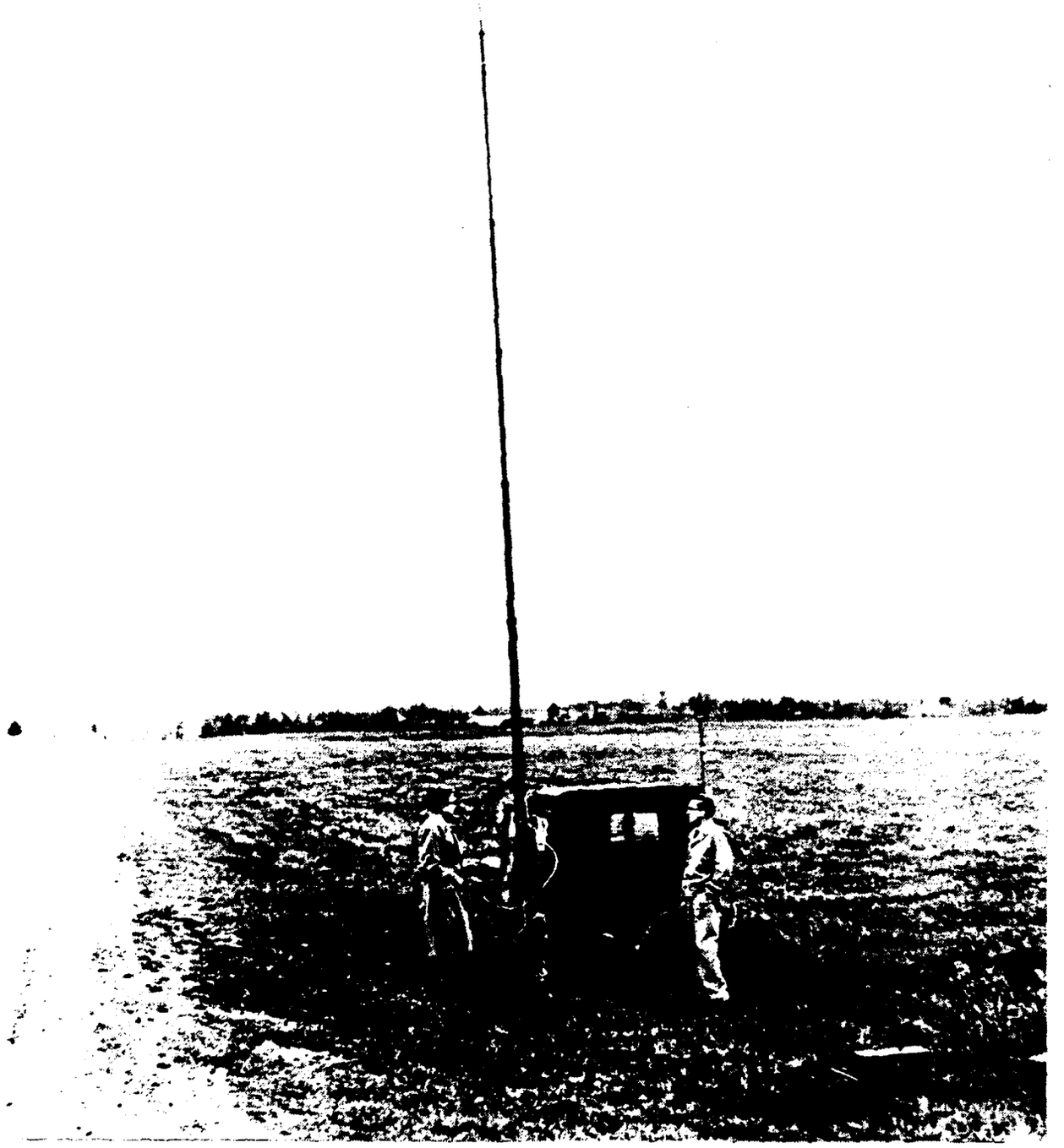
Command and Control

Project Two Wheels RADC completed the development of Project Two Wheels, the AN/MRN-14, an air traffic control facility. This facility, used in support of the Korean conflict, provided automated ground control capability.

Navigation

Radio Direction Finder (AN/CRD-6) Development of a radio direction finder was completed, resulting in a ground-based and air-transportable system capable of covering the frequency range of 225 to 400 megacycles. The equipment was designed as a homing device at air bases, in addition to performing general radio direction finding. It could indicate the direction from which a signal was received within an accuracy range of three degrees.

Radar Ground Control Approach Unit Griffiss AFB installed a new radar ground control approach unit on the flight line. The unit was able to pick up aircraft within a 30-mile radius on its screen.



Telescopic Mast with AN/MRC-20 Radio Set

Intelligence

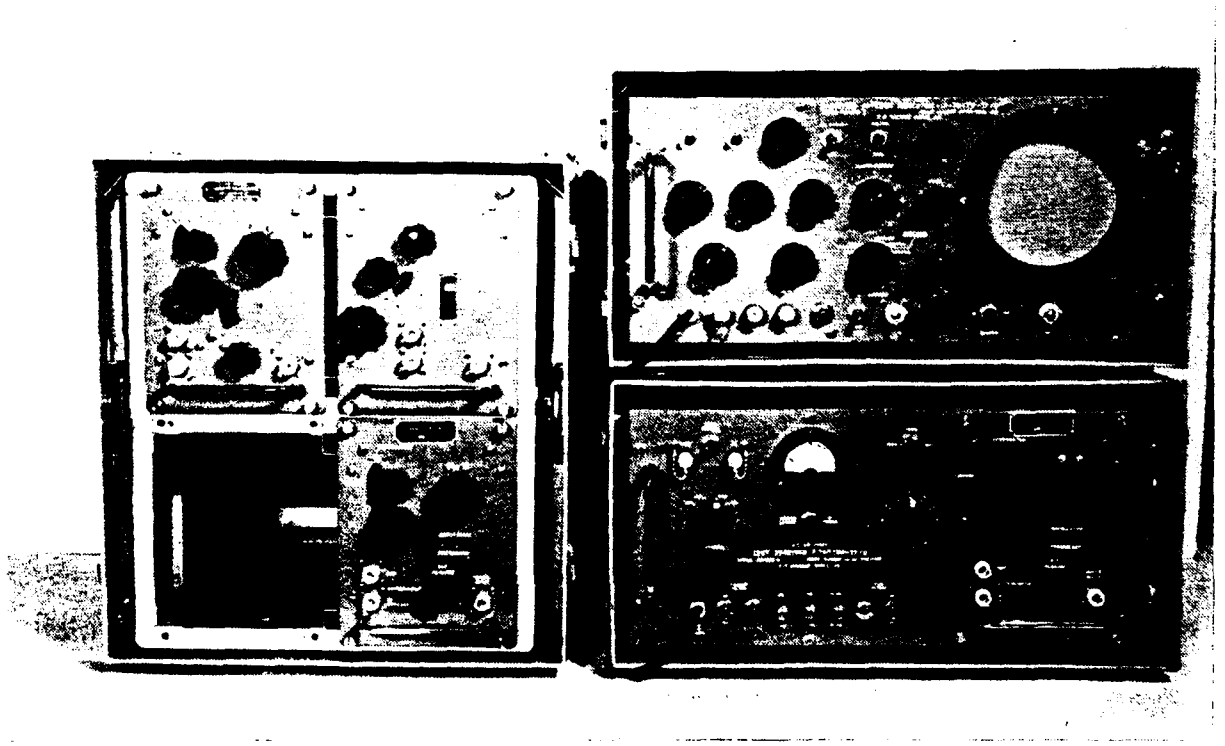
Portable Infrared Detector With the addition of the intelligence and reconnaissance mission to RADC's developmental function, the Center developed a portable infrared detector.

Reliability and Maintainability

High Power Radio Frequency Dummy Loads Airtron, Incorporated completed work on a contract for three jog-power "L"-Band dummy loads for testing at RADC. This was part of an effort to develop a series of high power radio frequency dummy loads to meet a variety of specialized requirements.

Impulse Interference Blanker Delivery of an experimental model of an Impulse Interference Blanker designed for communications receivers to RADC for testing took place.

Antenna Pattern Analyzer (AN/URM-16) An Antenna Pattern Analyzer was developed. The equipment consisted of a Radiation Pattern Indicator, a Test Receiver, and accessory tuning units.



Antenna Pattern Analyzer

The reassignment of Griffiss AFB from the Air Research and Development Command to the Air Materiel Command meant a shift of RADC responsibility, as the Center lost its status as host organization at Griffiss. The transition to tenant status meant relying on the Rome Air Force Depot for support services normally associated with installation host, and there would of necessity be a time of readjustment. One of the last key events at the base before RADC relinquished control was the Second Annual Air Force World-Wide Track and Field Events, hosted by Griffiss AFB on 18-19 June.

SENIOR LEADERSHIP

On 29 May, Brigadier General Stuart P. Wright (whose nickname was "Stud") assumed command from General Doubleday. General Wright came to RADC from Korea, where he had served as the Deputy Commanding General of the Fifth Air Force (Rear). General Doubleday departed on 2 June to become Commanding General of the Air and Airways Communications Service, with headquarters at Furstenfeldbruch, Germany. On 27 October, General Wright was promoted to the rank of Major General.

On 30 September, Colonel Daniel B. White became the RADC Deputy Commander. Colonel Franklin K. Paul, who had been the Vice Commander, was transferred to an overseas assignment. Mr Harry Davis continued to fill the position of Technical Director.

ORGANIZATION

Structure

Consolidation Considered On 23 March the Air Force revealed potential plans to consolidate HQ RADC and HQ, Cambridge Research Center at Bedford, Massachusetts. By 3 June, the consolidation plans were suspended.

Elimination of Chief of Staff The position of Chief of Staff was eliminated on 28 June.

RADC Becomes Tenant Organization On 1 July, Griffiss AFB was assigned to Air Materiel Command instead of ARDC, and RADC became a tenant organization. Due to this change, 1,957 civilian authorizations had been transferred from RADC to Rome Air Force Depot on 30 June, leaving the Center with 1,114 civilian positions.

DCS/Personnel and Administration After RADC became a tenant organization, the DCS/Personnel and Administration was formed.

Subordinate Units Reassigned Effective 1 July, 6530th USAF Hospital was reassigned from RADC to Air Materiel Command. The 6530th WAF Squadron was discontinued on the same date.

Personnel and Facilities

New Officer's Mess On 17 March, a ground-breaking ceremony was held for the new officer's dining hall at Griffiss AFB, which would also serve as an officer's club.

Carrabelle Test Site On 1 May, accountability for the Carrabelle Test Site was transferred to Tyndall AFB, Florida.

Camden Site RADC acquired the site at Camden, located about 25 miles northwest of the base, in support of the NAVARHO development.

Starr Hill Tower The state of New York granted permission for RADC to construct a tower on the state-owned forest preserve at Starr Hill, located about 19 miles northeast of Griffiss AFB.

RESEARCH AND DEVELOPMENT ACTIVITIES

Surveillance

AN/FPS-12 Radar RADC developed the AN/FPS-12 Low Altitude Coverage Radar system. This was the first multi-range-gated Doppler filter radar system.

Multichannel Rotary Joint A significant surveillance accomplishment was the development of a multichannel rotary joint for use with high-power radar.

AN/GRA-27 Radar Interference Blanker RADC developed the AN/GRA-27 radar interference blanker.

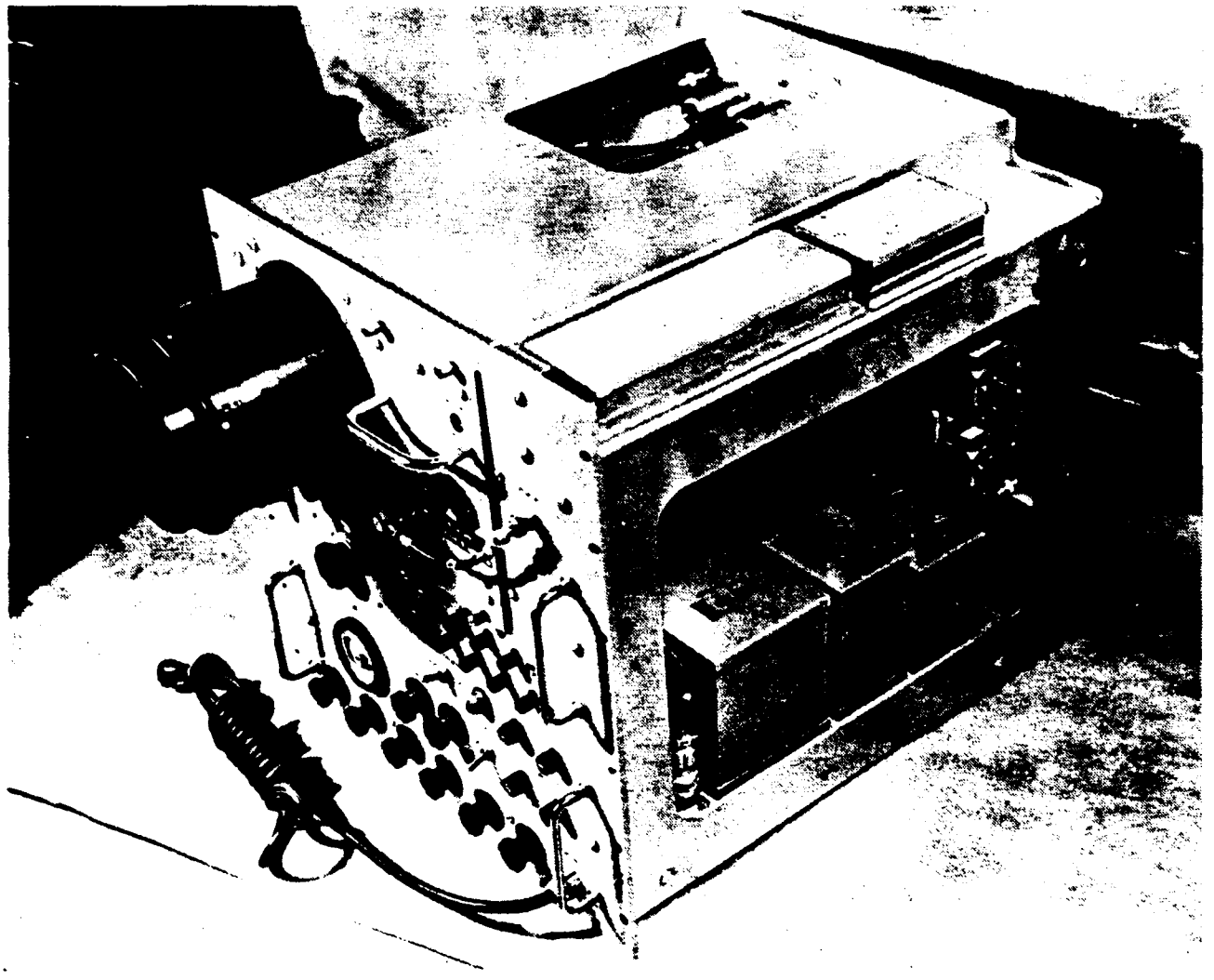
Traveling Wave Tube Technology RADC successfully applied Traveling Wave Tube Technology (TWT) technology to radar systems which made possible the amplification of radar signals.

Navigation

Multi-Signal Direction Finder Melpar, Incorporated completed an experimental model system of the AN/GRD-9 Multi-Signal Direction Finder and installed it at RADC in May. Tests showed the system to be able to take simultaneous bearing on two or more transmissions on a single frequency at a range of 160 to 550 megacycles.

Reliability and Maintainability

TS-454 Spectrum Analyzer Canoga Corporation completed and tested the first engineering model of the TS-454 Spectrum Analyzer, which would operate at frequency ranges of 1000 to 4500 megacycles.



Spectrum Analyzer

Other

Automatic Antenna Pattern Recorder Nine models of the AN/URM-16 Antenna Pattern Analyzer Group had been delivered, tested and accepted. The equipment included a broadband super-hetrodyne type receiver, a cathode ray oscillograph and a camera. The Center was in the process of closing the contract out and initiating two new ones for additional tuning units to operate at the VHF/UHF and the super high frequency ranges.

AWARDS

National Safety Council Award of Merit In August, the National Safety Council selected RADC for the Award of Merit, in recognition of successful reduction of ground accidents during the previous year.

The year 1955 was relatively tranquil by any standards, perhaps reflective of the overall mood of the country during this time in the Eisenhower years. The stability in leadership, mission, and organization and general lack of turmoil in the experience of the Center were particularly notable in contrast to the changes of the previous year.

SENIOR LEADERSHIP

There were no changes in the three senior leadership positions at RADC throughout 1955.

ORGANIZATION

Facilities

NAVARHO Installation Construction of the NAVARHO Installation, costing $600,000, was completed, and the facility was ready for operation by 1 December.

Laredo Site An operations building for a high-power long-range radar facility was completed at Laredo, Texas. RADC was responsible for the installation and operation of this radar site, even though funds for construction came from a special Air Force appropriation rather than from the RADC budget.

RESEARCH AND DEVELOPMENT ACTIVITIES

Surveillance

Steerable Array Radar and Communications (SARAC) As part of the Steerable Array Radar and Communications (SARAC) program, an experimental model was developed. The objective was the development of the first electronically steerable phased array radar.

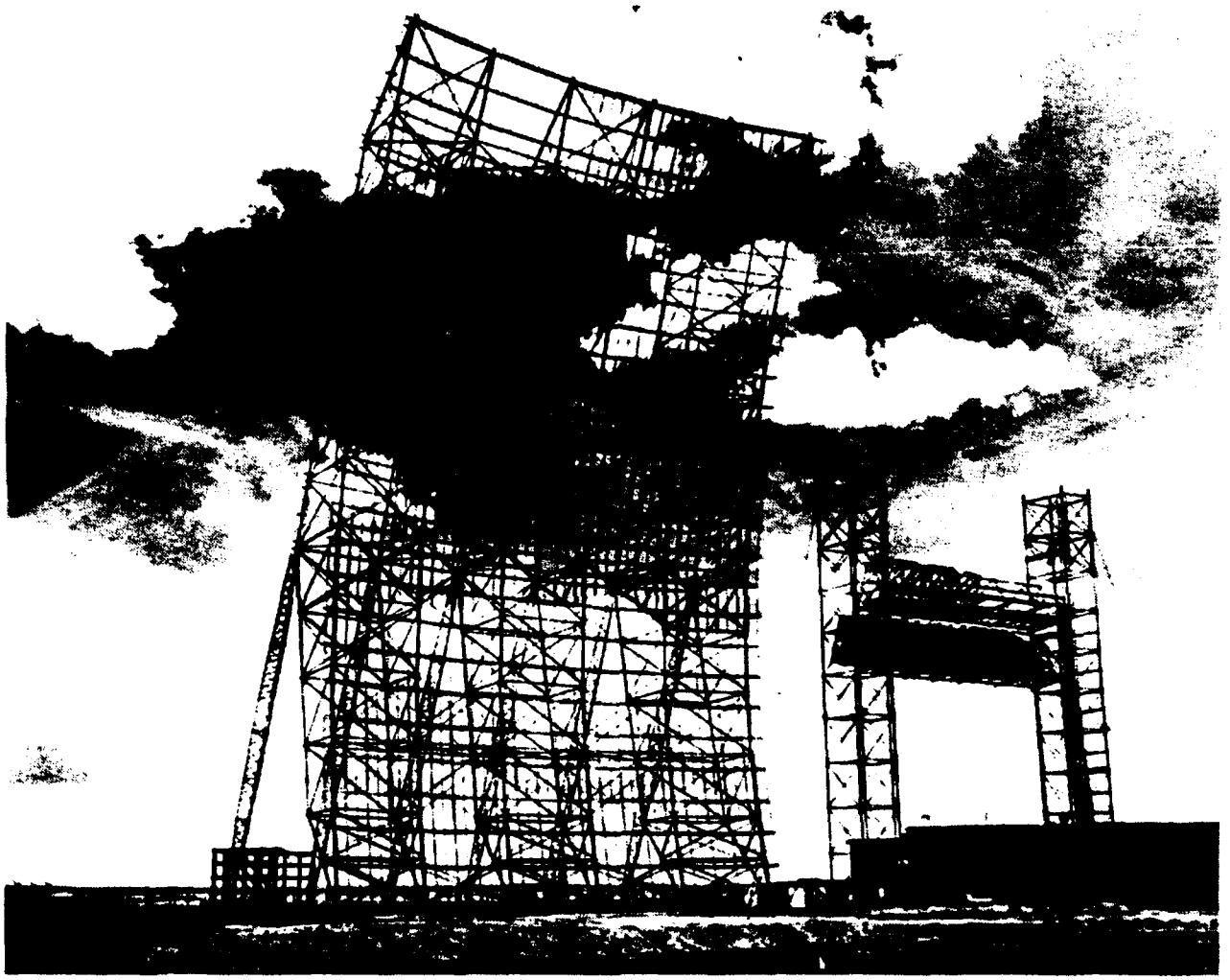
Wizard Program RADC conducted the Wizard program, a research effort designed to investigate ballistic missile strategy with a view toward developing a workable ballistic missile defense. A significant accomplishment of this effort was the development of the multi-function array radar terminal defense concept.

High Power Search Radar RADC developed a high-power search radar (AN/MPS-11) to be used by TAC and the US Marine Corps. Both the radar and all supporting equipment was transportable in nine trucks and two trailers and could be erected in less than three hours.

AN/PLR-3 Passive Detection System On 26 August, the Air Force publicly announced the Portable Passive Detection Receiver (mounted on a hat), developed by RADC. This was the first transistorized equipment produced by the Center.

Helmet-Mounted Radar

AN/FPS-17 Space Surveillance Radar RADC developed the AN/FPS-17 radar system. This was the first surveillance radar system designed to detect objects in space.



AN/FPS-17 Radar

Communications

Telephone Switching Facility (AN/GTA-6A) RADC was responsible for the development of the AN/GTA-6A, a telephone switching facility.

White Alice Communications Network Studies began for a proposed communications network across Alaska in order to extend the existing Distant Early Warning (DEW) line, the system designed to provide early warning capability of attack by enemy bombers.

Command and Control

AN/GPA-37 Radar Course Directing Equipment On 13 December, the first AN/GPA-37 Radar Course Directing Equipment, developed by RADC, was installed at the Verona Test Site. The first operational data link test flight took place on an F-86D fighter interceptor aircraft on 28 December.

Navigation

Long-Distance Navigational Aid (NAVARHO) Construction and installation of transmitters for a long-distance ground-based navigation system was completed by December, although tests indicated the need for further technical developments.

Airport Surface Detection Equipment An improved taxi radar was completed on 31 December for installation at Griffiss AFB for test purposes.

Intelligence

AR18A Lightweight Film Table In support of intelligence analysis, RADC developed a lightweight film-viewing table in order to provide portable and universal viewing capability.

The year 1956 saw the transfer of several ground data handling and intelligence projects from the Wright Air Development Center to RADC. In addition, the NAVARHO site at Camden, New York, and the Laredo, Texas, Test Site became operational. These were just a few of the highlights of this year in which senior leadership remained stable.

SENIOR LEADERSHIP

By the end of 1956, the former position of Technical Director was referred to as Scientific Director. Mr Harry Davis continued to fill this position. Command of the Center remained in the hands of Major General Stuart P. Wright, and Colonel Daniel B. White continued to fill the position of Deputy Commander.

ORGANIZATION

Facilities

Off-Base Sites A flurry of activity at RADC's off-base sites took place during the year. By 30 January, all facilities (including three transmitters) were completed at the NAVARHO site at Camden, New York, and the site was ready to commence operations. In Texas, the Center's Laredo test facility became operational. Lastly, RADC acquired a test facility at North Osceola (Dean Hill), located approximately 25 miles northwest of Griffiss AFB.

Structure

Project Transfers from Wright Air Development Center On 8 April, HQ ARDC transferred a number of projects involving intelligence and ground data handling from Wright Air Development Center to RADC. The change in responsibility also involved the transfer of nine military and 21 civilian authorizations.

Directorate of Communications On 1 July, the Directorate of Communications was formed.

Directorate of Control and Guidance The Directorate of Control and Guidance was established. Both this directorate and that of Communications were formed from the previous Directorate of Electronics.

RESEARCH AND DEVELOPMENT ACTIVITIES

Surveillance

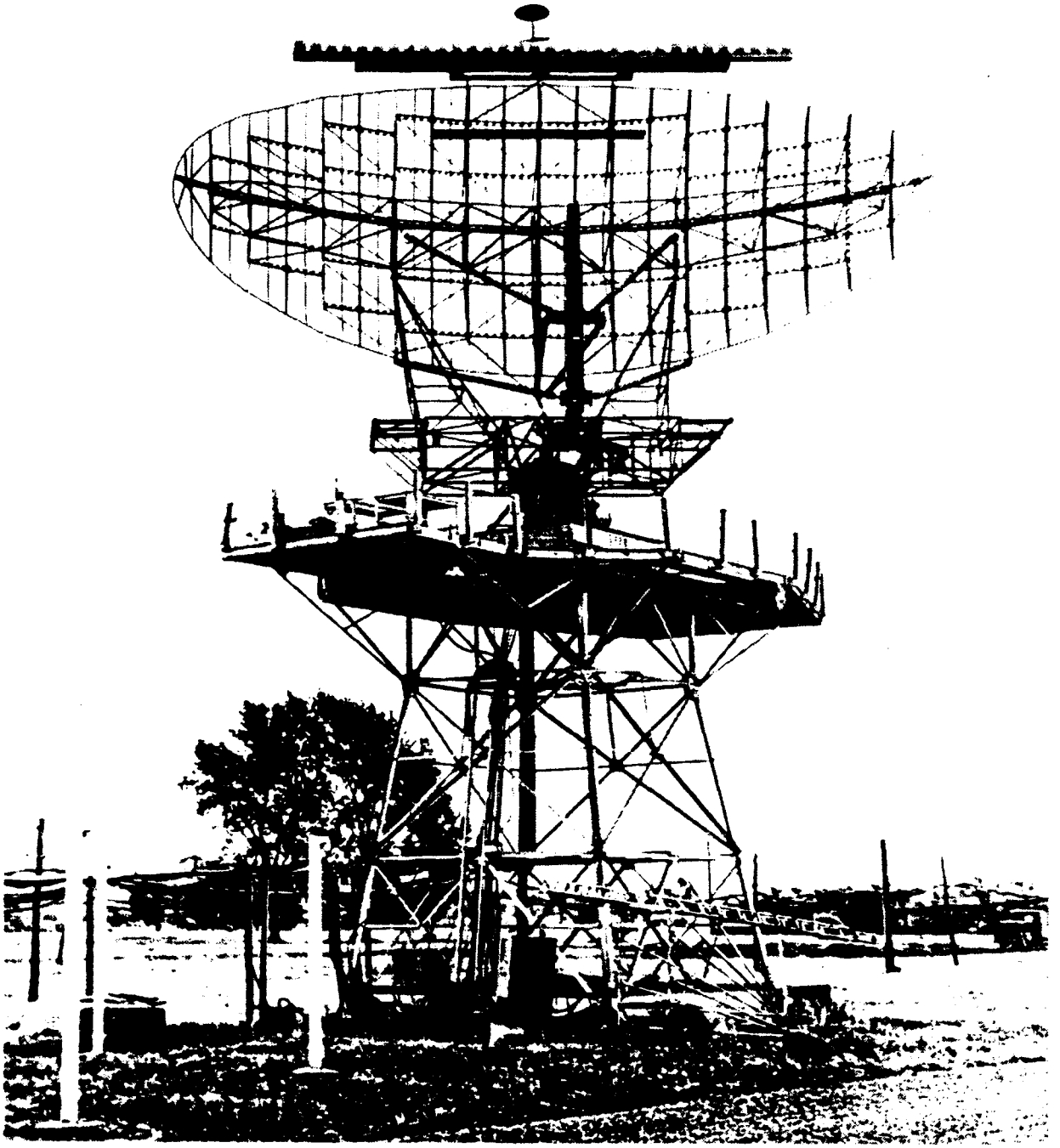
AN/MPS-16 Height Finder Radar RADC developed the first lightweight height finder radar equipment for Tactical Air Command. This high-power, long-range, mobile equipment supported tactical air control and ground-controlled interception.

DEW Line Radar The final shipment of the AN/FPS-19 radar for use along the Distant Early Warning (DEW) Line was completed on 11 May. This equipment was designed to operate during wind speeds of up to 40 miles per hour.

DEW Line Radar and Billboard Antennas at Nikolski Station in Alaska

Paraballoon Antenna RADC constructed an air-inflated paraballoon antenna, three stories high. Constructed of light-weight material, it could be disassembled quickly, packed into individual containers weighing only 200 pounds each, and then airdropped into a tactical area. This antenna was only 17.3 percent of the weight of a conventional antenna.

AN/FPS-20 General Surveillance Radar Production of the AN/FPS-20 Surveillance Radar began. This dual-modulator, fixed station, general surveillance system, developed by RADC became the main surveillance radar for the continental United States. Equipped for dual-channel operations with a klystron transmitter, this system provided long-range surveillance capability.



AN/FPS-20 Air Defense Radar

Communications

Microwave Relay Station The Center announced the development of a portable microwave communications relay station. Composing the station were a 100-foot magnesium tower and equipment, all of which weighed only 1100 pounds and could be conveyed by helicopter.

After transport to a site, the station could become operational in two hours.

Helicop-Hut RADC developed a light-weight, high-strength shelter for communications equipment. Capable of being transported by air, the Helicop-Hut, weighed less than 1,000 pounds.

Navigation

Tactical Air Navigation System (TACAN) A traffic capacity test of the TACAN beacon was completed on 28 February, with excellent results at a peak traffic load of 122 aircraft. The TACAN system was to provide electronic navigation in any direction, providing bearing and distance data from a ground station to aircraft.

Landing Control Central (AN/GSN-5) RADC developed the Landing Control Central (AN/GSN-5), the first experimental automatic landing system for the Air Force. With this equipment, aircraft could be landed automatically and safely in any weather.

Reliability and Maintainability

Radio Frequency Anechoic Chamber In order to conduct free-space tests, RADC constructed a microwave dark room, or Radio Frequency Anechoic Chamber. The chamber, nine feet by 20 feet and fifteen feet high, could support the study of antenna patterns and the interaction of microwave radiation on dielectric and magnetic substances.

Mobile Interference Measurement Laboratory (AN/MSM-7) Networth Manufacturing Corporation delivered a mobile interference measurement laboratory to RADC in July. The unit was designed to support electronic field testing outside of the Center's laboratory facilities and provided living accommodations for the crew. The cost of the unit was approximately $32,000.

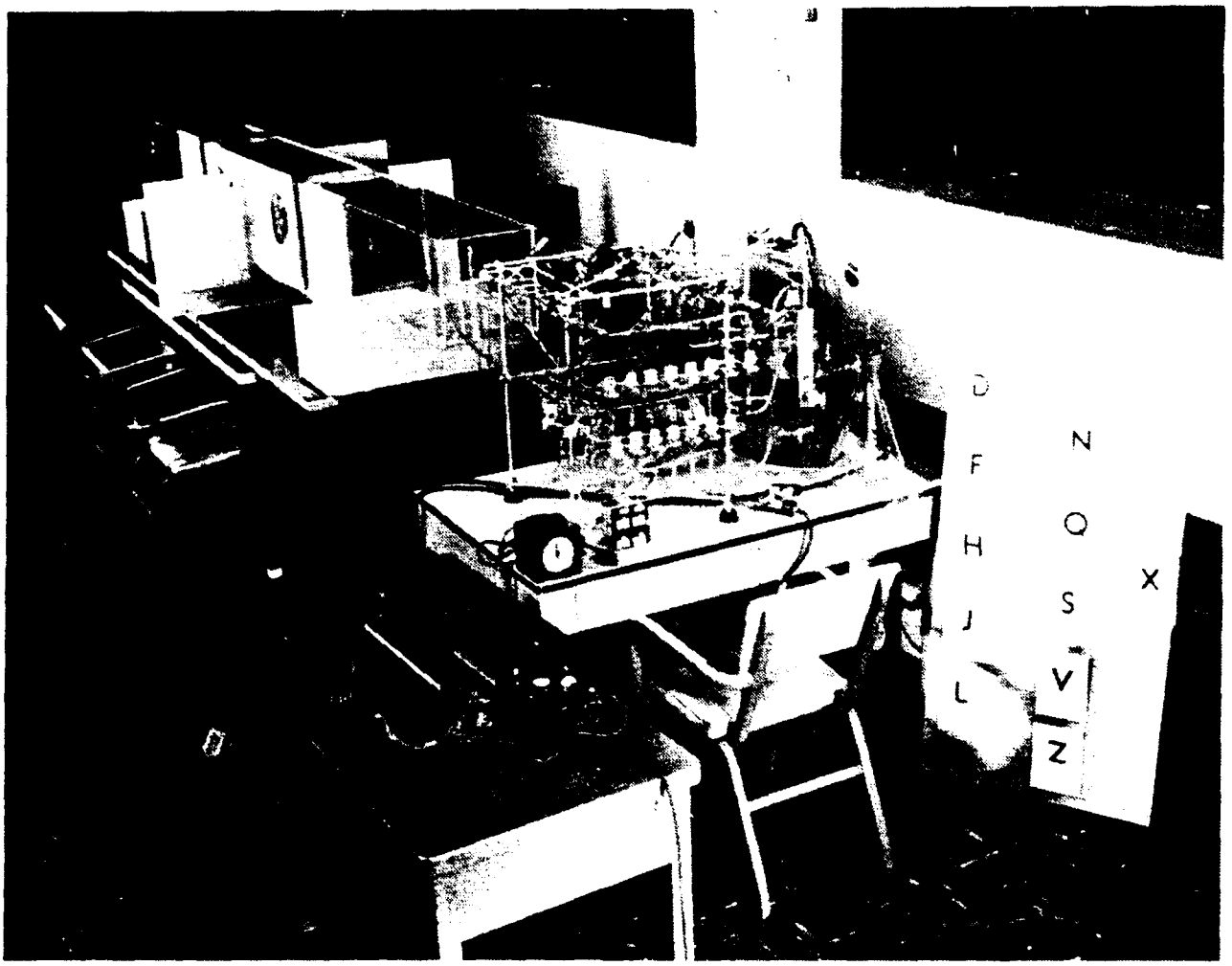
Reliability Design Handbook RADC published a Reliability Design Handbook, the first work of its kind to propagate the notion of "designing for reliability."

Automated Microelectronics Test Equipment In order to accomplish high-speed tests of new microelectronic systems, the Center developed the first Automated Microlelectronic Test Equipment. In addition to establishing an RADC in-house AMTE facility, the effort stimulated development in the private sector.

Intelligence

Olfactory Detection and Recognition RADC conducted research on the potential of the sense of smell to intelligence applications. A device containing compartments for different types of

odors was developed to measure smell detection, smell identification, and smell memory.



Olfactory Sensor

AN/ULT-2 Distributed Area Jamming System RADC developed the AN/ULT-2 distributed area jamming system. On 11 September, engineers from the Center's Electronic Warfare Laboratory presented a briefing on the system to representatives from the Air Defense Command, the Strategic Air Command, Air Proving Ground Command, and the Air Research and Development Command.

Minicard Intelligence Data Handling System RADC sponsored the development by the Eastman Kodak Company of the Minicard system for storage and filing of intelligence data on various types of microfilm strips. The stored data could be retrieved within seconds.

Minicard IDHS

Other

RADOLON Weather-Resistant Paint RADC developed a new weather-resistant paint, RADOLON, designed as a maintenance coating for radar housings. Adaptable for use in arctic or desert environments, RADOLON could extend radome life for at least three years.

RADC experienced some unsettling times during 1957, especially due to manpower restrictions which resulted in reduction in force measures. This was a particularly harsh jolt to the Center in that the current statistics showed the highest manpower authorizations in RADC history, before or since, total authorizations having increased from under 1000 in 1952 to well over 1600 in 1957. The launch of the Soviet satellite Sputnik on 4 October, however, shocked the nation, convincing American defense leaders that research and development would have to be a major priority in the defense budget. The ultimate result would be a considerably higher percentage of scientific and technical personnel among the Center's staff in the future.

SENIOR LEADERSHIP

On 1 August, Brigadier General Donald P. Graul assumed command of RADC, coming from Wheeler AFB, Hawaii, where he had commanded the 1808th Airways and Air Communications Service Wing. Shortly after World War II, General Graul had been Commander of Watson Laboratories. His predecessor at RADC, General Wright, had relinquished command on 1 July. In the interim, Colonel Daniel B. White, Deputy Commander, assumed command of the Center.

Meanwhile, Mr Harry Davis continued as the Center's Scientific Director throughout the year.

ORGANIZATION

Mission

Scrutiny of Mission During the spring, RADC and the Cambridge Research Center began a mission analysis to search for any redundancy, either in overall mission or in individual programs. Although this was not the first time, this issue had been considered, the missions and work of both centers underwent their most thorough scrutiny. Investigators concluded that there was no significant redundancy that could not be resolved, although a clarification of mission statements would assist in this resolution. They did not recommend the relocation of RADC to Cambridge.

Personnel and Facilities

Civilian Manpower Reductions In January, the RADC civilian authorizations totaled 1,452, with 1,405 civilians assigned. To reduce costs, RADC was directed to gradually reduce to a total of

1,299 by 30 June 1958. Even so, recruitment to fill vacancies remained something of a problem during the first half of the year. In August, the requirement to reduce payroll expenditures resulted in a freeze on all promotion actions, initially until 30 September. Subsequently, the freeze of all position actions was extended until further notice. The constraints were crucial enough to require reduction in force procedures. By November, the freeze on promotion actions was lifted, after the launch of Sputnik resulted in a rethinking of military R&D priorities.

Off-Base Sites RADC acquired three off-base facilities, at Ava, Clark Hill, and Stockbridge. The former was situated about 18 miles north of Griffiss AFB; the Clark Hill site was 12 miles north; while the Stockbridge facility was 16 miles southwest of the base.

RESEARCH AND DEVELOPMENT ACTIVITIES

Surveillance

L-Band Klystron One major RADC accomplishment was the development of the L-Band Klystron, the first high-to-average power liner beam tube to utilize a high-power modulating anode and external cavities.

Over-the-Horizon Detection In the area of Over-the-Horizon technology, the Center provided support to the National Research Laboratory research which had applications to both missile and aircraft detection at over-the-horizon ranges.

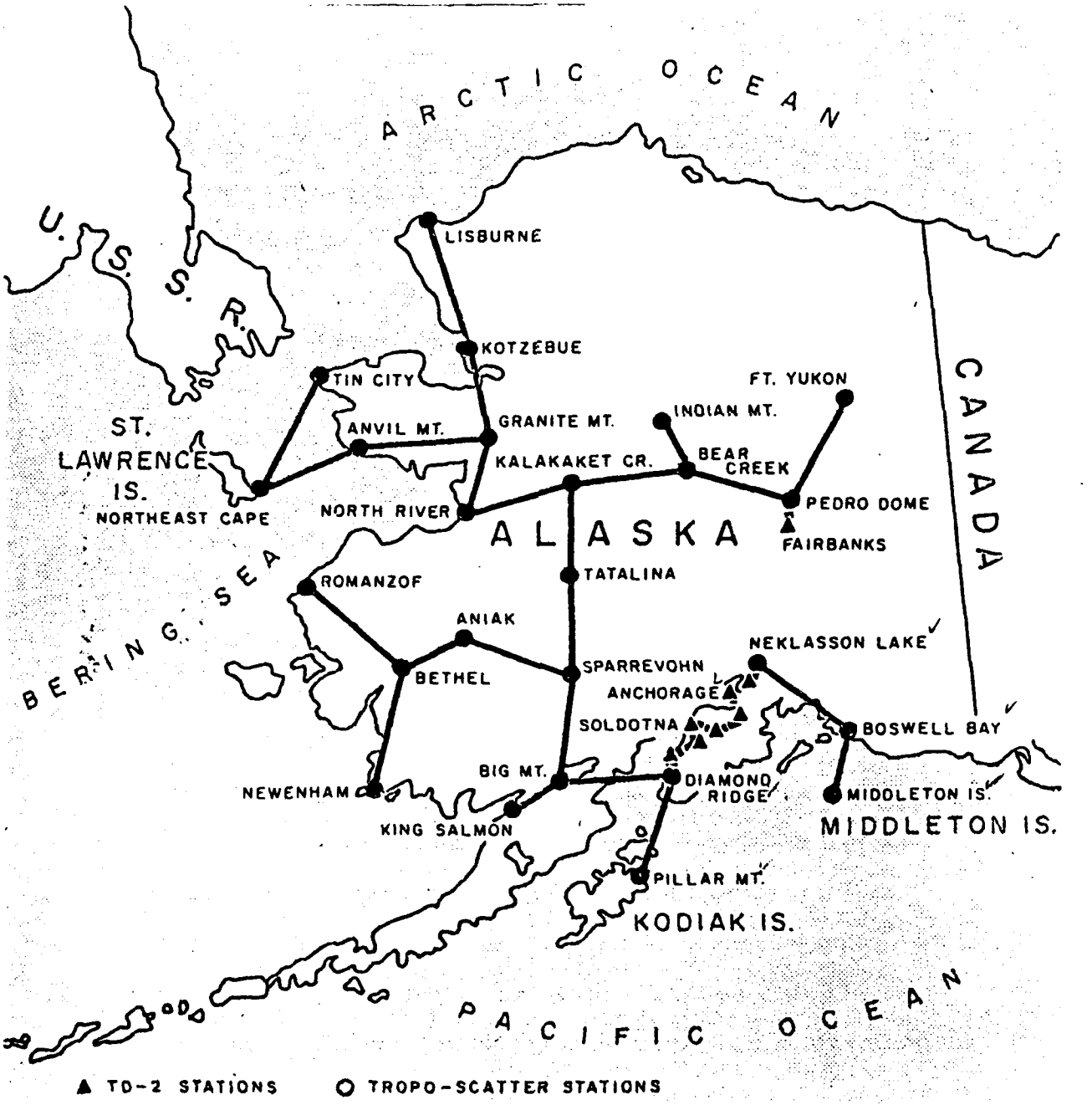
Mark XII IFF System The Mark XII Identification Friend or Foe (IFF) System was first introduced during 1957.

Communications

Satellite Communications Concept The idea for initiating communications by satellite was formulated on 6 May. The proposal was for the construction of an AN/FRC-40 ultra high frequency communications device which would use the moon as a passive element.

Single Sideband Tropospheric Equipment AN/FRC-53 Single Sideband Tropospheric equipment and the AN/FRC-54 FM tropo set, developed for RADC by Westinghouse Electric Corporation, were installed at Verona and Liberty Dam, Maryland, for testing.

White Alice In conjunction with the contractor, RADC formulated test procedures to evaluate the overall operational effectiveness of White Alice, an Alaskan communications network. From the latter part of 1956 through 1957, approximately 900 miles of the network were tested. The performance of the portions tested was so successful that the Air Force decided to eliminate further segment tests.



Map of White Alice Communication Network

Command and Control

All-transistor Digital Computer Project contractor delivered a digital all-transistor computer weighing only 200 pounds, with a greater capacity than many larger computers. This project, which was managed by the Intelligence and Electronic Warfare Directorate, resulted in ruggedized equipment that could be easily transported into the field and showed greater survivability because of its all-transistor construction.

Navigation

NAVARHO Testing RADC completed a final report on a flight and field evaluation, conducted from May 1956 to May 1957, of the NAVARHO system. The report recommended that the Air Force adopt NAVARHO for global long-range navigation.

Intelligence

Intelligence Data Processing Sponsored by RADC, Northrop Aircraft, Inc. completed the first phase of an intelligence data processing development project (AN/GSQ-20) in October. The efforts produced equipment items capable of processing aerial, radar, and infrared photographic reconnaissance data.

Automated Language Translation Due to fiscal constraints, the contract with International Telemeter for the development of a Russian-to-English electronic translator was terminated in the fall. The equipment was delivered to RADC, though not completely developed. In a demonstration, a 1400-word Russian-English dictionary was stored on a photoscopic disk.

Viewer Stereoscopic Roll Film Bausch and Lomb, under contract for RADC, completed the development of a Viewer Stereoscopic Roll Film. By enabling someone to view the nine-inch aerial film in stereo directly from the negative, the device eliminated the need to print photographs before examining them.

Following the renaissance of science and technology as applied to the national defense and the close scrutiny of the missions of both RADC and the Cambridge Research Center, RADC received a new formal mission statement. The newly stated mission, however, was more of a clarification -- particularly of roles -- since we see RADC continue to perform the same type of research and development projects as previously.

SENIOR LEADERSHIP

Colonel Daniel M. Harvey, previously the Director of Communications, became the Deputy Commander on 21 May. Colonel White was named the Director of Communications prior to retiring from the Air Force. General Graul continued in command and Mr Harry Davis remained the Scientific Director.

ORGANIZATION

Mission

New Mission Statement The new mission statement for RADC, dated 25 March, as contained in ARDC Regulation 23-1, read (in part) as follows:

> 3. Mission: The RADC primary mission areas are intelligence devices, ground communications devices; and the ground environment of surveillance, of approach and landing, of navigation and of electromagnetic radiation warfare.
>
> 4. Responsibilities. The Commander, RADC, will:
>
> a. Conduct technical development and technical support within the scope of the technical requirements and the technical program as directed by Headquarters ARDC in support of the center's primary mission.
>
> b. Conduct research as authorized by Headquarters ARDC within the scope of the center's mission and approved research planning objectives.
>
> c. Conduct and support weapon system studies, development and tests within the scope of approved ARDC system development plans, system development directives and system requirements.
>
> d. Initiate recommendations for operational support requirements, develop and/or standardize operational support items as directed by Headquarters ARDC.
>
> e. Conduct tests of items developed by the center; schedule and test those items developed by others when directed by Headquarters ARDC; and utilize for these purposes all facilities available to ARDC on an optimum basis.
>
> f. Prepare and submit to Headquarters ARDC time-phased plans based on approved R&D objectives and within the center's primary mission areas. Such plans will include projected requirements for technical and supporting facilities and other resources in accordance with approved USAF procedures.

g. Provide technical and test support to the Air Materiel Command to support AMC procurement and maintenance programs within the center's primary mission.

h. Support the technical program of other centers in the primary areas of responsibility and in other areas as directed.

RADC supplemented the official mission statement, adding the clarification that RADC was:

To conduct technical development in the ground environment area of aircraft warning, control, navigation, approach and landing; electromagnetic radiation warfare; human engineering and microwave effects; electronic test equipment; and intelligence collection and processing.

To perform and/or support the operational development program as directed to include ground radar, data collection and processing equipment, electromagnetic radiation warfare devices; communications devices and electronic test equipment.

Facilities

Ransomville (Model City) Off-Base Site In support of the development of advanced communications systems, RADC acquired the Ransomville (Model City) site, located approximately 200 miles west of Griffiss AFB, near Niagara Falls. The 120-acre location was used specifically for experimental work in troposcatter communications.

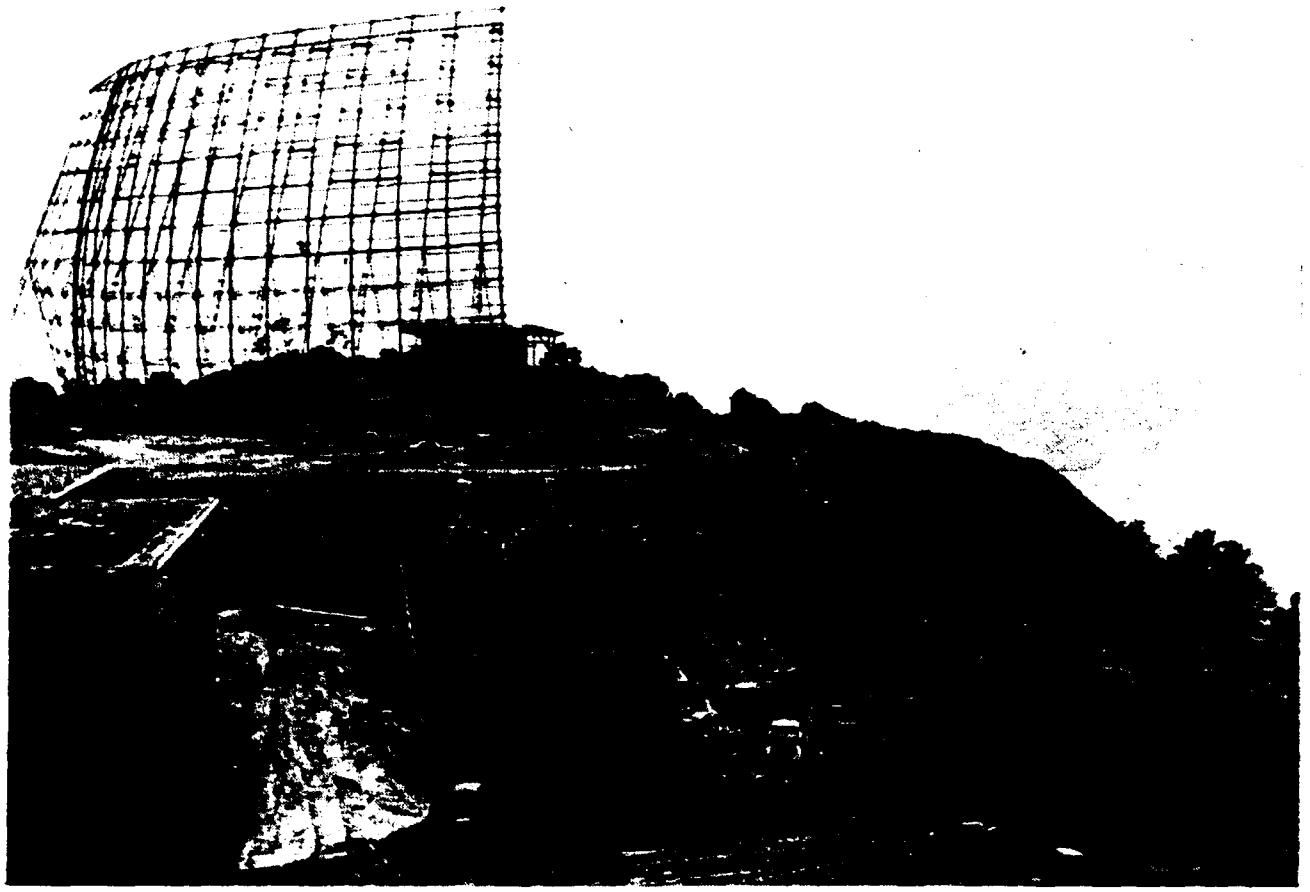
Model City

Quick Reaction Capability Laboratory The RADC Quick Reaction Capability Laboratory was established as a functional organization in December.

RESEARCH AND DEVELOPMENT ACTIVITIES

Surveillance

Ballistic Missile Early Warning System (BMEWS) At the Trinidad site, a prototype of the Ballistic Missile Early Warning System (BMEWS) provided surveillance and tracking of ballistic missiles, as an overall step in the BMEWS development.



Trinidad

Electronically Steerable Array Radar (ESAR) RADC developed the AN/FPS-46 Electronically Steerable Array Radar (ESAR). This was the first full-size pencil-beam phased-array radar system.

AN/FRC-56 "Texas Tower" Radar The AN/FRC-56 "Texas Tower" radar was installed across the arctic region of Canada. This system provided increased radar coverage for offshore deployments. Radar technology developed by RADC had been vital to the successful completion of the "Texas Tower" system.

Communications

Tropospheric Scatter Communication RCA delivered the AN/PRC-39 Tropospheric Scatter equipment in January. The system was installed at sites in Iceland and Labrador.

Single Sideband Radio RADC conducted long-range tests on a single sideband radio system. Developed for use by the Strategic Air Command, this system was the first high-frequency radio equipment capable of being automatically tuned and operated. Primarily intended for voice communications, it could carry signals beyond a distance of 2,000 miles with considerable reliability.

Pincushion - Angle Diversity During September and October, RADC tested a "pincushioning" tropospheric concept, in which the radiation of a number of beams could be focused into a single beam and significantly increase the power of the set. Not only would the new system offer increased range, but it would also open up more channels for use.

Intelligence

Reconnaissance Photograph Transposer RADC developed the AN/GSQ-1 Reconnaissance Photograph Transposer, which could view aerial photographs and permit precise measurement of coordinates of objects depicted.

Roll Film Stereoscope The roll film stereoscope, produced as part of the intelligence and reconnaissance support mission of the Center, was the first stereoscope developed with the capability of viewing aerial reconnaissance film on rolls.

High Altitude Charting A balloon equipped with a 1 1/2-inch camera, developed by RADC, was launched in New Mexico, reaching an altitude of 100,000 feet. The photographs simulated photos from an 18-inch camera at 300 miles.

Radar Plotting Board RADC developed an AR-8 radar plotting board for SAC, making it possible to compare Position Plot Indicator photographs with charts of the geographic area photographed.

Reliability and Maintainability

Reliability Notebook RADC published a Reliability Notebook, the first of its kind dedicated solely to the analysis of reliability.

Solid State RADC developed the first successful procedure for extracting boron from silicon. The process of continuous zone refining of silicon tetraiodide provided the basis for significant advances in performance of solid state equipment.

Command and Control

AN/FSQ-27 Data Processing System The polymorphic AN/FSQ-27 data processing system, developed by RADC, was the predecessor of subsequent expandable-memory, programmable computer systems. The Center also developed a display and analysis console that provided enhanced interaction capability with the AN/FSQ-27.

It might be possible to describe 1959 as a year of comparative stability for RADC, certainly in the Center's leadership, as well as in organization. The start of operations at the Center's Trinidad Radar Site was a significant research milestone, particularly considering the growth of interest in surveillance following the launch of a Soviet satellite almost two years earlier.

SENIOR LEADERSHIP

Major General Donald P. Graul remained at the helm of RADC, while Colonel Harvey and Mr Davis continued in their respective roles as Deputy Commander and Scientific Director of the Center.

ORGANIZATION

Facilities

Trinidad Radar Site The Trinidad Radar Site commenced operation on 4 February, gathering data on missiles fired on the Atlantic Missile Range, satellites, and meteors.

Long Range Digital Communications Permanent long-range digital communications (AN/GRC-49) sets were installed at Stockbridge and Ava. Installed as part of a project known as "Lost Chord," the equipment provided training, primarily for personnel from Airways and Air Communications Service.

Biological Hazards of Microwave Radiation A facility was established at the Verona site to test the results of exposure of animals to radio frequency and X-ray radiation.

RESEARCH AND DEVELOPMENT ACTIVITIES

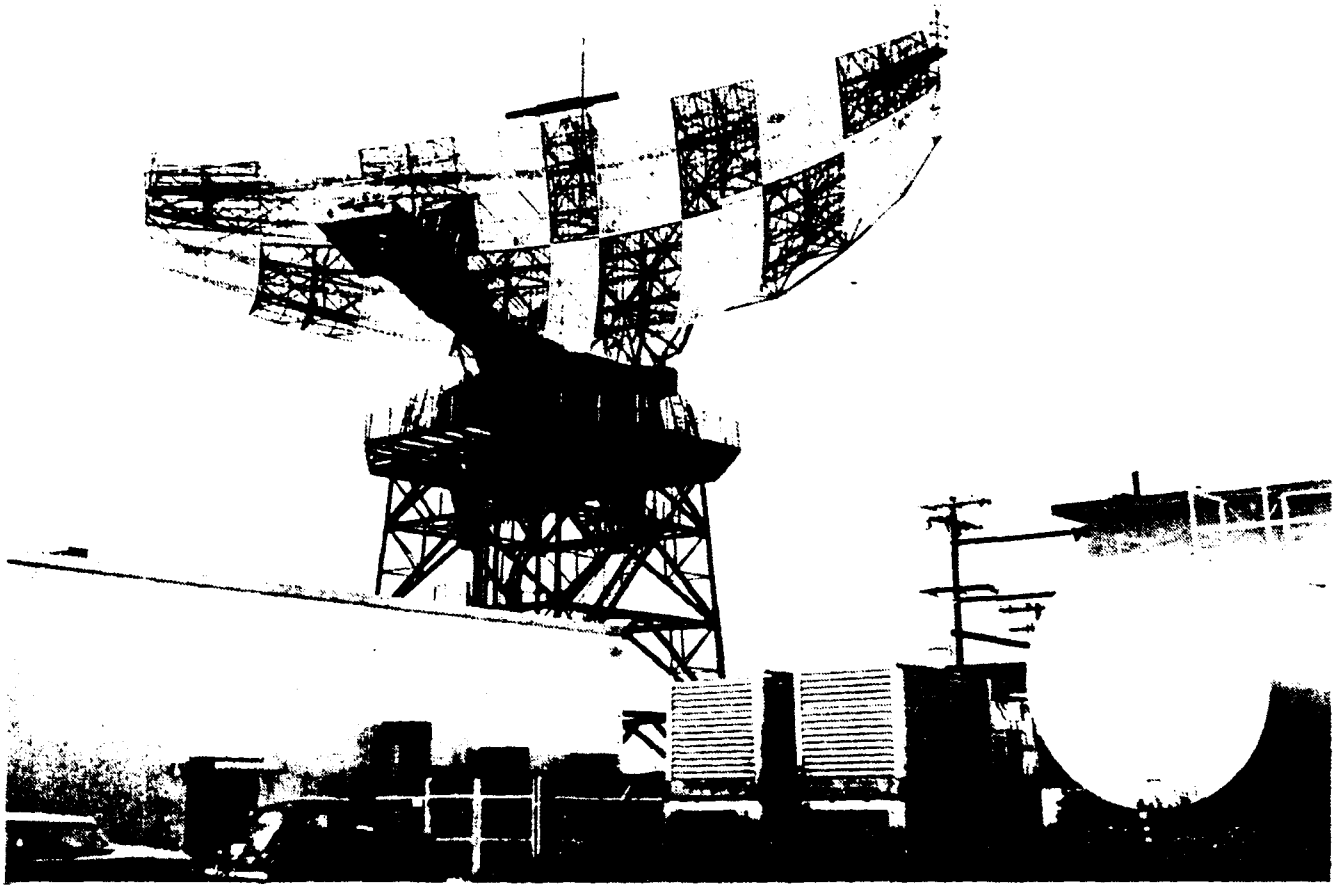
Surveillance

High Power L-Band Rotating Sections for Multicoupler Systems The development of a high-power L-Band rotating section for multicoupler systems was completed in March. This met the need for high-power rotary joints to transfer a number of power sources from the stationary base to the rotating antenna in order to develop high power, multi-beam, long-range radar.

Crypto Secure Identification Friend or Foe Progress by the Hazeltine Corporation in the developmental contract for the Crypto Secure Identification Friend or Foe (IFF) system reached the breadboard demonstration stage. Technical characteristics of the links were specified and approved for the construction of an engineering model.

Frequency Diversity Radar The Frequency Diversity Radar program was a major radar developmental program at RADC. Some of the prototypes developed as part of it included the AN/FPS-26, the

AN/FPS-27, the AN/FPS-28, and the AN/FPS-35, in addition to the AN/FPS-24 frequency diversity radar depicted below. This equipment was designed to succeed existing Semi-Automatic Ground Environment (SAGE) radar systems, which had served as the backbone of air defense of the CONUS, in order to provide enhanced electronic counter countermeasures (ECCM) capability.



AN/FPS-24 Radar

Ballistic Missile Early Warning System (BMEWS) The Ballistic Missile Early Warning System (BMEWS) became the first operational missile detection radar. This ESD-managed program utilized studies accomplished by RADC and technology developed under the sponsorship of RADC. A prototype of the BMEWS began operating at the RADC Trinidad site in 1959. The BMEWS system would provide long-range, immediate warning of a missile attack over the polar region utilizing stations in the northern hemisphere.

Ten Kilowatt Tetrode Amplifier Under a contract with RADC, the Radio Corporation of America, Inc. completed the development of a ten-kilowatt tetrode amplifier (Amplifier Modulator Group OA-751/GR(XW-2)). This equipment marked an improvement in amplifier tubes within the range of 225 to 400 megacycles.

Broadband 10MW Duplexer The development of a broadband 10MW Duplexer, in progress for several years, was completed in July. The equipment performed satisfactorily during high-power tests at the 10 megawatt level.

High Power Pulse Switching Under a contract with Polytechnic Institute of Brooklyn, a two-megawatt all-magnetic modulator was developed. The design established the criteria for the design of high-power magnetic pulsers and demonstrated that magnetic pulsers had practical applications.

Intelligence

TROPICAN The TROPICAN program was designed to apply infrared technology to the reconnaissance mission. Experiments demonstrated the capability to detect "enemy" campfires in Puerto Rico.

Command and Control

Information Storage and Retrieval RADC purchased the Filmorex equipment from Jacques Samione, of Paris, in order to provide data storage and retrieval for the Center's procurement office. Utilizing rectangular microfilm, each film could store up to two pages of a document or abstract, along with a section used for code numbers for subject or bibliographic information.

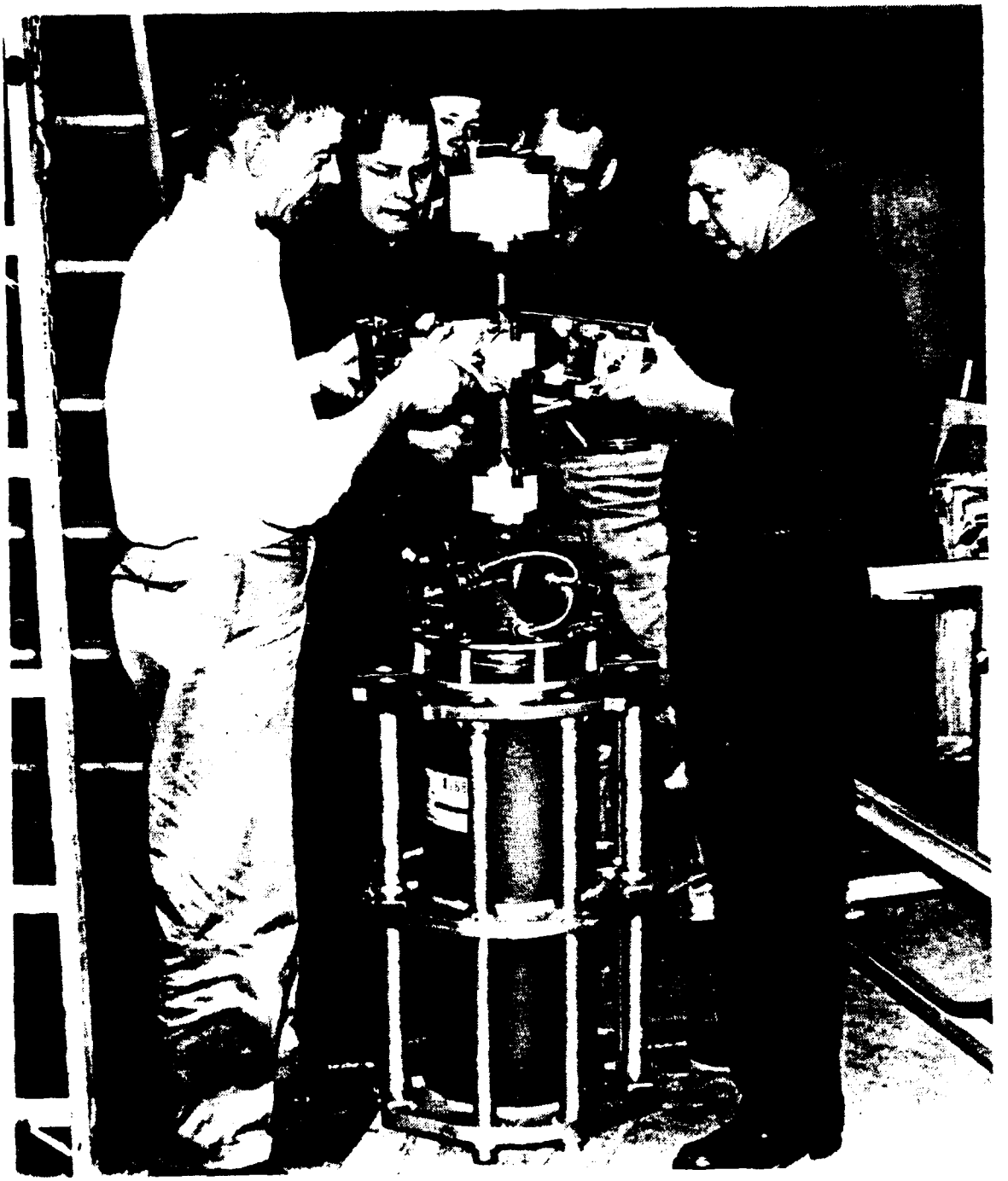
Communications

Tropospheric Scatter Communications Tests of two tropospheric devices, the AN/FRC-53 single sideband and the AN/FRC-54 frequency modulation, between sites at Verona and Model City, New York were completed in February. Included in the tests were voice tapes and both normal and high-speed teletype.

High-Frequency Tropospheric Communications Tests of high-frequency equipment in the 8,000 megacycle per second range between Forestport, New York, and Mount Rose, New Jersey, (a 213-mile distance) were completed in March. Signal levels were less than researchers had anticipated.

Satellite Communications In April, RADC published a technical document (RADC-TN-59-110) entitled, "An Integrated Communications and Navigation Plan for the Air Force until 1980 and Beyond." The document continued the efforts of the RADC Satellite Communications Program.

AN/FRT-41 High Frequency Transmitter RADC developed the AN/FRT-41 high frequency transmitter using a klystron, i.e. a special electron tube which operates as an amplifier or an oscillator at UHF or super high frequency (SHF) bands.



Klystron Tube

As RADC came nearer to completing ten years of research and development at Griffiss AFB, it had every reason to be proud of its many accomplishments in the area of Command, Control, Communications, and Intelligence technology. While the Center had endured considerable fluctuation and even some turmoil during its history thus far, its record was a productive one. But the scope of its work seemed to be expanding, and the research and development opportunities abounded. For the first time in its history, RADC administered over $100 million in contracts during FY 1960.

SENIOR LEADERSHIP

In March, Mr Harry Davis left the position of Technical Director to accept a position at the Office of the Secretary of Defense. Dr John S. Burgess, who had been filling in as acting Technical Director, officially assumed the position of Technical Director at RADC on 4 September. Major General Donald P. Graul and Colonel Daniel M. Harvey continued as Commander and Deputy Commander respectively.

ORGANIZATION

Facilities

Ferrimagnetic Material Test Facility A test facility for processing, analyzing, and performing electrical measurements of ferrimagnetic substances was established.

Laredo Test Site The Laredo test site assumed the function of tracking artificial satellites and reporting the data to Project "Harvest Moon" (later known as "Space Track").

Structure

RADC "Wheel" Functional Concept The following functional definitions were established: data acquisition was the responsibility of the Directorate of Control and Guidance; data transmission, of the Directorate of Communications; data processing, the Directorate of Intelligence and Electronic Warfare; and data presentation, the Directorate of Engineering.

Air Force Command and Control Development Division On 1 July, RADC became part of the Air Force Command and Control Development Division. There was no change in mission or in strength.

RESEARCH AND DEVELOPMENT ACTIVITIES

Surveillance

AN/FPS-26 Radar On 20 January, after testing, RADC accepted the AN/FPS-26 air defense radar from AVCO, the contractor, stipulating that the contractor must correct certain component deficiencies.

Electronically Steerable Array Radar In November, the Electronically Steerable Array Radar (ESAR) was powered up for the first time. This radar was capable of positioning a beam in space by electronic means, eliminating the need for mechanical antenna rotation. ESAR subsequently proved useful in the development of Cobra Dane.

Radar Set (AN/FPN-34) RADC accomplished final acceptance of the AN/FPN-34 radar from the Bendix Radio Corporation. A dual-channel, L-band radar, this equipment had a range of 120 miles and 60,000 feet and was designed for terminal area surveillance.

Long Baseline Radar (LOBAR) System Developmental studies demonstrated the feasibility of a long baseline radar (LOBAR) system to provide more accurate target tracking capability.

AN/ASM-13 Airborne Test Range The AN/ASM-13 program provided the development of a universal airborne test range used to plot ground-based antenna patterns.

Intelligence

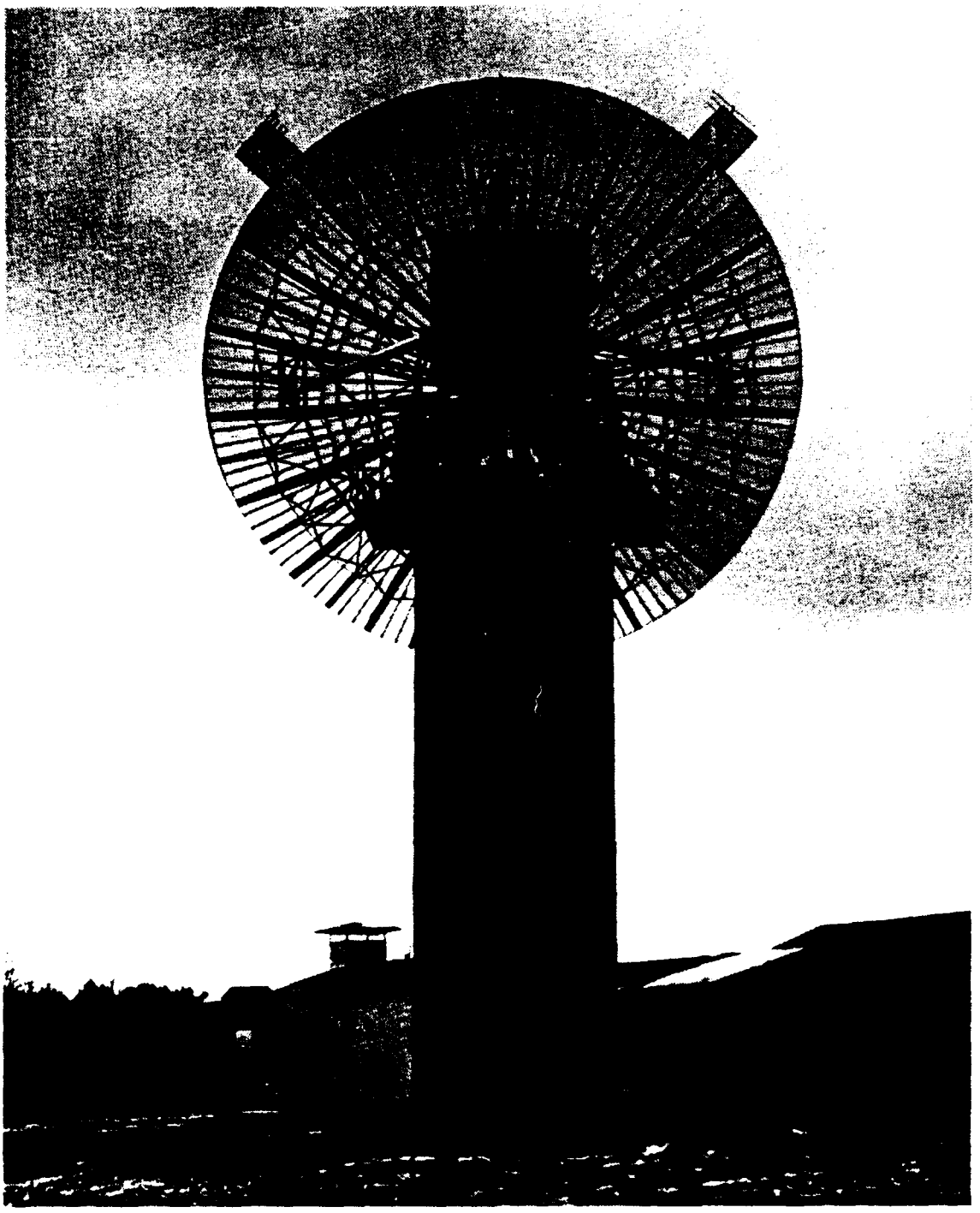
AN/TLQ-8 Passive Jammer Locator RADC developed the AN/TLQ-8 passive jammer locating system.

Automatic Language Translator Russian-English automatic translation equipment was successfully demonstrated. The translator's dictionary, containing 70,000 entries, was located in the equipment's photoscopic memory. At the time, the equipment only translated word-by-word and ignored grammatical rules. Even so, it provided a good sense of the gist of any given Russian article.

Communications

AN/FRC-40 Communications System On 27 June, RADC signed a contract with the Hughes Aircraft Company at an original cost of $2,810,096 for the development of the AN/FRC-40 under the Satellite Communications Program.

Voice Communications From Space Utilizing a 30-foot antenna, RADC's Floyd site received a message from the Trinidad site which had been bounced off the NASA aluminized balloon satellite, ECHO I. This marked the first international human voice reception from space for military purposes.



Floyd Antenna Which Received Echo I Transmission

AN/GSC-4 Digital Communications Set The AN/GSC-4 modem was delivered. This transistorized terminal system could transmit digital data over telephone lines (utilizing six channels and 18 subchannels) at a rate of 5,850 bits per second.

Reliability and Maintainability

Microelectronics In March, RADC initiated a program to develop a technological competency in the area of microelectronics. This new technology would enable the development of systems which could be adapted to continue performance even after a number of individual cells had failed.

Antenna Pattern Analyzer Flight tests of an airborne antenna pattern analyzer (AN/ASM-13), designed to measure horizontal and vertical radiation patterns of ground antennas, took place. The equipment accurately measured patterns.

Electromigration Study RADC sponsored an initial electromigration study for integrated circuit metallization. This first analysis of this failure mechanism would make significant contributions to new technologies utilizing integrated circuitry.

Command and Control

456L Quadrajector As part of its data display developmental function, RADC developed the 456L Quadrajector, a display system intended for the Strategic Air Command. This equipment provided the capability for large-screen size multicolor displays.

Other

Bomb Scoring System Reeves Instrument Corporation developed and tested a Bomb Scoring System Radar AN/USQ-24 for RADC. The equipment, requested by the Air Training Command and the Strategic Air Command, provided a way to score a single ground crew against a target, with the capability to score either actual or simulated releases against realistic targets.

The year of the Center's tenth anniversary saw notable changes in the Air Force acquisition community, with the redesignation of the Air Materiel Command and the Air Research and Development Command as the Air Force Logistics Command and the Air Force Systems Command respectively. Similarly, the next higher headquarters above RADC, the Air Force Command and Control Development Division, became known as the Electronic Systems Division. Through all this and even in the midst of some internal reorganization, RADC continued to carry out its research and development mission.

SENIOR LEADERSHIP

On 3 July, Major General Daniel C. Doubleday, who had served as the second RADC Commander from 1951 to 1954, once again assumed command of the Center, replacing Major General Donald P. Graul. Before returning to RADC for his second term as Commander, General Doubleday had been the Commander of the Air and Airways Communication Service at Scott AFB, Illinois. In turn, General Graul went to Scott AFB, where he assumed the position of Deputy Commander of the Air Force Communications Service.

On 30 June, Colonel Harvey, the Deputy Commander retired from active duty. Colonel David M. Crabtree assumed the position of Deputy Commander in place of Colonel Harvey, effective 18 July. Dr John S. Burgess continued as Technical Director.

ORGANIZATION

Personnel and Facilities

Fire at ROAMA Headquarters Building A fire at the Rome Air Materiel Area headquarters, which was responsible for personnel services for RADC, resulted in the loss of 6700 civilian personnel records and files on 28 January. Because RADC maintained a decentralized personnel unit at the Center, the loss of ROAMA records had no negative impact on the Center.

Electromagnetic Vulnerability Laboratory On 19 April, the Electromagnetic Vulnerability Laboratory was established. At the same time, personnel resources were realigned, consolidating functions of the DOD Compatibility Program.

Data Processing Facility In April, RADC established a Data Processing Facility, for the purpose of filling Air Force requirements for an integrated information processing capability.

Microelectronic Laboratory The RADC Microelectronics Laboratory became operational in June and began an applied research program. This was the only microelectronics laboratory in the Air Force.

Trinidad and Laredo Test Sites Operational and maintenance jurisdiction over the test sites at Trinidad and Laredo was transferred from RADC on 1 July.

Structure

Electronic Systems Division As the result of a reorganization on 1 April, the Air Force Command and Control Development Division joined with the Electronic Systems Center to become the Electronic Systems Division (ESD). RADC remained subordinate to this organization. The same Air Force-wide reorganization resulted in the redesignation of the Air Research and Development Command as the Air Force Systems Command and the Air Materiel Command as the Air Force Logistics Command. The reorganization resulted in certain functional realignments.

Internal Reorganization The DCS/Operations was redesignated as the DCS/Plans and Operations. The DCS/Intelligence was established as a separate staff agency, and on 10 May it was redesignated as the DCS/Foreign Technology. That office assumed responsibility for the technical and documents library, storing and disseminating technical data (including technical intelligence data), and foreign release.

RESEARCH AND DEVELOPMENT ACTIVITIES

Surveillance

Space Track System HQ AFSC decided to give full technical responsibility for the development of a sensor for the 496L Space Track System to RADC. The development of this was particularly significant after the Soviet lead in satellite technology in October 1957 and the subsequent failure to locate Explorer XII for six months after it was launched.

Cavity Band Pass Filter RADC developed a cavity band pass filter designed to eradicate false emanations from high-power radar systems.

Communications

Passive Satellite Research Terminal As the result of a Memorandum of Understanding between the Director of Research DOD and the Secretary of the Air Force, designation AN/FRC-40 for the proposed Satellite Communications System was deleted, and the new name became Project 4519. The Floyd Satellite Communications Terminal ultimately became known as the RADC Passive Satellite Research Terminal.

AN/FCC-17 Multiplexer RADC developed the AN/FCC-17 solid state frequency-division multiplexer. Expandable from 12 to 600 communications channels, this was the first device with the capability of 100 percent data loading.

Analog-to-Digital Conversion In a significant breakthrough in the area of data transmission, RADC achieved capability to convert from analog (speech format) to digital data. Although the method proved tolerant of variations in sound, certain misidentification sometimes produced errors.

Command and Control

Bamboo Tree Project In the Bamboo Tree program, RADC accomplished design and configuration of a guidance complex which would be used at Tempelhof and Tegel Airfields, in Berlin, Germany. Interference tests were conducted at the Verona site, in support of this project.

Visual Displays Compendium In December, RADC published the first edition of its Compendium of Visual Displays. The first comprehensive reference work of its kind, the Compendium provided information on display equipment and new efforts, but did not make recommendations geared toward specific applications.

Intelligence

Image Interpretation Cell In order to provide mobile imagery interpretation capability, RADC developed the image interpretation shelter. This mobile cell had the capability to support multi-sensor viewing, imagery interpretation, and intelligence reporting.

Counter-Counter Measures and Infrared Manuals RADC published two ground-breaking manuals, the Electronic Counter-Counter Measures (ECCM) Design Philosophy Manual and the Infrared Interpretation Manual.

Reliability and Maintainability

Reliability Predication of Electronic Equipment In the area of reliability and compatibility, RADC published MIL-HDBK-217, "Reliability Predication of Electronic Equipment. This handbook replaced the RADC Reliability Notebook as the "Bible" of the Center's reliability staff.

Other

L-Band Filter RADC developed a waffle-iron L-Band filter.

Tensions between the United States and the Soviet Union reached a near-breaking point during the Cuban missile crisis. Among the many US agencies called to provide special support to President Kennedy's determined resistance to the Soviets was RADC. After the Cuban quarantine had been declared, RADC was tasked to provide emergency airlift of electronic equipment to the crisis vicinity. After the initial no-notice flight, RADC maintained a flight and maintenance crew on alert for the duration of the quarantine. The Center supported a number of other emergency flights until the Soviets finally backed down under the pressure of the US opposition.

SENIOR LEADERSHIP

Throughout 1962, there were no changes in the three senior leadership position of Commander, the combined position of Deputy Commander and Chief of Staff, and the Scientific Director. These positions continued to be filled by General Doubleday, Colonel Crabtree, and Dr Burgess, respectively.

ORGANIZATION

Mission Statement On 23 January, the following mission statement for RADC, as contained in ESD Regulation 23-3, was officially approved. The statement focused on the working relationship between RADC and ESD.

1. Plan, program and conduct research, advanced development, engineering, and equipment and component development to expand technology and the utilization thereof for data acquisition, processing, transmission, and display.

2. Specialize in the areas of communications, computer application, data display, data processing and handling, electronic components, electronic countermeasures, electromagnetic vulnerability, intelligence, man-machine relationships, survivability, surveillance and warning, range instrumentation, communications security, and electronic countermeasures, electronic counter-countermeasures engineering testing.

3. Provide and direct engineering services for command and control systems, as required.

4. Provide recommendations to ESD SPO's, unless otherwise directed, on specifications and procedures to insure timely actions by contractors and other ESD agencies on standardization, reliability, Aerospace Ground Equipment (AGE), Personnel Subsystems (PSS), and engineering data.

5. Provide advice and assistance to ESD and other Governmental agencies in the areas of RADC specialization for

advance planning, command and control subsystems of the weapon systems programs and for other special technical problems outside the normal management structure.

Resources and Facilities

Laboratory Director's Fund In August, the Discretionary Fund (also known as the Laboratory Director's Fund), a two million dollar fund, was first granted. The fund provided the flexibility for new in-house initiatives and an opportunity to try out new ideas.

Trinidad Radar In February, the Radio Corporation of America (RCA) assumed responsibility for the operation of the Trinidad Radar.

BMEWS Test Facility at Syracuse HQ AFSC assigned responsibility for the BMEWS Test Facility at Syracuse, NY, through the year 1965 to RADC on 11 April.

Carrabelle Test Site Closed In July, the Center's test site at Carrabelle, Florida was closed. The Center relocated its work on tropospheric and ionospheric communication to the New York State Tropospheric Test Range. On 1 October, jurisdiction over the Carrabelle Experimental Annex was transferred from RADC to Eglin AFB.

Structure

Reassignment to HQ AFSC On 13 February, RADC was reassigned to HQ AFSC for administrative purposes. Responsibilities of RADC and ESD for mutual support continued.

Directorate of Aerospace Surveillance and Control On 15 July the Directorate of Control and Guidance was renamed the Directorate of Aerospace Surveillance and Control.

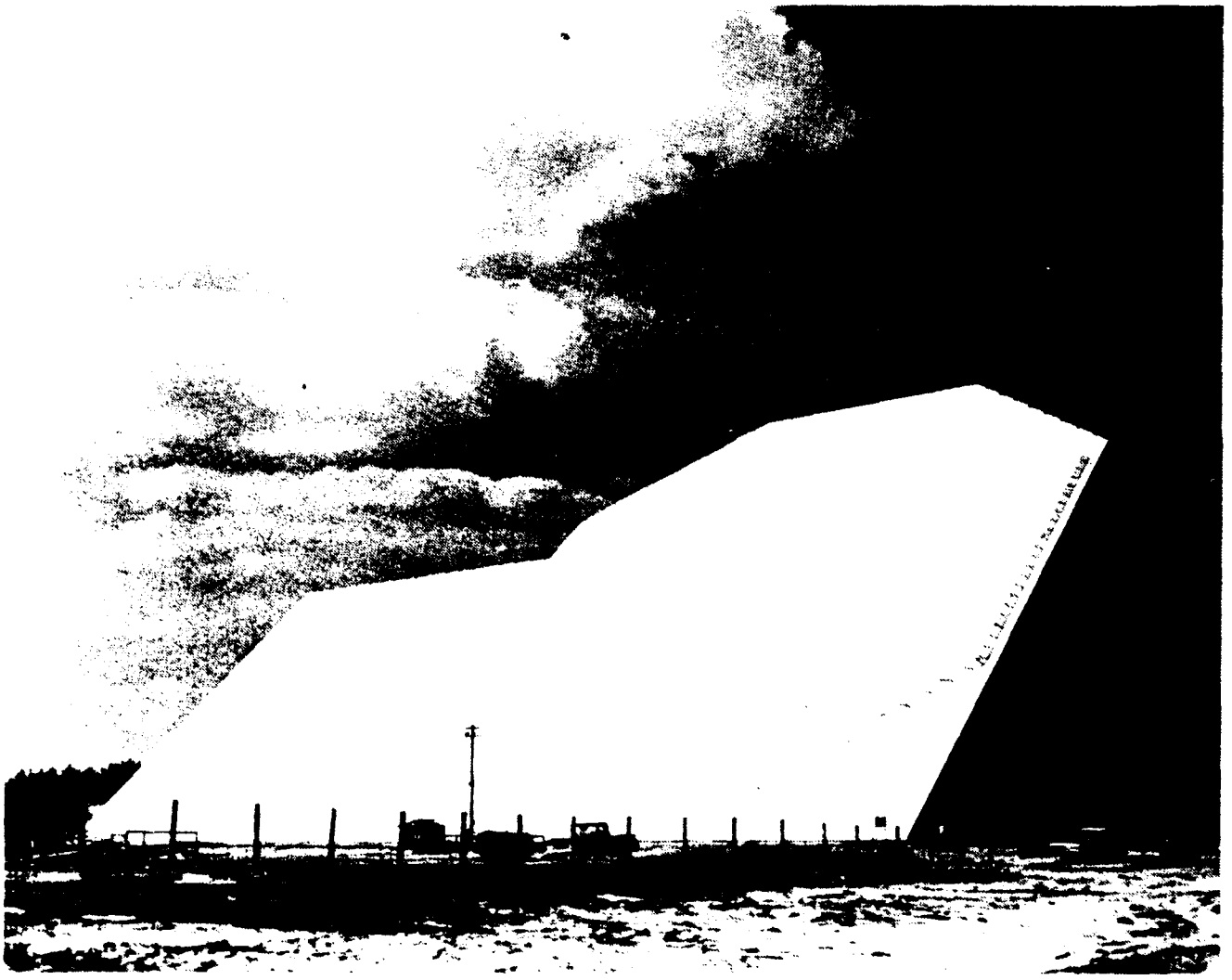
RESEARCH AND DEVELOPMENT ACTIVITIES

Surveillance

Side-Looking Radar In this developmental breakthrough both in the surveillance and the intelligence and reconnaissance arena, RADC produced the side-looking radar (SLR).

Ionospheric Detection RADC successfully demonstrated the feasibility of ionospheric detection using one-hop backscatter while sea and ground clutter was present. This could be utilized to detect aircraft or missiles at altitudes below 100 miles and at ranges of up to 2,000 miles.

AN/FPS-85 Spacetrack Radar RADC was tasked with engineering responsibility for the development of a spacetrack radar (AN/FPS-85) and sponsored a developmental contract with the Bendix Corporation. As the initial operational application of the phased-array concept, in which a beam from several transmitters was transmitted without the movement or rotation of conventional radar, the AN/FPS-85 would be the first phased-array radar developed to track objects in space.



AN/FPS-85

Communications

Ground Communications Station In March, radar search data from an aircraft was transmitted utilizing the Ground Communications Station (AN/GSC-7) and was used by the Semiautomatic Ground Environment (SAGE) computer for the first time.

AN/TCC-20 Switching Center RADC developed the AN/TCC-20, the first solid-state, completely electronic switching center for both fixed-plant and tactical utilization.

Lithospheric Experiments RADC conducted experiments which yielded the parameters required to determine the possibility of high-frequency radio transmission through the granitic basement complex of the earth.

Tunnel Diode Reflection Amplifier Experiments by RADC resulted in the production of improved scattering methods which proved useful in ground marker beacons and microwave communications reflectors.

Error-Correcting Encoder/Decoder In a significant development in the area of secure communications, RADC developed an error-correcting encoding/decoding device.

Transportable Passive Satellite Communications Terminal In the first air-to-ground transmission via satellite, the Transportable Passive Satellite Communications Terminal (TRACT), an RADC-developed communications system, received a transmission channeled through space.

Intelligence

"Limited War Intelligence Reduction Complex" Brochure On 10 August, the Interpretation and Targeting Group of RADC's Information Processing Laboratory published a brochure entitled "Limited War Intelligence Reduction Complex." The concept called for such procedures as the use of off-the-shelf and interchangeable equipment.

Multi-Sensor Screening Viewer The multi-sensor screening viewer developed by RADC enabled analysts to view simultaneously four different sensors. It also provided the combined capability for rear projection or direct viewing.

Sentence Analyzer A sentence analyzer designed to support automated language translation was developed.

AN/GSQ-17 Finder System RADC developed a general/special purpose computer system, the AN/GSQ-17 Finder system, which eliminated the need for the manual reduction, identification, location, correlation, and storage of electronic intelligence (ELINT) data. This system featured a display-assisted intercept association capability.

Reliability and Maintainability

Reliability Physics Symposium The Armour Research Foundation and RADC co-sponsored a Symposium on the Physics of Failure in Electronics during the fall. Held in Chicago, this was the first international symposium devoted to the physics of reliability and electronic device failure.

Command and Control

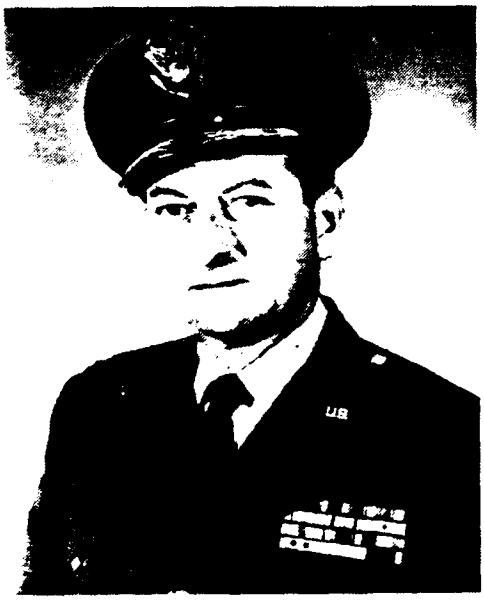
Cryogenic Random Access Memory In March, RADC developed Cryogenic Random Access Memory techniques in order to access data in a large computer memory without an excessive number of leads.

Magneto-Optical Display The Magneto-Optical Display, developed by RADC, represented an early effort in the area of data display to produce a usable discrete-element display.

Fiber Optic Switch A significant accomplishment of RADC in the area of fiber optic technology was the development of the first fiber optic switch for computer systems.

Electrostatic Image Recorder RADC provided a demonstration of the capability to make a black-on-white transparency on a reusable film loop.

The assignment of RADC to the Research and Technology Division of HQ AFSC and plans for a significant internal reorganization of the Center were all part of a broad proposal to realign and consolidate Air Force laboratories, resulting in seven Air Force laboratories designated by function. The proposal, which did not occur as planned, called for RADC to become the Air Force Electromagnetics Laboratory. The other six laboratories would have been the Rocket Propulsion, Weapons, Aero-Propulsion, Materiels, Avionics, and the Air Force Flight Dynamic Laboratories. The first two would have been at Edwards AFB and Kirtland AFB respectively, while the others would have been located at Wright-Patterson.



SENIOR LEADERSHIP

On 1 December, Colonel David M. Crabtree, the RADC Deputy Commander, assumed command of the Center upon the retirement of General Doubleday. Colonel Crabtree had extensive experience in the field of engineering, both in the Air Force and in the civilian world. Holding a Master's in Industrial Engineering from Stanford University, Colonel Crabtree's civilian accomplishments included working as a research engineer for the Shell Oil Company and serving in charge of radio operations for the Mutual Telephone Company in Hawaii.

Dr Burgess remained as Chief Scientist throughout the year. After Colonel Crabtree assumed command, the position of Deputy Commander was unfilled throughout the remainder of the year.

ORGANIZATION

Mission Statement The mission statement of RADC included the following:

> Plan, formulate, present and execute the AFSC exploratory and advanced development programs in the areas of high power electromagnetic components; point-to-point communications techniques; ground signal detection and processing; information processing and display; intelligence data processing and special collection; reliability and maintainability; electromagnetic compatibility; command and control; instrumentation and test; and associated areas.
>
> Conduct in-house research to maintain a high level of technical competence.

Act as Air Force Systems Command focal point for information in assigned areas.

Execute assigned projects for and work closely with the Army, Navy, National Aeronautical Space Agency, Advanced Research Projects Agency and other government agencies.

Support Air Force Systems Command programs and insure the rapid application of research and technology to advanced systems.

Conduct foreign aerospace technology activities within the scope of the assigned mission.

Facilities

Facility Construction New facilities under construction during the year included upgrades and additions to the High Power Laboratory and a facility (Building 247) for testing, reconnaissance photography work, and other intelligence activities. This Intelligence and Electronic Warfare facility would support experimental work with intelligence gathering equipment, intelligence data processing, and sensor record processing equipment.

Passive Satellite Research Terminal During the latter part of the year, the Center formally opened the Passive Satellite Research Terminal at its Floyd site.

Structure

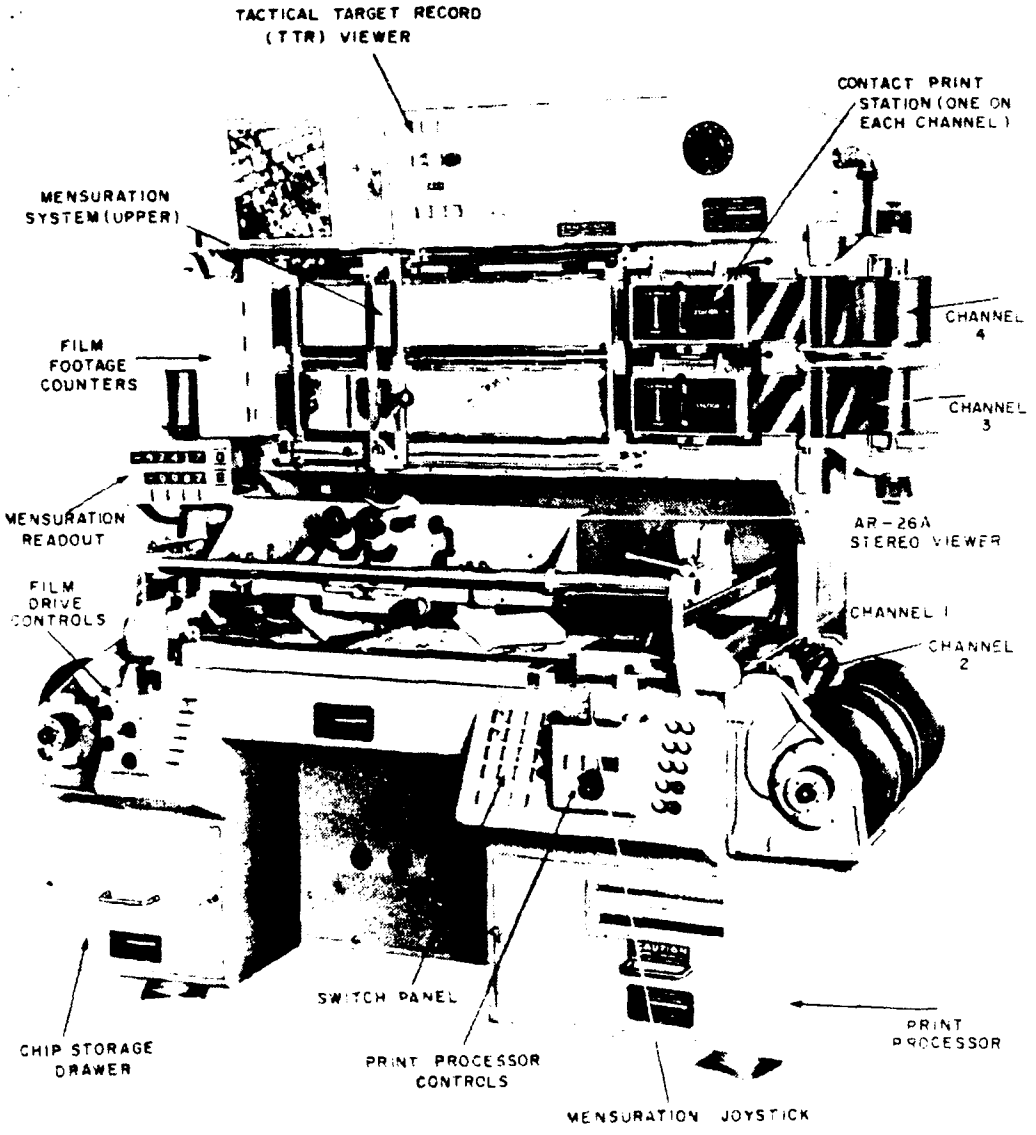
Assignment to HQ AFSC Research and Technology Division Effective 1 January, RADC was assigned to the recently formed Research and Technology Division at HQ AFSC.

Internal Reorganization On 25 November, the Center undertook a major internal reorganization, shifting from a directorate-based organization to one based on divisions. The major mission areas were aligned under seven divisions: 1) Surveillance and Control, 2) Communications, 3) Engineering, 4) Intelligence and Information Processing, 5) Procurement, 6) Flight Test, and 7) Foreign Technology. In addition to these divisions, four chief offices -- the Assistant for Staff Support, the Chief Scientist, the Assistant for Systems Support, and the Plans and Programs Office -- reported to the Commander. This organizational setup replaced the previously existing nine directorates. What had previously been designated as divisions under the former system were now branches, and the former branches were renamed sections.

RESEARCH AND DEVELOPMENT ACTIVITIES

Intelligence

Reconnaissance Technical Squadron Headquarters In the October/November period, the design of the headquarters unit for the Reconnaissance Technical Squadron was completed. The squadron would be equipped with such equipment as the image interpretation cell and the multisensor and tactical target record viewers.



Multisensor and Tactical Target Record Viewer

CHICODER RADC developed a feasibility model of a CHICODER, a device designed to convert Chinese characters for automated language translation.

Atomic Strike Recording Set The AN/GSQ-44 Atomic Strike Recording Set, developed by RADC, was installed in the European theater.

Countermeasures Recording Set In support of the countermeasures mission, the RADC-developed Countermeasures Recording Set (AN/FLR-9) became operational. This direction finding system supplied world-wide deployable, high-frequency radio signal monitoring capability.

Surveillance

Rampart Radar RADC conducted tests of automatic tracking S-Band radar. The evaluations utilized frequency step pulse in order to gather missile re-entry data at the White Sands Missile Range in New Mexico. Previous work in "Pincushioning" was critical for the design of the Rampart tracker.

RATSCAT Located at the White Sands Missile Range, Holloman AFB, New Mexico, RATSCAT was a radar reflectivity measurement range used to measure radar cross-sections of objects. Radar was tested at an experimental interval between the RATSCAT and a Stallion radar site located uprange, which was used to obtain the cross-range aspect of re-entry data.

Command and Control

Back-Up Intercept Control (BUIC) System RADC developed the Back-Up Intercept Control (BUIC) system, which would later be improved in order to replace the Semi-Automatic Ground Environment (SAGE) air defense system.

Epitaxial Reactor RADC set up an epitaxial reactor in order to cultivate controlled-resistance silicon layers. These silicon layers were used to produce micro-miniature integrated circuits.

Reliability and Maintainability

Maintenance Prediction As part of its reliability and maintainability function, RADC developed the first maintenance prediction technique.

Other

Visual Analysis Console (BR-90) The BR-90 Visual Analysis Console, developed by RADC, was the first general-purpose console for use in computer or communications equipment to be employed in the visual analysis subsystem by the Strategic Air Command.

The phase-down of the host organization at Griffiss AFB, the Rome Air Materiel Area, resulted in mixed consequences for RADC. On the one hand, the Center experienced some major inconveniences related to the logistics and support functions provided by the base. On the other hand, as the AFLC organization vacated facilities at Griffiss AFB, there was the potential for RADC to acquire more building space.

SENIOR LEADERSHIP

On 15 July, Brigadier General Allman T. Culbertson assumed command of RADC, becoming the seventh Commander of the Center. Colonel Crabtree, his predecessor, retired from active duty. Prior to his assignment to RADC, General Culbertson had been the Vice Commander of the Air Proving Ground Center at Eglin AFB, Florida. A bomber pilot during the Second World War, he had flown in the first bombing attack against the city of Berlin.

On 9 April, Colonel Leonard N. Palmer, previously the Chief of the Communications Division, became the Deputy Commander of RADC, filling a gap which had existed in that position since Colonel Crabtree had assumed command of the Center in the previous December. Colonel Palmer was subsequently tasked to function as the Assistant for Staff Support, in addition to his primary duty as Deputy Commander. Dr John S. Burgess continued to fill the position of Chief Scientist.

ORGANIZATION

New Mission Statement A new mission statement for RADC, effective 22 December, declared that the Center would

> plan, formulate, present and execute the Air Force Systems Command Exploratory Development Programs in the electromagnetic areas of: transmission and reception (below 15 gc); information processing; display; reliability and compatibility; ground based surveillance; ground communications; intelligence; instrumentation and test; and related advanced development programs.

Facilities

Microelectronics Techniques Laboratory In September, a Microelectronic Techniques Laboratory was completed. Construction of the laboratory had started the previous year.

RESEARCH AND DEVELOPMENT ACTIVITIES

Communications

Parabolic Phased Array The Ohio State University conducted communications experiments with a four-element parabolic phased array testbed, under contract with RADC. The device utilized active and passive satellite communications links.

Status Control and Alerting and Reporting System (SCARS) RADC produced the Status Control and Alerting and Reporting System (SCARS) for NATO. This electronic communications system was specifically developed to support the Supreme Allied Commander, Europe.

Intelligence

Mark II Russian Language Translator The Mark II, a practical application of the use of artificial intelligence, became the first operational automated language translator designed to translate from Russian to English.

Electro-Optical Rectifier With a view to the enhancement of imagery interpretation capability, RADC developed an electro-optical rectifier designed to eliminate panoramic distortions on photographic images.

Reliability and Maintainability

Self-Repairing Circuitry A demonstration of circuitry with self-repair capability was held. Minneapolis Honeywell was the contractor for this RADC-sponsored effort.

AN/MSM-63 Electromagnetic Measurement Van RADC developed the AN/MSM-63 Electromagnetic Measurement Van.

Command and Control

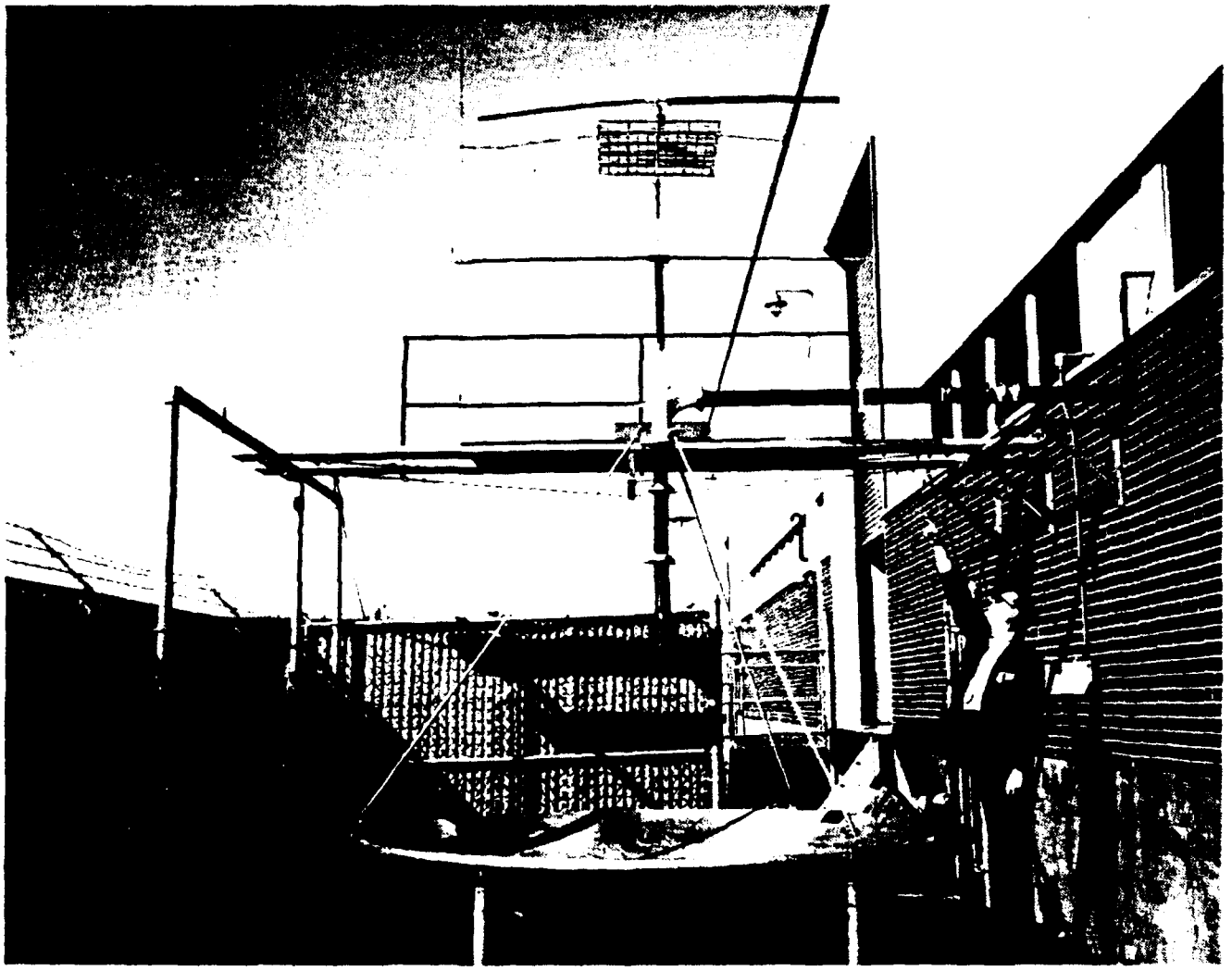
Solomon Parallel Computer Under a contract sponsored by RADC, Westinghouse Aerospace Division constructed a breadboard model of the Solomon Parallel Computer. This program resulted in an iterative-array computer able to test circuitry and the operation of a portion of the overall Solomon (Illiac IV) system. The computer was able to perform 100 different operations simultaneously. RADC publicly announced the accomplishment on 8 October, when it proclaimed the computer as the top achievement for the month of September.

Cryogenic Associative Processor RADC tested the Cryogenic Associative Processor. IBM was the contractor which developed this RADC-sponsored system.

Dove Data Storage and Retrieval Device Under a contract sponsored by RADC, Braddock, Dunn and McDonald, Incorporated, constructed a simple prototype of the Dove Data Storage and Retrieval Device. The project, named for its designer, John F. Dove of the Surveillance and Control Division, would be used to store data in a digital format on metallic tape.

Other

Experimental Microwave Powered Helicopter At a 28 October press conference, Raytheon, under contract with RADC, demonstrated an experimental microwave-powered helicopter. The significance of this effort was not merely in the development of the equipment, but in the technological advances, particularly the use of a microwave beam to transfer power. The helicopter subsequently was included in a federal science and engineering exhibit.



Microwave-Powered Helicopter

Electron Beam Density During the latter half of the year, the Radio Corporation of America, under an RADC-sponsored contract, attained an electron beam density of 800 to 1000 amperes per square centimeter, utilizing a hollow tungsten cathode filled with cesium vapor.

The latter half of the year saw a significant expansion in the Center's support for the operations in Southeast Asia, which had been gaining an increasing amount of public attention. In addition to carrying out research and development aimed at supporting the Southeast Asia Operational Requirements, Project 1559 development provided a means to expedite production for the field. RADC's Quick Reaction Capability organization provided rapid in-house contractual support for projects capable of completion within nine months. RADC supplied ground-based radars, communications, intelligence, and information processing equipment to South Vietnam. Engineering support provided by the Center took the form of contracting, procurement, and equipment testing.

SENIOR LEADERSHIP

General Culbertson continued in command of the Center throughout the year. On 28 June, Colonel James J. Dimel assumed the additional duty function of Assistant for Staff Support, leaving Colonel Leonard N. Palmer as the Deputy Commander. On 15 July, Colonel Palmer was named Assistant to the Commander. On 8 September, upon the retirement of Colonel Palmer, Colonel Gustav E. Lundquist was assigned the position of Deputy Commander, with the additional duty of Chief of Staff. Dr Burgess continued to hold the position of Chief Scientist.

ORGANIZATION

Facilities

Tummonds Hill and Youngstown Off-Base Facilities In support of the RADC troposcatter communications developmental program, the Center acquired two off-base locations at Tummonds Hill and Youngstown. The former was located 100 miles west of Griffiss, while the Youngstown site was an additional 100 miles in the same direction. Together these sites formed the Troposcatter Communications Test Range.

RESEARCH AND DEVELOPMENT ACTIVITIES

Support for Southeast Asia

C-123 Aircraft Lost On 7 June, one of the Flight Test Division's C-123 aircraft was lost in Southeast Asia.

Project 1559 Support to Southeast Asia The major 1559 projects in support of operations in South Vietnam included the Optical Tracking Telescope and Range Finder, the IFF/SIF for Manpack Radar, and the Tactical Ground-Based Transponder, all surveillance and command and control projects. The Tactical Digital Communication Evaluation System, and the Automatic Voltage Regulator were communications equipment provided under the same program.

Man-Pack Radar Three man-pack radars developed in support of the operations in Southeast Asia were being evaluated at the end of the year. One was developed in-house, one by General Electric, and one by the Emerson Electric Company. This equipment would provide Forward Air Controllers the means to locate enemy forces in order to direct friendly aircraft to their targets.

IFF/SIF Equipment for Manpack Radar This project was intended to meet the need for Identification Friend or Foe (IFF) and Selective Identification Features (SIF) capability which could be included in a man-pack radar. Procurement effort began in May, and on 10 December, HQ USAF approved the program and funded it at $95,000.

Inflatable Antenna for Communications The concept of this project was for the development of low, high, and ultra high frequency antennae, about 25 pounds in weight and able to be inflated by a foot pump to a height of sixty feet, and later folded and transported elsewhere. The radiating element would be a metallized tip of the mast. Studies started in March indicated that the concept was feasible.

Digital Message Entry Device Also in support of Southeast Asia, RADC developed a Digital Message Entry Device, which would provide limited private communications capability to forward air controllers requesting close air support. By the end of the year, the Tactical Air Warfare Center was testing the equipment.

Radio Beacon Man-Pack Equipment In June, RADC completed the development of low frequency and X-Band Ground Beacons for use as forward area markers or as navigational aids.

Electromagnetic Surveillance Techniques In June, RADC completed the development of a lightweight (350-pound) surveillance antenna operationally equivalent or better than systems that were up to ten times larger and heavier.

MIRAGE Display In July, the Center completed the development of a lightweight (960-pound) Microelectronic Indicator for Radar Ground Equipment (MIRAGE) Display which had virtually the same capability as the AN/UPA-48 Display Console.

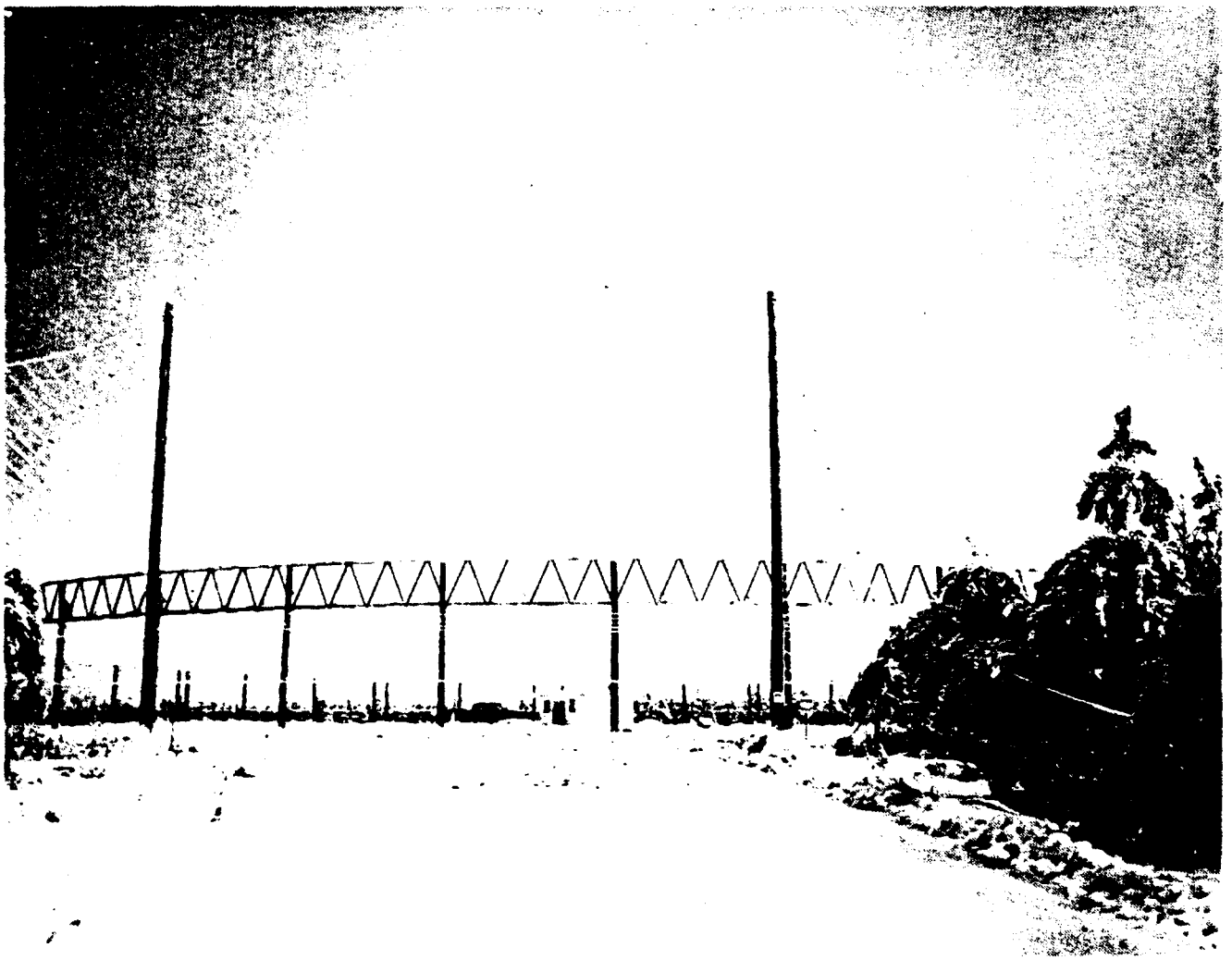
Microminiaturization Techniques In September, the Center completed the development of a Micromin Dickie Fix Receiver and MTI filter for AN/FPS-8 radar.

AN/PRC-71 Transceivers Battery-powered AN/PRC-71 transceiving units developed by RADC were used by forward air controllers in Southeast Asia.

Intelligence

Rear Projection/Direct Viewer This imagery analysis device was developed by RADC for viewing infrared imagery. One useful feature was the open film gate intended to permit analysts to annotate film.

Luneberg Lens Direction Finder During the latter part of the year, the nearly completed High Frequency Luneberg Lens Direction Finder (HFLLDF), located at Clark Hill, was evaluated. The frequency range was from 10 to 50 megacycles. This unique system stood 60 feet high and was composed of wide-aperture multi-beam equipment, which made it possible to determine the directional angle of intercepted radio signals.



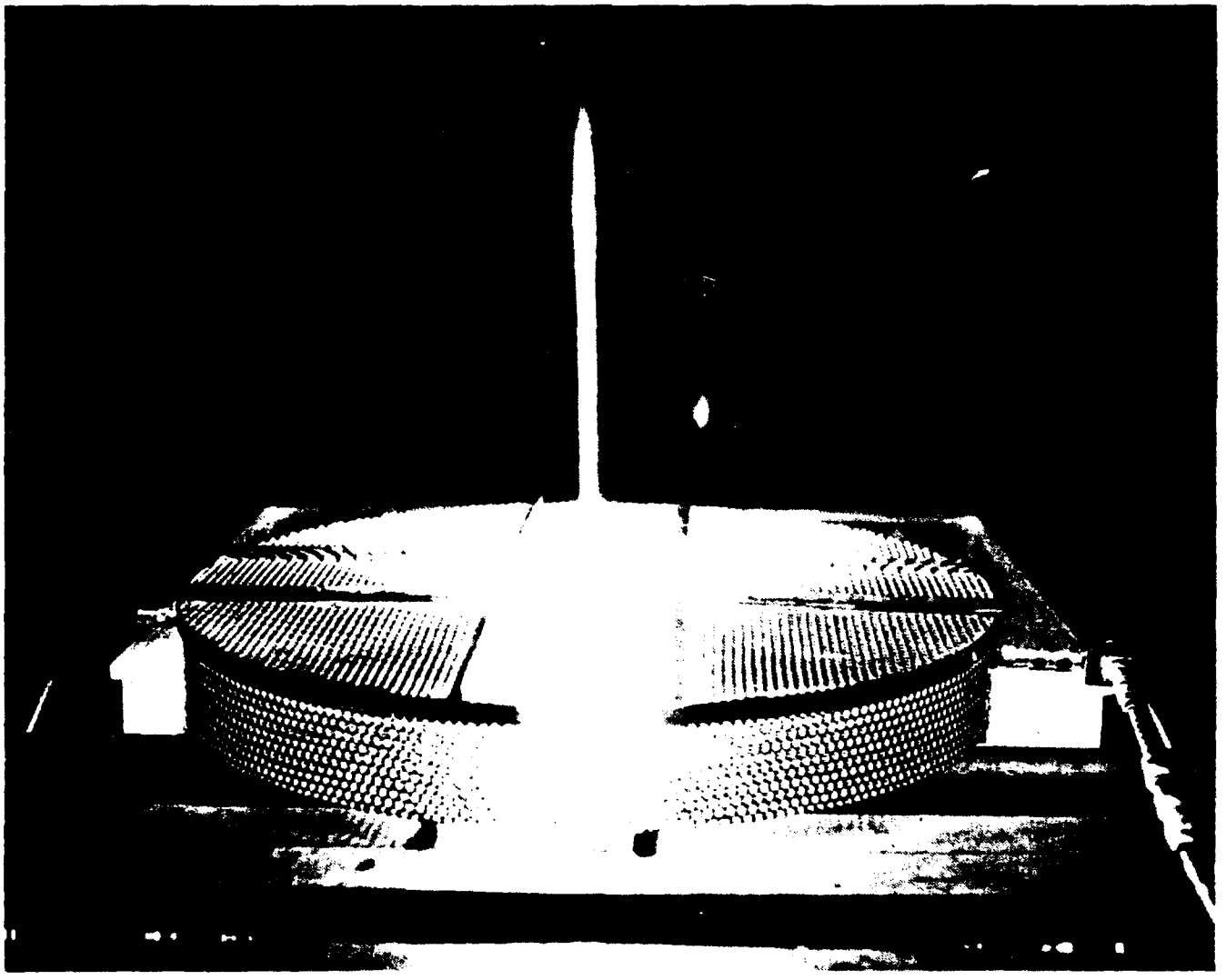
High Frequency Radio Direction Finder

Thailand-Based Reconnaissance Program RADC was responsible for managing a reconnaissance program based in Thailand. The program was sponsored by the Advanced Research Project Agency (ARPA).

Multifont Print Reader A multifont print reader was delivered to the Center's Foreign Technology Division, in support of the RADC intelligence program. This device, developed in April, was especially crucial to cover the existing backlog in foreign intelligence.

Communications

Plasma Column Antenna An experimental model developed by RADC produced a plasma column which could be used as a survivable antenna.



Plasma Column Antenna

AN/TTC-22 Communications Shelter RADC developed the AN/TTC-22, the first shelter housing tactical telephone central switching and providing manual long-distance trunking and local automatic dialing service. Both the 100-line, two-wire automatic switchboard and the two-position manual long-distance switchboard utilized commercial, off-the-shelf equipment.

Balloon/Drone-Supported UHF Radio Repeater In mid-October, ultra high frequency radio repeaters, a joint development of RADC, the Avionics Laboratory, and Sylvania, were completed and ready for testing. Test flights began on 12 November and were completed on 7 December. The development was a significant enhancement to communications in tactical situations, by using either high-altitude balloons or drones equipped with UHF radio repeaters to increase range for messages between ground stations.

Multiple Frequency Survivable Network RADC introduced an experimental survivable communications network, which connected existing commercial broadcasting stations to provide emergency support to DOD teletype communications.

Surveillance

AN/FPS-92 Tracking Radar In June, RADC was assigned engineering control of the AN/FPS-92 tracking radar. This radar would be added to the Site II BMEWS.

Interferometer Radar RADC was responsible for the design and construction of the Active Swept Frequency Interferometer Radar (ASFIR) system.

Reliability and Maintainability

Data Retrieval System for Reliability In April, RADC completed designing a data storage and retrieval system for the Minuteman data collection effort in preparation for the publication of a reliability notebook.

Vulnerability Reduction Considerable progress was made in the area of reducing vulnerability to electromagnetic interference. Mr Woodrow W. Everett, Jr. was among the RADC personnel recognized for technological improvements in wave guides, electronic tube components, and greater electronic compatibility.

"Pin Stripe" Project In Project Pin Stripe, RADC took part in underground nuclear testing carried out in Nevada. The purpose of these tests was to ascertain the effects of nuclear radiation on microelectronic circuitry.

Command and Control

Laser Display Model Around May there was significant progress in the development of a Laser Display Model, being designed and constructed by Texas Instruments under a contract administered by RADC. The model was able to replicate a television image with a resolution of 250 lines per inch. (The ultimate goal was a resolution of 1000 lines per inch.)

Sealed-Off Light Valve RADC developed a sealed-off light valve. This device was the first thermoplastic valve designed to enable medium-screen group viewing.

Integrated Information Processing System (INTIPS) Researchers used the Integrated Information Processing System (INTIPS), developed by RADC, to solve difficulties in computer organization.

Billion Bit Memory Another important breakthrough in the area of data processing technology was the development of a billion-bit computer memory capacity. Work on this non-mechanical memory, with a cycle time of less than two microseconds, had been ongoing for about four years.

Other

X-Band Klystron The Center's High Power Laboratory developed a one-half megawatt continuous-wave X-band klystron in March. This amounted to a four-fold increase over the previous state of the art capacity.

AWARDS

Air Force Outstanding Unit Award In August, at an RADC open house, the Center received an Air Force Outstanding Unit Award for the period 1 January 1962 to 31 December 1964. The award citation especially emphasized the Center's "accelerated development of improved Over-the-Horizon Radar Systems." The enhanced Over-the-Horizon radar expanded tracking coverage of missiles and aircraft and provided a better comprehension of the auroral clutter and atmospheric phenomena.

As in the previous year, the support of RADC to the combat operations in Vietnam were significant. Many of the technical programs mentioned below made up part of that support. In addition, personnel representing RADC spent almost 3,500 man-days of temporary duty in South Vietnam in more direct support of the conflict, particularly with the establishment of an RADC element there. This TDY support included civilian and contractor personnel, as well as military members assigned to the Center.

SENIOR LEADERSHIP

After Colonel Gustav E. Lundquist, Deputy Commander of RADC, was transferred to Wright Patterson AFB on 27 June to assume command of the Systems Engineering Group, he was replaced by Colonel Jean A. Jack, who came to RADC from the Arnold Engineering Development Center. Dr John S. Burgess continued as the Chief Scientist, and General Culbertson remained at the helm as the RADC Commander.

ORGANIZATION

Mission

Research Technology Division Regulation 23-3 On 11 March, the Research Technology Division added to the RADC mission statement the clarification that the Center was "to provide technical support to current and future systems programs and operational support projects in the areas of RADC technical cognizance." On 5 August, the following was added:

> Evaluate for the Air Force and the other Services as requested, the technical quality of Independent Research and Development (IR&D) programs assigned by Headquarters RTD, AFSC, and USAF organizations as required; assure consideration of such evaluation and technological activity in planning and development stages of future AF aerospace efforts in assigned mission areas.

Personnel and Facilities

Personnel Functions As of 15 August, all personnel functions which had formerly been carried out by RADC became the responsibility of the Consolidated Base Personnel Office.

Digital Communications System Evaluator By 16 September, the Digital Communications System Evaluator (DICOSE) became fully operational. This was the first military facility capable of simulating and evaluating digital communications networks through the use of both wire and high-frequency networks. At any point in the communications route, the evaluator would be able to check the integrity of a message.

Integrated Circuit Measurement Facility In October, a facility designed to perform measurements on integrated circuits was constructed at RADC.

Structure

RADC Southeast Asia Foreign Technology Element In March, RADC established a Southeast Asia (SEA) Foreign Technology element in the Vietnam AFSC Liaison Office.

Computer Sciences Center As the result of an internal reorganization, RADC formed a Computer Sciences Center in June. This center was intended to develop and exploit general computer usage and interactive computer programming, in which a number of users were to share computer time simultaneously.

RESEARCH AND DEVELOPMENT ACTIVITIES

Surveillance

Helicopter Radar An RADC-developed helicopter radar was designed to provide overland detection of low-flying aircraft.

Manpack Radar RADC developed a man-transportable micro-miniaturized radar device to provide detection of low-flying aircraft.

Communications

AN/TRC-87 UHF Radio Nine AN/TRC-87 UHF radio voice communication sets were dispatched to Southeast Asia early in the year. These UHF sets had a frequency range of 225 to 400 megacycles and had a tested range of 235 miles when transmitting to an aircraft at 35,000 feet. Accessories delivered would permit operations from a distance of up to five miles.

Speech Compression System In July, RADC developed a model speech compression system, which proved the feasibility of sending analog voice transmissions over narrow bandwidths.

Tropospheric Scatter Communications Terminal Six Transportable Tropospheric Scatter Communications Terminal (AN/TRC-103) sets were delivered in August.

Command and Control

SKYSPOT Close Air Support Bombing System The goal of the SKYSPOT RADC developmental program was to provide a ground-directed close air support bombing system by combining computer technology with radar.

Reliability and Maintainability

Failure Rate Compendium The Center published a compendium on failure rates of nonelectronic parts.

Automatic Circuit Tester As an in-house effort, RADC designed and constructed an automatic circuit tester.

Electron Beam Microprobe RADC developed an electron beam microprobe, a device which could test the reliability of solid state microcircuits.

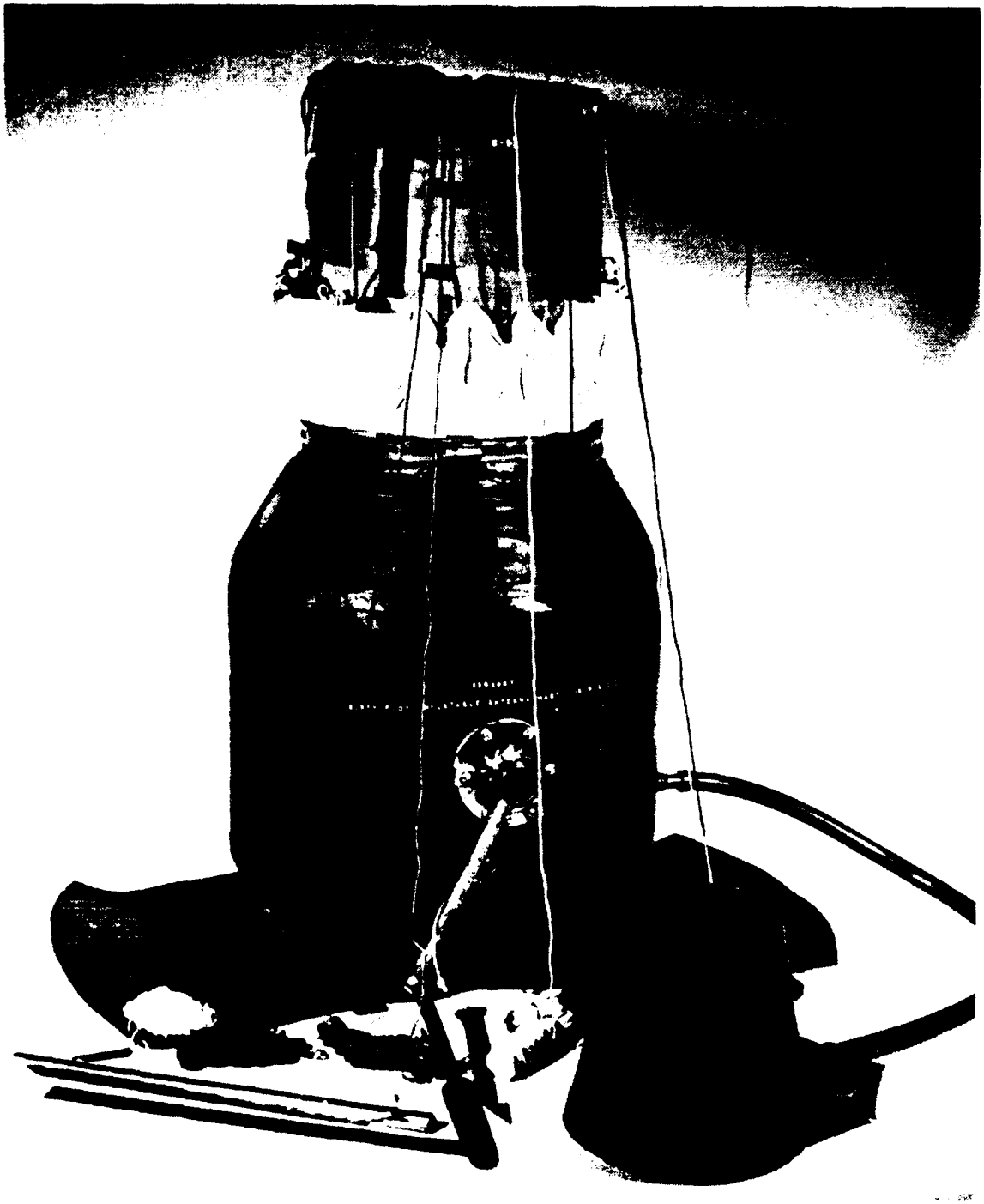
Interference Notebook In June, RADC published the Center's first Interference Notebook. This work provided a summary of the most important contributions in interference prediction, analysis, suppression and control, and measurement.

Command and Control

Multicolor Laser Display Under an RADC-sponsored contract, Texas Instruments developed the first laser display which was able to support full color visual display capability.

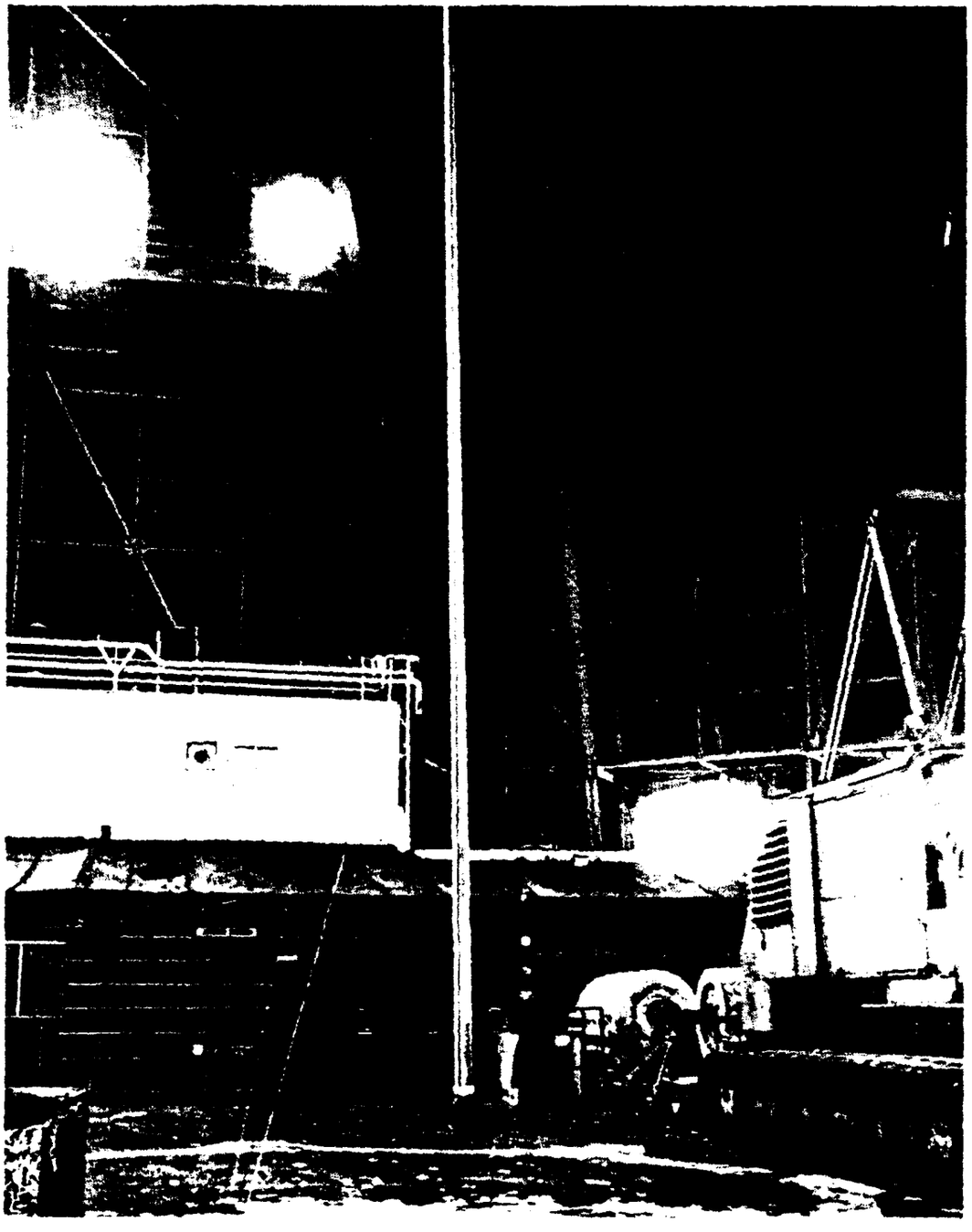
Other

AN/GSA-19 Blanking System In support of the Strategic Air Command's training program, RADC developed a central blanking system to be used at SAC's radar bomb-scoring facilities.



Antenna Prior to Inflation

Inflatable Antennae Twelve inflatable antennae were shipped to Vietnam during the year. Utilizing a foot-operated inflation pump, these antennae could be inflated to approximately six inches in diameter and sixty feet in height.



Antenna After Inflation

Electronic Countermeasures In July, RADC designed and developed an electronic countermeasures planning kit, which it deployed to Southeast Asia in support of combat operations.

Advanced Infrared Technology As part of its intelligence and reconnaissance developmental program, RADC's made significant progress in advanced infrared technology. New developments provided real-time data readout to aircrews, while in flight, in support of air combat operations in Vietnam.

During 1967, RADC continued carrying on its research and development mission. Support for the operations in Southeast Asia continued to take the form of developmental work and manpower support. Turning its attention to the local community, RADC began a weekly radio series providing informative highlights on RADC personnel and activities to the local area over Rome radio station WRNY.

SENIOR LEADERSHIP

On 31 July, Colonel George A. Zahn became the eighth Commander of RADC, replacing General Culbertson, who retired from active duty. Prior to assuming command of RADC, Colonel Zahn had been assigned to the Electronic Systems Division as the Deputy for Communications. He had more than twenty-five years of experience in the field of communications electronics, both as a military officer and as a civilian.

Meanwhile, the positions of Chief Scientist and Deputy Commander continued to be filled by Dr John S. Burgess and Colonel Jean A. Jack respectively.

ORGANIZATION

Structure

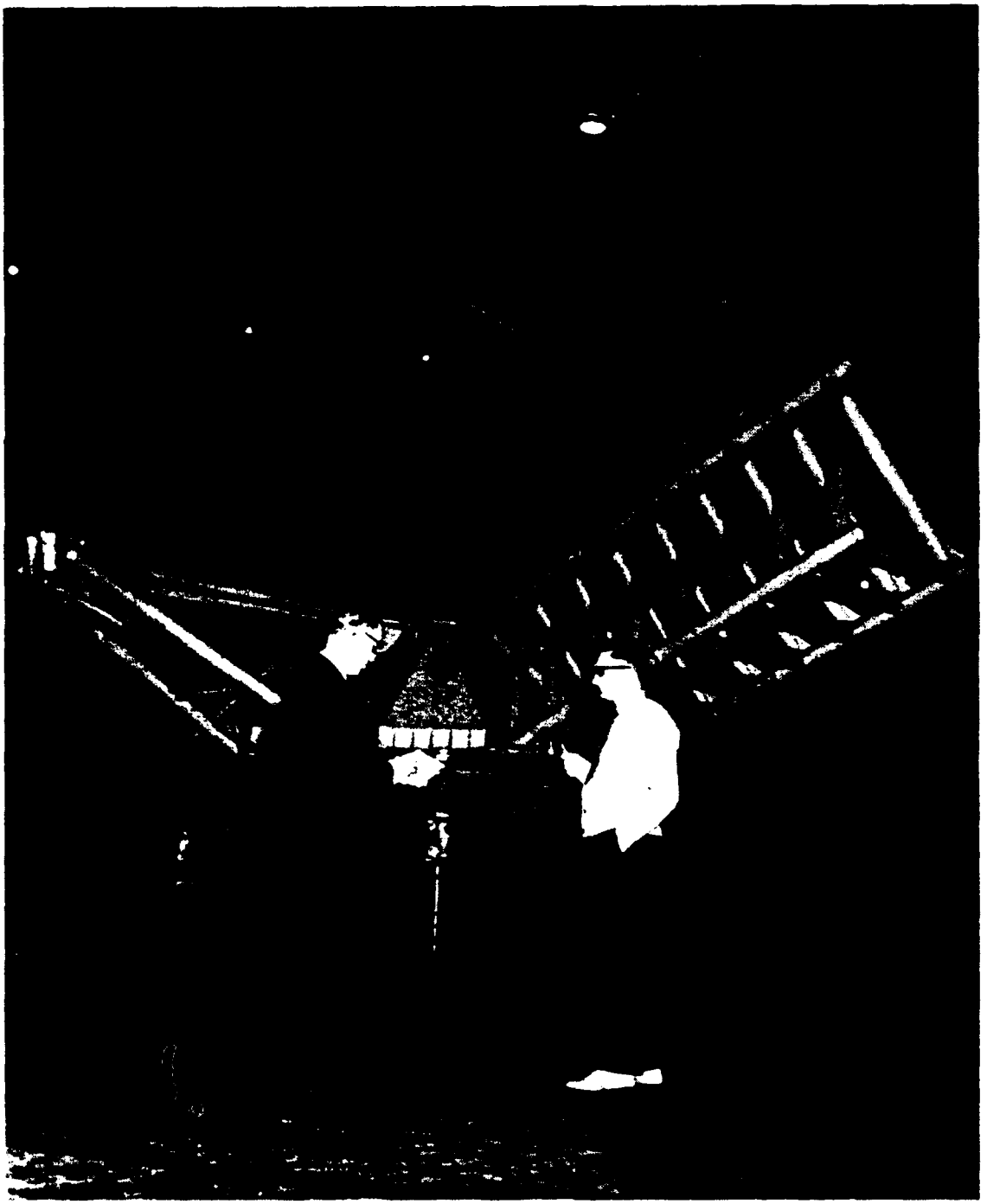
ROAMA Discontinued On 1 April, the Rome Air Materiel Area (ROAMA) was officially discontinued. Contrary to earlier predictions, however, the Air Force Logistics Command retained its responsibility for Griffiss AFB by assigning host functions to the Headquarters Ground Electronics Engineering Installation Agency.

Reassignment On 15 November, RADC was reassigned from the HQ AFSC Research and Technology Division to the HQ AFSC Director of Laboratories. The Center's mission remained unchanged.

Facilities

"Little Ida" Facility Electronic equipment and antennas were installed at the "Little Ida" facility in September. The facility was located at the Starr Hill test site, operated by RADC as a microwave relay station and a baseline equipment calibration terminal. As a result of requirements defined by the environmental studies for the Over the Horizon Detection Program (previously referred to as "Expanded Little Ida"), the site had received a mission of high frequency propagation reception.

Bearing Test Facility Construction of a Bearing Test Facility was completed in May. The purpose of this facility was to accomplish tests of rolling-element bearings operating at an accelerated life rate, with the capability of applying test loads of up to 95 tons and overturning moments of up to 1,783,000 pounds per foot.



RADC Bearing Test Facility

Failure Analysis Laboratory RADC established a Failure Analysis Laboratory, the purpose of which was to ascertain reasons for failures in microelectronic devices.

RESEARCH AND DEVELOPMENT ACTIVITIES

Support to Southeast Asia

Manpower Support to Southeast Asia By the end of the year, about 11 percent of RADC's technical manpower resources were spent in support of Southeast Asia operations. An estimated 25 civilian employees had been sent to combat zones to provide orientation and training on the use of RADC-developed equipment.

SAFE SIDE Intrusion Detection Equipment On 29 November, Westinghouse Instruments Laboratory delivered seven Ultrasonic Transmitter/Receiver sets to RADC as part of the SAFE SIDE program to provide enhanced security equipment. On 27 December, the equipment was shipped to Southeast Asia.

AN/TRC-103 Solid State Troposcatter RADC developed the AN/TRC-103 solid state troposcatter communications system for operational use in Southeast Asia.

Surveillance

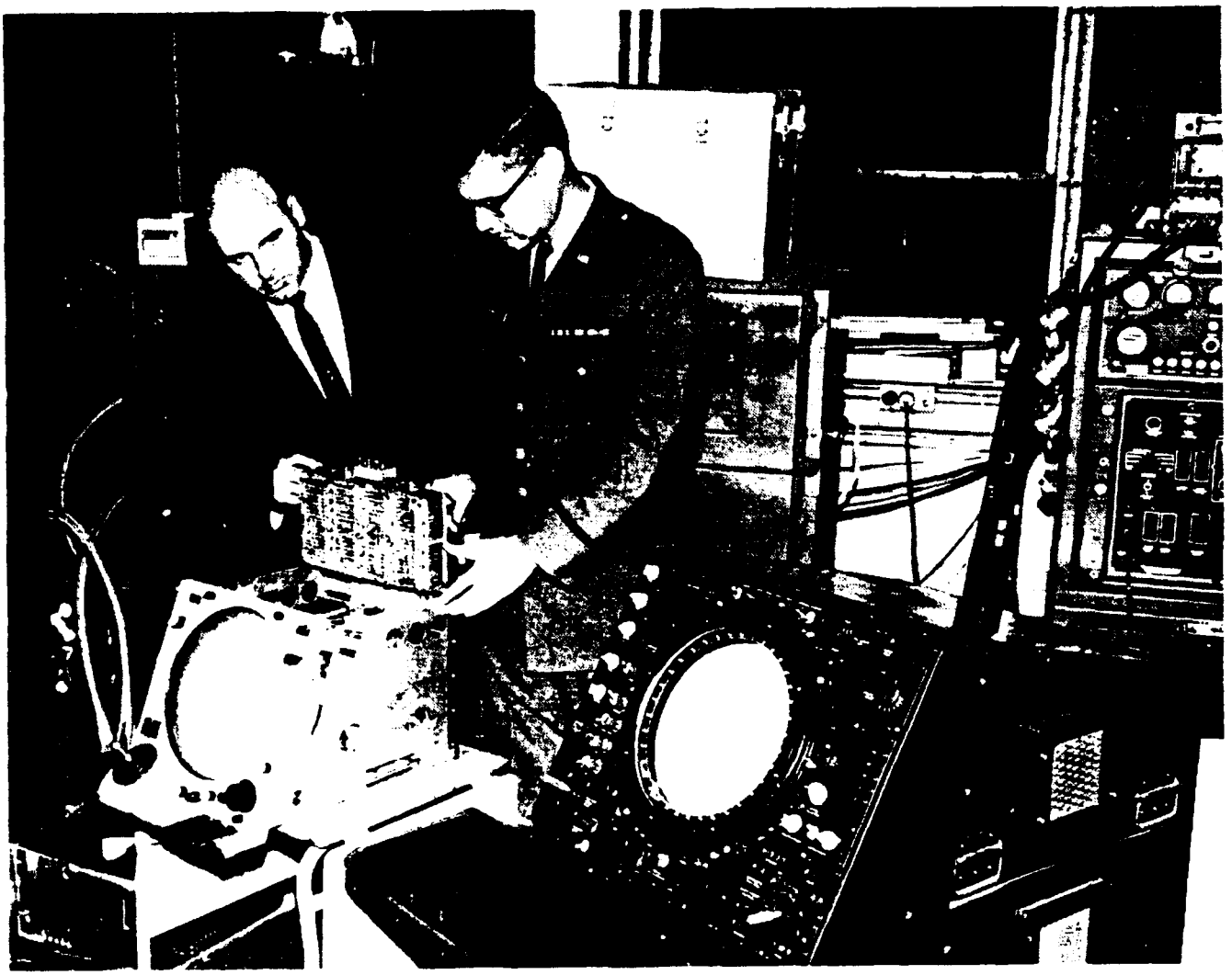
Radar Bias Error Determination by Photogrammetry This RADC in-house effort resulted in the perfection of a method to measure the range and angle bias error of radar by using standard Air Force Aerial Cameras and a photogrammetric space resection method. In March, the method was used for the initial calibration of a ground-based radar.

Interferometer Radar The flight testing of the Active Swept Frequency Interferometer Radar (ASFIR) ended on 31 March. This marked the completion of almost two and one-half years of development for this system.

Ground Beacon IFF Control Equipment In April, Litton Systems Inc., under contract with RADC, delivered a light-weight 14-foot antenna and a pedestal assembly to RADC, as part of the Ground Beacon Identification Friend or Foe (IFF) Control Equipment program. RADC formally accepted the equipment, and the items were installed at the center as part of an engineering evaluation of the program, also known as the Spartan System program.

AN/TPS-48 Radar In August, the AN/TPS-48 radar, part of a Project 407L Tactical Air Control System, was delivered to the Tactical Air Command. After delivery, the equipment underwent wind, moving target indicator, and assembly tests at Eglin AFB. After successfully completing testing, TAC used the equipment as a Control Reporting Center Radar.

MIRAGE II Display In March, General Electric delivered an engineering model of the Microelectronic Radar Integrator for Ground Equipment (MIRAGE) II display to RADC. The display was a general purpose radar indicator which utilized a plan position indicator on a 12-inch cathode ray tube. The use of microelectronic components in integrated circuits provided reduced size and weight with enhanced performance and reliability.



MIRAGE

Communications

AN/PRC-72 Multimode Manpack Radio Test and approval of the AN/PRC-72 multimode manpack radio occurred in September. This set, weighing 36 pounds, contained four transceivers operating in HF, VHF, and UHF. It could provide ground-based forward air controllers with communication capability with all HF/SSB, VHF/AM, and UHF/AM equipment used by the Air Force.

AN/PRC-66 Radio Sets In September, Canadian Commercial Corporation delivered six AN/PRC-66 radio sets to RADC, and field tests were finished on 3 October. Featuring microminiaturization methods for less weight and added reliability, this UHF/AM manpack transceiver, shown on the left, would be used by tactical forces to communicate with friendly aircraft.

Satellite Communications Program In October, the Lincoln Experimental Satellite (LES-5) was utilized for the Center's Satellite Communications Program, involving multiple signals from separate communications terminals.

Lightweight Troposcatter Communications In November, RADC developed the AN/TRC-104 and the AN/TRC-105 troposcatter communications systems. Weighing approximately 500 pounds, these were the first lightweight troposcatter systems that transmitted by bouncing signals off the troposphere.

AN/MRC-113 Tropospheric Scatter Communications RADC developed the AN/MRC-113 Tropospheric Scatter Communications Radio system in December. Consisting of several equipment items, including a receiver, exciter, amplifier, microwave radio-relay set, voice multiplexer, and antenna group, this system was a complete microwave and troposcatter communication facility.

Microwave Tactical Equipment Also in January, the Center developed lightweight microwave equipment utilizing solid state technology for use in tactical operations.

Command and Control

Communications, Navigation, and Identification (CNI) This RADC developmental program envisioned a common aircraft instrumentation hardware capable of communications, navigation, and identification signal processing. In July, a number of technical experts began a preliminary concept design and worked on identifying problem areas. They completed a preliminary draft of their

report in September and began to brief high-level Systems Command and Department of the Air Force officials.

AN/USA-26 Tactical Modular Display Under a contract with RADC, Motorola developed the AN/USA-26 Tactical Modular Display, a display system which could be utilized in either an airborne or a ground environment. The display was twelve inches, weighed 76 pounds, and used up to 400 watts of energy.

Multicolor Laser Display In January, RADC demonstrated a model of the first dynamic, multicolor laser display, developed by Texas Instruments.

On-Line Data Processing In March, the RADC Computer Sciences Central initiated a nationwide testbed for government on-line computer users. In order to demonstrate and promote advanced on-line methods, the center established a network enabling hundreds of remote users to utilize a central RADC computer.

Intelligence

Extended Range Film In March, Technical Operations Incorporated accomplished photographic developers and methods enabling black-and-white photographs to record over a wide range of brightness, with lower overall contrast. This would enhance photographic records of certain tactical or experimental events in a "high-light" environment (for example, photographs of missile or rocket exhausts).

AN/GYK-6 Data Processing Central RADC developed a Data Processing Central (AN/GYK-6). This information processing system developed out of the Center's first systematized efforts in the area of analog electronic intelligence (ELINT) data processing.

Catadioptric Lens On 6 November, the Catadioptric Lens, developed in support of ground intelligence collection activities, was delivered to RADC.

Reliability and Maintainability

Military Standard for Microelectronics As part of an RADC-administered contract, the Hughes Aircraft Company produced a Handbook of Design Criteria for Microelectronic System Packages. This four-volume guide provided the first military standard for microelectronic equipment, which initiated a standardization program of microelectronics for the DOD.

Quick Reaction Reliability System Support RADC established quick reaction reliability system support facilities and capability to conduct failure analysis and evaluate microelectronic solid state component products. This capability provided System Program Offices at the Product Division access to RADC expertise in the

area of semiconductor reliability, in order to better resolve problems which might occur during acquisition.

Integrated Circuitry In December, RADC designed integrated circuitry for computer and communications systems which would enable the use of smaller equipment requiring less size.

AN/FSM Video Integrating Analyzer Set The AN/FSM Video Integrating Analyzer set was delivered to the Verona test site, where preliminary acceptance tests were accomplished. This equipment had been modified to enhance sensitivity, range, stability, and accuracy of measurement, and to provide digital recording capability.

Navigation

LORAN-D Transmitter Complex In September, factory acceptance tests of the LORAN-D Transmitter Complex were completed. Sperry Gyroscope had developed this equipment under a contract administered by RADC to provide a smaller, more easily transportable transmitter complex for the LORAN-D Tactical Navigation System.

Other

Head-Mounted Eye Motion Recorder Kaiser Aerospace and Electronics developed a Head-Mounted Eye Motion Recorder for RADC. This somewhat uncomfortable-looking device provided a practical method of quickly and precisely measuring the effects of a display design on the viewer's capacity to extract information.

Head-Mounted Eye Motion Recorder

100-Watt Thermoelectric Generator Acceptance tests for a 100-watt thermoelectric generator were completed in October. The Center administered a contract with Atomics International for the development of this device, which was designed to provide power for communication equipment mounted on a balloon. After minor problems were corrected the contractor delivered the generator to RADC.

Combination Filter System RADC developed a combination filter system, designed to eliminate interference.

In the areas of mission and organization, 1968 would be characterized as a fairly stable view -- keeping in mind, of course, that the Center (as was the entire DOD) was busy supporting a Southeast Asian conflict that was becoming increasingly controversial in the view of many Americans. The work of RADC was enhanced by new facilities -- in particular, the new Electronics Laboratory (Building 3) -- and capabilities. The formation of the Science and Engineering Advisory Committee and the Civilian Policy Board were steps to achieving better use of resources and better communication among the Center's staff.

SENIOR LEADERSHIP

On 31 July, Colonel Jean A. Jack, Deputy Commander, retired from active duty. The following day, he was replaced by Colonel Paul J. Slocum, previously RADC Chief of Plans and Programs. Dr John S. Burgess continued as the Center's Chief Scientist, and Colonel George A. Zahn remained in command.

ORGANIZATION

Facilities

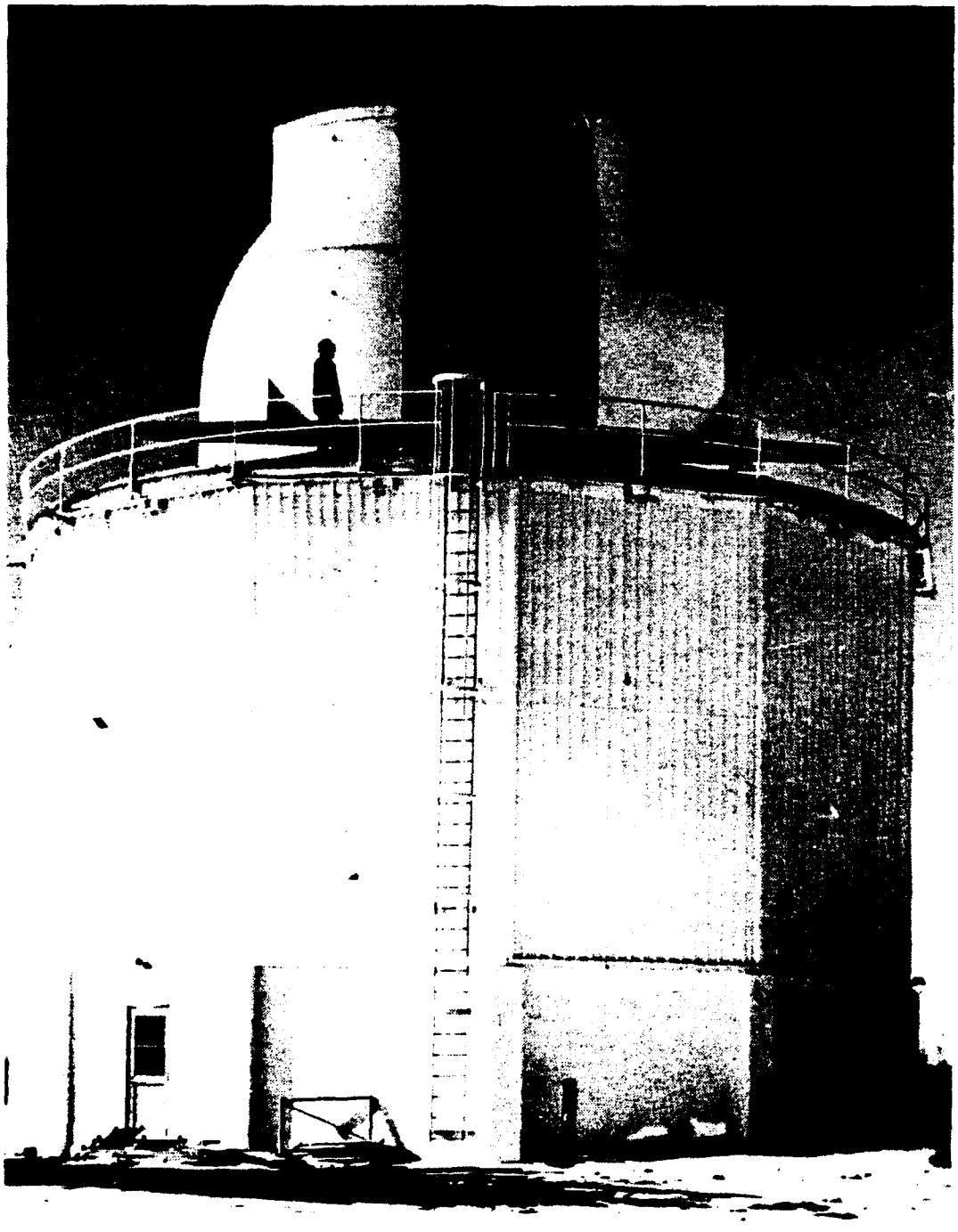
Laser Propagation Test Facility RADC established a Laser Propagation Test Facility at the Verona Test Site, which operated in conjunction with the Precision Angular Tracking Station. The purpose of the facility was to provide accurate prediction of optical system performance under atmospheric conditions and provide criteria for equipment design.

Computer Sciences Central Goes On-Line In August, RADC replaced the GE-635 computer in its Computer Sciences Central with a GE-645. This upgrade enabled the facility to expand its services to on-line users in 40 different organizations, including other Air Force activities, other elements of the Department of Defense, and colleges and universities in the vicinity.

Reliability Analysis Center RADC organized the Reliability Analysis Center, the first Information Analysis Center within the DOD which was dedicated to the study of reliability. The Reliability Analysis Center became operational in August.

Electronics Laboratory Dedication On 25 October RADC dedicated a new electronics laboratory (Building 3), providing facilities for the development of command and control displays and reliability and maintainability techniques. As the first major construction at Griffiss AFB for about fifteen years, the facility cost $1,370,272 and measured 80,000 square feet of floor space.

Precision Angular Tracking Station (PATS) On 6 March, the RADC Precision Angular Tracking Station (PATS), located at the Verona Test Site, officially opened. RADC developed this station in order to provide a ground-based precision tracking platform, to test optical and millimeter wavelength components and methods, as well as experimental navigation and communication instruments.



PATS Facility

Structure

RADC Science and Engineering Advisory Committee RADC Regulation 80-8, dated 1 February, established the RADC Science and Engineering Advisory Committee. Answering directly to the Commander, the committee reviewed technical program objectives to determine the best use of resources, in addition to seeking improved communications within RADC.

RADC Civilian Policy Board On 5 December, as mandated by RADC Regulation 40-1, the Civilian Policy Board was established, replacing the Scientific and Professional Committee.

RESEARCH AND DEVELOPMENT ACTIVITIES

Support to Southeast Asia

Lightweight High Frequency Antenna Collins Radio Company developed a lightweight, tactical, high-frequency antenna for the Combat Control Teams in Southeast Asia. Less than one cubic foot in volume and weighing less than 25 pounds, these antennae could be used with either vehicular or manpack radio equipment.

Lightweight Low Frequency Helix Antenna Under an RADC-sponsored contract, Goodyear Aerospace delivered a lightweight inflatable antenna in March, intended for use by Combat Control Teams. The equipment used solid state microcircuitry and electronic synthesizers and was applicable to either vehicular or manpack systems. Weighing 27 pounds and 1.2 cubic feet in volume, the 35-foot mast could be inflated and erected in 20 minutes by a two-man team.

"ASTROMAST" RADC conducted tests on the "ASTROMAST," a deployable antenna mast produced by the ASTRO Research Corporation for use in Southeast Asia. Delivered in October in both a 60-foot and a 100-foot versions, the Astromast was designed to meet government requirements for a high-antenna mast, which was rapidly deployable for tactical use.

Seventh Air Force Intelligence Data Handling System The Intelligence Data Handling System (IDHS), deployed to Seventh Air Force in support of operations in Southeast Asia, became operational.

Interference Cancellation System The Interference Cancellation System, designed for operation in Southeast Asia with collocated transmitters and receivers, was developed by American Nucleonics, under contract with RADC.

Surveillance

AN/TPS-54 Tactical Radar On 20 May, the development of the AN/TPS-54 medium-range, lightweight tactical radar was completed. This radar could be transported via helicopter and set into operation one hour after arriving on site.

AN/FPS-24 Radar The AN/FPS-24 radar, utilizing a hydrostatic bearing, became operational in the SAGE system on 30 June. The development of the bearings was the work of Goodyear Aerospace, under contract with RADC.

Lightweight Three-Dimensional Antenna In July, Westinghouse developed a lightweight, three-dimensional antenna, under an RADC-sponsored contract.

High-powered Wide Bandwidth Transmitter On 23 September a high-powered wide-bandwidth transmitter capable of operating at a center frequency of 3.35 GHz -- also capable of 500 MHz instantaneous bandwidth -- was accepted. The system was installed at the Floyd Site at the Signal Processing Test Facility.

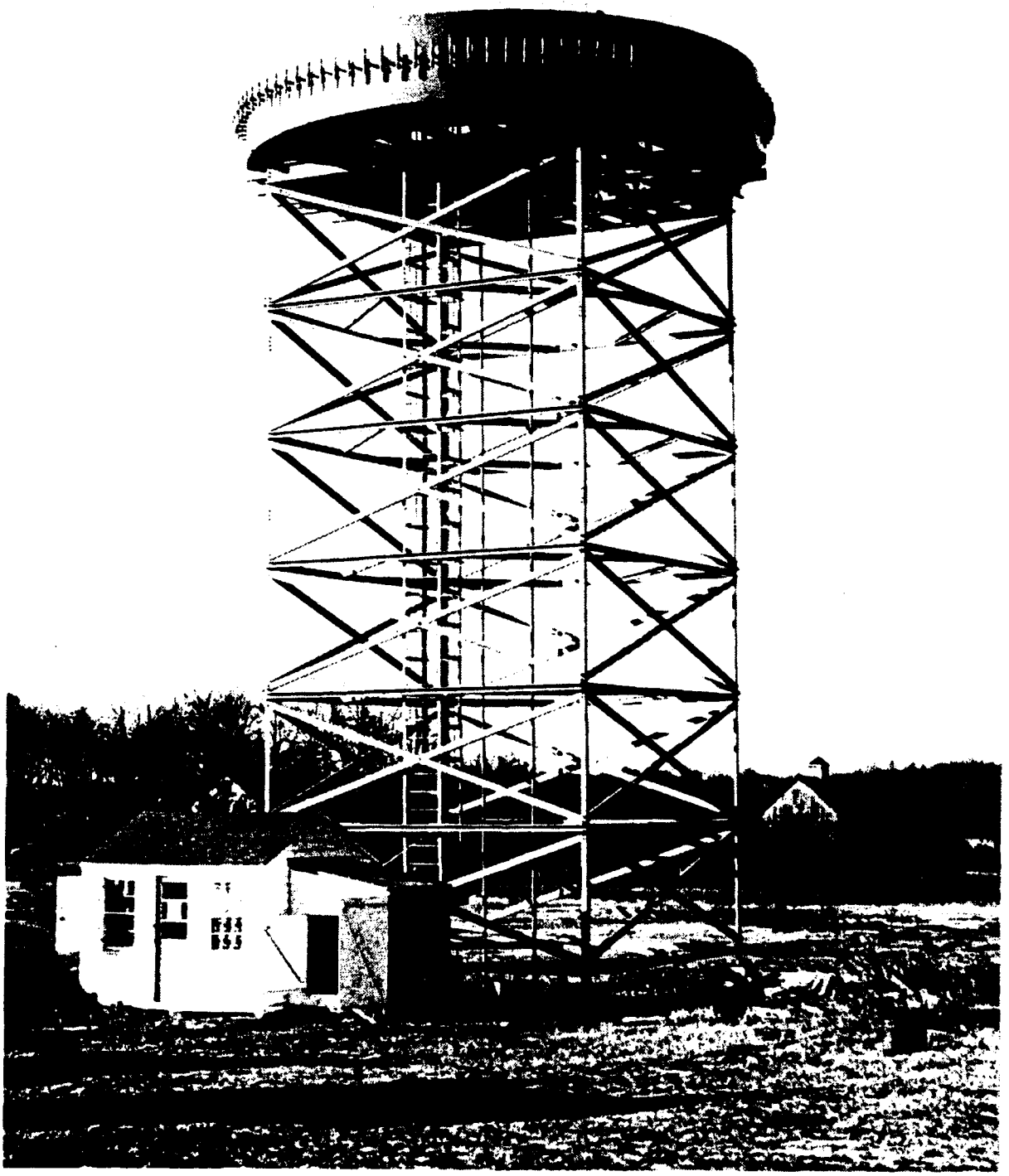
Advanced Ballistic Missile Re-Entry System Radar RADC was responsible for procuring and installing instrumentation radar equipment for the Advanced Ballistic Missile Re-Entry System (ABRES), a program under Space and Missile Systems Organization management. The Center contracted with Continental Electronics for equipment development. Final acceptance took place on 9 December, and the radar was fully operational on that date.

Wideband Pulse Compression Radar The Wideband Pulse Compression radar located at the Signal Processing Test Facility went on the air for the first time on 13 December.

AN/FPS-85 Spacetrack Radar The Aerospace Defense Command's 14th Aerospace Force assumed operational control of the AN/FPS-85 Space Track Radar -- previously designated the Electronically Steerable Array Radar (ESAR) -- at Eglin AFB in late December. This was the first phased-array radar system especially designed to detect and track objects in space. The physical structure of the system was 13 stories high, and the radar contained 5,134 transmitters and 4,660 receivers and utilized three computers.

Intelligence

Wullenweber Antenna This RADC-managed program resulted in an electronically scanned antenna system known as the Wullenweber Antenna. The unique design of this system enabled it to scan and direct the antenna beam at an extraordinarily rapid speed.



Wullenweber Antenna

Wideband Recording Equipment RADC developed electron and laser beam recording systems that were considerably superior to conventional magnetic tape recorders.

Communications

Project SEEK BURST (Digital Message Entry System) In June, Litton Industries, Incorporated, under contract with RADC, delivered digital message entry equipment to the Tactical Air Warfare Center at Eglin AFB. The system, which utilized existing tactical radio equipment, would be used by Forward Air Controllers and could produce tape or printed output (the latter via teletype printer).

AN/PRC-72 Multimode Manpack Radio Production of the AN/PRC-72 multimode manpack radio, powered by battery and weighing only 35 pounds, was completed on 30 June.

QRC-248 Transmitter-Receiver System In September, RADC selected the special purpose QRC-248 transmitter-receiver system as its most outstanding technological accomplishment for the fiscal year.

Automatically Equalized Modem (AN/USC-19) On 1 November, the North American Rockwell Corporation delivered an experimental model of an automatically equalized, microminiaturized modem to RADC. The modem could transmit at rates of 1200, 2400, or 4800 bits per second. At the 4800 rate, the error level was less than one error for every 10 million bits. An adaptive data equalizer built into the receiver made this low error rate possible.

Radar-Remoting Multiplexer-Demultiplexer In November, Raytheon, under contract with RADC, developed an experimental radar-remoting multiplexer-demultiplexer. This equipment was designed for use with the Miniature Microwave Manpack Radio set.

Wireline Simulator RADC developed a wireline simulator, the first in existence, which could function as an impaired channel or as a typical wireline link in order to evaluate a number of communications devices.

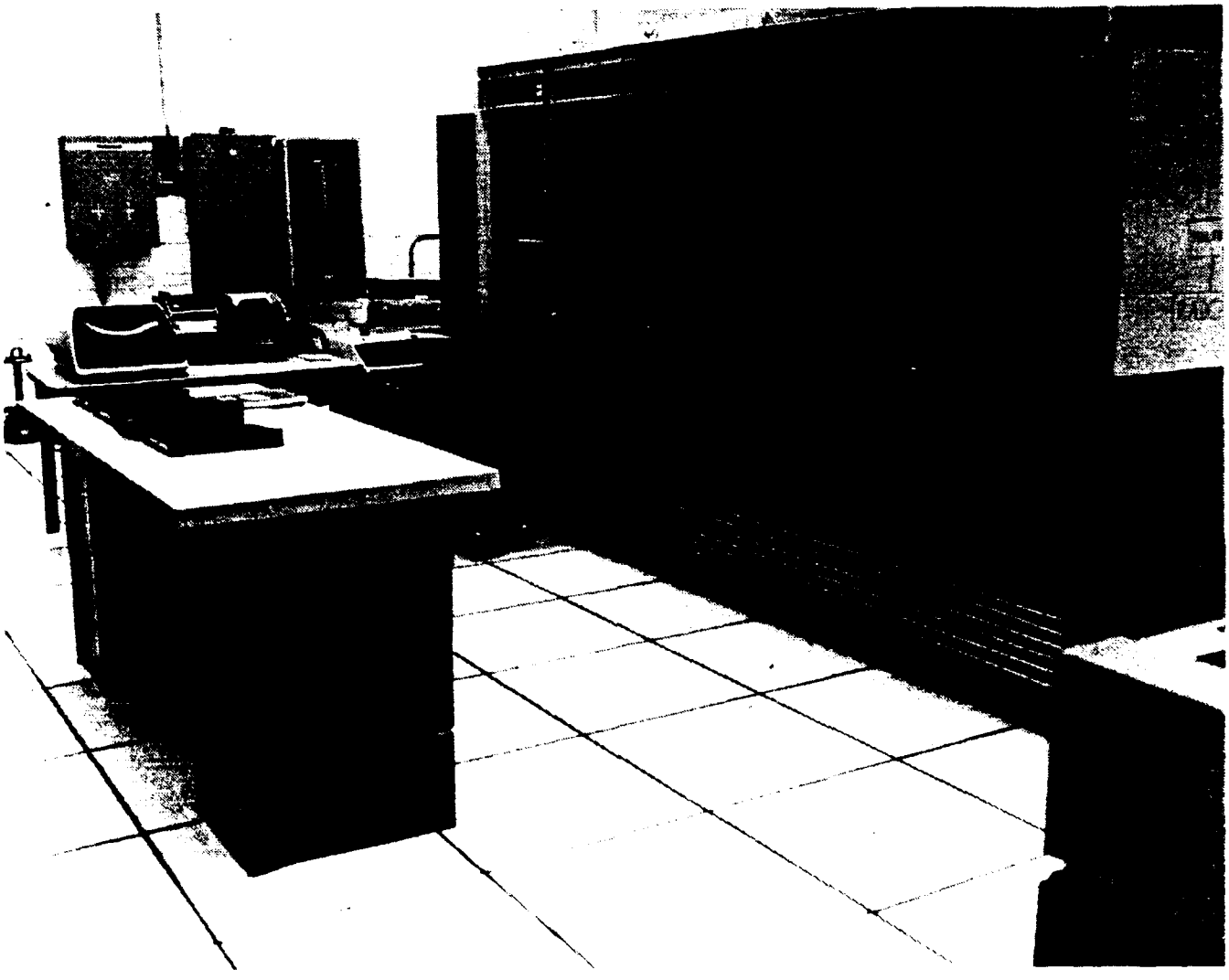
Ultra Lightweight Troposcatter RADC developed a significant enhancement to the previous year's lightweight troposcatter system. The ultra lightweight communications system weighed under 250 pounds.

Lightweight Broadband Amplifier (AN/GRA-84) In July, RCA delivered a lightweight broadband AN/GRA-84 amplifier to RADC for evaluation. The amplifier was designed for tactical use within either a fixed or a mobile base.

Command and Control

Japanese Base Air Defense Ground Environment (BADGE) On 31 March, the government of Japan accepted the Japanese Base Air Defense Ground Environment (BADGE).

Associative Memory RADC developed an associative memory with the greatest content-addressable computer memory capacity operating in the United States.



Associative Memory Computer

Other

180 Megawatt Spark Gap Modulator On 11 December, acceptance testing was successfully completed for the 180 megawatt spark gap modulator at the High Power Laboratory. This marked a major success in the use of a pulse-forming network at a quarter of a million volts.

Flare Firing Intervalometer The Center produced a Flare Firing Intervalometer, a self-contained unit designed to fire flares for battlefield illumination. This electronic triggering device permitted either manual firing or automatic firing by intrusion detection equipment.

High Pressure Crystal Growth Furnace In support of semiconductor development, RADC accomplished a high-pressure furnace for growing crystals. This achievement contributed to the technology utilized in commercial furnaces in which gallium arsenide and indium phosphide were grown.

This year was marked by considerable social turmoil within the United States. As domestic unrest, particularly against the war in Southeast Asia, continued, 1969 also marked the first year of Richard M. Nixon's presidency. There was fiscal unrest and manpower ceiling reductions in certain government agencies, which directly affected RADC. The official historical account of the Center's activities for FY 1969 noted a critical imbalance in the ratio of science and engineering personnel to support personnel, particularly in the face of the vulnerability of newly recruited scientific/engineering staff to potential reduction in force action. While major disruptions were avoided, the impact on future recruitment efforts was foreboding.

SENIOR LEADERSHIP

Colonel Zahn, RADC Commander, retired from active duty on 31 July. Assuming command in his place was Colonel Robert C. Mathis, who officially became the ninth Commander of RADC effective 1 August. Prior to his assignment to RADC, Colonel Mathis had been the Assistant to the Deputy Director of Defense Research and Engineering in the Office of the Secretary of Defense. This was not Colonel Mathis's first assignment to RADC. From 1956 to 1961, he had been a program director and an electronic engineer at the Trinidad site. During that tour, on 12 August 1960, the colonel (then a major) was the first person to transmit a voice message by satellite.

Colonel Paul J. Slocum remained as Deputy Commander, and Dr John S. Burgess continued to serve as Chief Scientist.

ORGANIZATION

Facilities

Signal Processing Laboratory The new Signal Processing Laboratory was completed in October. Utilizing an AN/FPS-8 antenna and capable of operating at any pulse-repetition frequency up to 4 KHz, this laboratory was constructed to function as a test facility for new signal processing techniques.

Relocation of Satellite Experimental Facilities During the last half of the year, RADC moved its Satellite Experimental Facilities from the Floyd site to Verona. As a result, these resources, which consisted of experimental satellite terminals

operating at ultra high and super high frequencies, could be collocated in the same building.

West Lee Off-Base Site RADC leased an off-base facility in October, to be used for testing intrusion detection equipment. The site was at West Lee, 13 miles northwest of the base.

Burhanna Road On 30 December, Burhanna Road at Griffiss AFB was officially named after Colonel Howard Burhanna. Colonel Burhanna, who had been the Chief of the Procurement Division, had passed away on 22 January.

Structure

Foreign Technology Division Abolished On 1 April, the Foreign Technology Division of RADC was officially abolished, in compliance with a letter from the Director of Laboratories dated 13 March. The activities were transferred to the Foreign Technology Division of AFSC, located at Wright Patterson AFB and to other functional areas of RADC. This particular change meant a reduction in manpower authorizations of six civilians, five enlisted, and six officers.

New Organizational Structure On 1 September, RADC implemented a new organizational structure. The number of mission divisions was increased from four to five, and some name changes occurred. The five mission divisions were 1) Information Sciences, 2) Reliability and Compatibility, 3) Communications and Navigation, 4) Intelligence and Reconnaissance, and 5) Surveillance and Control. In the area of mission support, a new Technical Support Division was created. One benefit of the reorganization was that personnel tended to be grouped with others in similar technical disciplines.

RESEARCH AND DEVELOPMENT ACTIVITIES

Southeast Asia Support

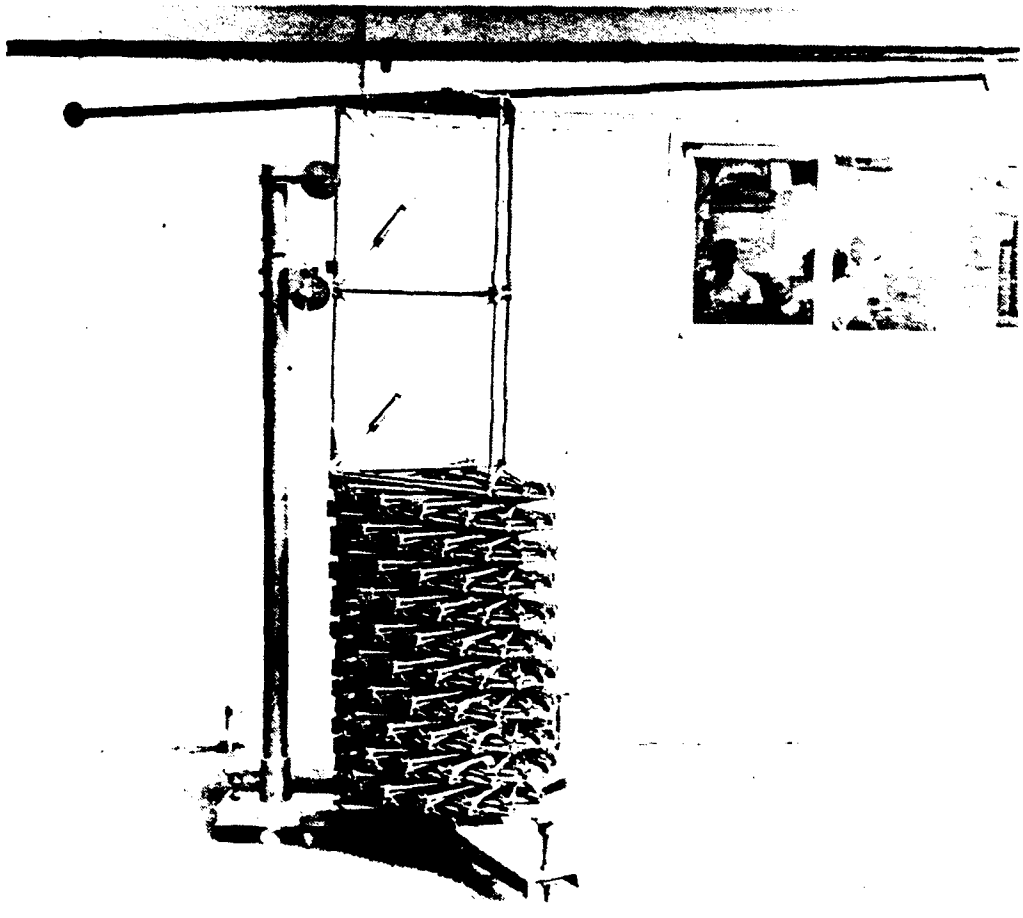
AN/PPN-17 Transponder Set Under a contract with RADC, Avion Electronics, Incorporated developed and produced the AN/PPN-17 transponder for use in Southeast Asia as a portable navigation aid during night or conditions of low visibility. By May, Avion Electronics had produced 19 units for evaluation.

Advanced Adjacent Channel Interference Control In September, a technique for advanced adjacent channel interference control was developed in response to significant problems with interference in Southeast Asia. The new method provided the capacity to automatically cancel interference.

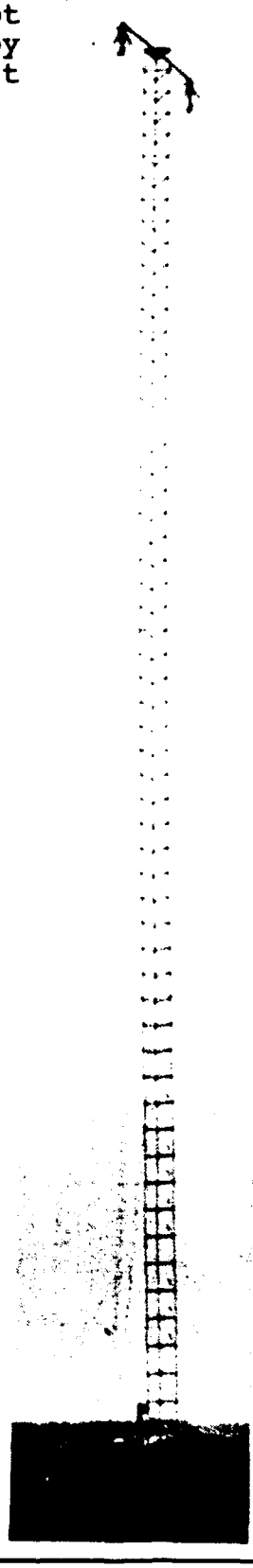
Manpower Support By the middle of 1969, RADC was investing 176.7 man-years of support to operations in Southeast Asia, amounting to an increase of 61.3 man-years over the figure for 30

June 1968, and more than double the support provided two years earlier. Research and development support continued to encompass a significant number of the projects sponsored by the Center.

Rapidly Deployable Antenna ASTROMAST The 60-foot version of the rapidly deployable ASTROMAST, developed by the ASTRO Research Company, was deployed to Southeast Asia on 16 April.



ASTROMAST Antenna Retracted



Extended ASTROMAST

Surveillance

High Frequency Luneberg Lens Rapid Commutator In January, the development and delivery to RADC of the Luneberg Lens Rapid Commutator was completed. This project was a directional processing device to be used with a multibeam antenna array. The device was specially fitted to the High Frequency Luneberg Lens Antenna, a multibeam array with 36 beams spaced at 10 degree intervals.

Communications

Have Ability Program Under contract with RADC, RCA and ECI were developing models for an ultra-reliable replacement for the currently used AN/ARC-34 airborne communications system. By January, the Air Force had assigned nomenclature to both systems (AN/ARC-144 for the RCA set and AN/ARC-145 for the ECI model). By May, aircraft compatibility tests of both models were done, and reliability and qualification evaluations began in June. Both designs had been used for other equipment, even before the selection for Have Ability was made.

Ultra-High Speed Data Modem Honeywell delivered an experimental model of the AN/GSC-25 Ultra-High Speed Data Modem to RADC in May. Utilizing dedicated voice channels, the modem was able simultaneously to transmit and receive digital data at speeds of 4800, 9600, or 14,400 bits per second.

Adaptive Data Modem In May, Page Communications Engineers delivered the AN/USC-18 Adaptive Data Modem, under an RADC-sponsored contract. The experimental model provided was capable of simultaneously transmitting and receiving digital data utilizing various media, such as high frequency, troposcatter, or wire.

Dual Tropospheric Scatter Simulator In an RADC-sponsored contract, Communications and Systems, Incorporated developed a Dual Tropospheric Scatter Simulator, which it delivered to RADC in November. The device processed a 70 MHz intermediate frequency signal just as if the signal had been sent over a troposcatter link and replicated most of the problems encountered when using troposcatter links.

Satellite Loading Simulator In order to assess the performance of a tactical satellite communications system, RADC developed a satellite loading simulator in November. This device was designed to simulate digital data transmission from ground and air terminals simultaneously.

Command and Control

Large Screen Command and Control Display RADC developed a large-screen command and control display. This equipment was able to furnish high-resolution, dual-line television in full color, with a comparable digital TV-computer interface.

Integrated Communications Navigation Identification System As discussed previously, RADC had originated a concept for an Integrated Communications Navigation Identification System, which would provide a theoretical foundation for future advanced command and control systems. The Center sponsored studies by Magnavox Research Laboratories and the IBM Federal Systems Division to perform waveform studies in support of the concept. Both contractors completed their studies on 10 December.

QRC-460 Autotrack Check System In December, RADC delivered a QRC-460 Autotrack Check System, which had been developed as an in-house project, to the General H. H. Arnold and the General H. S. Vandenberg -- the Air Force Advanced Range Instrumentation Ships.

JOVIAL Standardization and Improvement On 6 November, HQ AFSC requested that RADC update Air Force Manual 100-24, which had established JOVIAL as the Air Force Command and Control standard programming language in June 1967. Since then, the use of JOVIAL had not been widely implemented.

Intelligence

Systran System for Russian-English Machine Translation The development of Basic Systran, a system for computerized Russian-English translation, was completed during 1968. Consisting of 20 programs and six macros, the system could be updated on an ongoing basis. On 15 January, it was provided to the Foreign Technology Division at Wright Patterson AFB.

Laser Image Processing Scanner (LIPS) A Laser Image Processing Scanner was developed and constructed in April as the result of an in-house developmental effort. This system for scanning and recording film was the first of its kind to provide the capability to scan, digitize, and record high-resolution imagery from photographs for computerized manipulation.

Varsican Printer In July, Opto/Graphics, Incorporated delivered a printer which utilized an electrostatic process and could be used with the Varsican rear projection viewer to RADC. A demonstration took place at the Worldwide Reconnaissance Seminar, and the printer was delivered to the 544th Aerospace Reconnaissance Technical Wing at Offutt AFB for operational test and evaluation. The electrostatic process produced complete photo prints, without using silver, in less than two minutes and at a cost of about 25 percent that of silver prints.

Program Assisted Console Evaluation and Review (PACER) From 1 October to 14 December, RADC conducted tests of tne Program Assisted Console and Review (PACER) system. The purpose of the equipment was to furnish reconnaissance and targeting data base support to the Strategic Air Command (SAC). The program had begun in November 1966, and testing for full operational capability was expected in 1971.

AS-11B1 Automated Analytical Stereoplotter Under an RADC-sponsored contract, the Bendix Corporation investigated computer programs for the development of the Automated Analytical Stereoplotter (AS-11B1). This device provided computer-controlled photogrammetric measuring capability.

Infrared Technology RADC developed the first hybrid infrared laser reconnaissance system. In a separate program, the specialized expertise of RADC resulted in a tasking to train inflight gunship FLIR operators in Southeast Asia.

30 Megaherz Amplifier Philco-Ford Corporation developed a 30 MHz microelectronic intermediate frequency radar amplifier for RADC, which could be used for electronic counter-countermeasures. The contractor had delivered 20 experimental models in July 1968 for testing. In February, RADC delivered three models to Lincoln Laboratories, where they would begin operational use in the AN/APN-69 Radar Transponder aboard a KC-135 for use in the Pacific region.

Instant-Profiling Correlator In January, Bendix Research Laboratories developed an instant-profiling correlator for RADC. Use of the equipment would significantly shorten the time needed to accomplish aerial mapping and charting.

Other

Microwave Power Supply On 29 January, the in-house development of a Microwave Power Supply was completed. This equipment was capable of utilizing either alternating or direct current and supply direct current to radio equipment.

Joint US-Italian R&D In June, the Automated Chart Analysis Device and Otticao Meccanica Italiana Optical Orthophoto Printer were delivered to RADC for demonstration. This was the first hardware produced by a joint R&D effort by the United States and the Italian Air Force.

AWARDS

Air Force Outstanding Unit Award On 31 July, RADC received the Air Force Outstanding Unit Award for its support, in the form of "urgently needed techniques and equipment," to combat operations in Southeast Asia for the period 1 January 1967 to 31 December 1968.

In July, the Strategic Air Command became the host organization for Griffiss AFB. With the need to reduce and consolidate within the DOD, there was considerable speculation about the future of RADC. One rumor circulating was that both ESD and RADC might be consolidated and moved to Patrick AFB, Florida. (Apparently, the Air Force Director of Legislative Liaison had mentioned a study of this possibility to a local congressman.) This development never evolved (the Air Force subsequently informed the congressman that there were no such plans), and the Center continued to perform its mission as in previous years. Stringent manpower restrictions curtailed recruitment, and RADC was unable to absorb a number of highly qualified scientists and engineers who were displaced by the closing of NASA's Electronic Research Center at Cambridge, Massachusetts.

SENIOR LEADERSHIP

On 30 January, Colonel Slocum, Deputy Commander, retired from active duty, but it took almost eight months for the Air Force to name a replacement. On 3 August, Colonel John C. Toomay became the Deputy Commander of RADC. Colonel Toomay had previously been at the Industrial College of the Armed Forces, Washington, D.C. Dr Burgess carried on in his capacity as Chief Scientist, and Colonel Robert C. Mathis remained in command.

ORGANIZATION

Facilities and Resources

Eagle Hill Test Site Lease Expires On 30 June, the lease for the Eagle Hill Test Site expired and was not renewed. The Center determined that the site was surplus to RADC's requirements.

Service Funding Beginning 1 July, RADC -- along with three other AFSC organizations -- implemented service funding on a one-year test basis. This meant that "customers" would be billed for the R&D work done by the center as it was accomplished, in effect making RADC a "government-owned, government-operated corporation."

New Electronic Research Laboratory In September, the Senate Armed Forces Committee disapproved funding amounting to $1.06 million for a new electronic research facility at RADC -- part of the 1971 Military Construction program. In October, however, the same committee restored the funding to the 1971 Military Construction Bill.

RADC Radio Broadcast Annex In September, the RADC Radio Broadcast Annex went "on the air" as the only radio broadcast facility located on Griffiss AFB. The cost of the facility was only $1,500, largely due to fact that the conversion of excess rooms in Building 112 to broadcasting was a self-help project.

Northeast Test Area Range RADC established the Northeast Test Area Range at the Stockbridge facility. This new range furnished a location for conducting temperature zone sensor evaluations to assist in the testing of advanced surveillance technology.

RESEARCH AND DEVELOPMENT ACTIVITIES

Support to Southeast Asia Operations

Manpower Support RADC support for the war in Southeast Asia continued to increase. By the end of June, the Center was providing 224.6 man/years of support, an increase of 47.9 man/years over the year before. In addition to the R&D efforts of the Center, this assistance took the form of military, civilian, and contractor travel to the Far East in support of RADC projects there.

English to Vietnamese Translation On 5 June, RADC successfully demonstrated for the first time the capability to perform automated translation of technical orders and manuals from English to Vietnamese. This would be a significant contribution to the eventual "Vietnamization" of the war.

Medium Altitude Infrared System (MAIRS) In October, RADC produced a Medium Altitude Infrared System (MAIRS), a simplified infrared system for night reconnaissance in Southeast Asia.

Surveillance

Advanced Design Array Radar In May, a test program for an Advanced Design Array Radar (ADAR) prototype was completed. The tests yielded successful results in high resolution automatic tracking. The purpose of the program was to develop a powerful high-resolution phased array radar for ballistic missile defense.

Fabrication of High-Pass Filters As the result of an in-house effort, the Center developed a method of utilizing sections of waveguides to produce high-pass filters. Developed in June, this method would be used in AN/FPS-6 radar equipment at a cost which was approximately 14 percent that of other techniques.

COSMOS Satellite Tracking On 23 July, the RADC Signal Processing Test Facility received and traced wideband radar data on a Soviet COSMOS satellite at a 1,000-kilometer range. This achievement proved the feasibility of high-resolution space object identification (SOI) capability.

Over-the-Horizon Radar Technology RADC engineers developed and constructed components for a frequency modulation/continuous wave (FM/CW) radar capable of detecting and tracking objects at over-the-horizon ranges. The radar installation and evaluation was accomplished on 15 September, while flight tests of a Beverage array antenna were completed on 30 September. On 30 October the

radar and the Beverage array were integrated and operated as a single system for the first time.

Communications

Digital Message Entry Devices Fifteen Digital Message Entry Devices (DMED), which had been developed at RADC, and two receiving terminals were used during the NORAD exercise Fairplay in February.

Troposcatter Multipath Analyzer In March, the Air Force formally accepted the Troposcatter Multipath Analyzer, which Sylvania Electronic Systems had developed under contract with RADC. This equipment conducted multipath measurements on tropospheric scatter communications links.

Troposcatter Multi-Channel Digital System Tests were completed during the month of June on experimental troposcatter multi-channel digital equipment. New procedures discovered during this effort would help solve existing difficulties in the high-speed troposcatter transmission of digital data.

Tactical Satellite Communications System In September, RADC conducted experiments at the Center's Satellite Communications Facility to test the multiple access performance of an experimental model of a Tactical Satellite Communications System (TACSAT-1).

Command and Control

AN/USA-26 Modular Microelectronic Display RADC adapted the earlier AN/USA-26 tactical modular display for ground and airborne environments, originally developed by Motorola Incorporated for RADC in 1967, from a management to a radar mode of operation. A press conference on 25 May provided a demonstration of the system's new flexibility. Personnel converted the display internally from radar tracking to data management, without the normally required, time-consuming reconfiguration.

Dynamic Real-Time Information Projection System A new large-screen, high-resolution television projection system developed by RADC was installed at the Center in April. The Dynamic Real-Time Information Projection System (DRIPS) was intended as a substitute for currently used film systems as a means of eliminating technical problems commonly associated with film technology. DRIPS marked the first attempt to combine a computer interface with a real-time display to provide dynamic computer-generated and pictorial data.

Intelligence

Laser Image Processor Scanner (LIPS) In January, CBS Laboratories delivered the Laser Image Processor Scanner (LIPS) to RADC for testing. The Center officially accepted the system in March. The system -- intended for use by the Foreign Technology

Division -- made it possible to digitize high resolution photographs so that data could be manipulated and image degradations could be removed. Computer-generated digital images could also be recorded on photographic film.

Target Acquisition System As part of the Compass Eagle Program -- a program to sponsor the acquisition of intelligence and reconnaissance equipment -- the Center completed the development of a new Target Acquisition System in January.

Foreign Technology Division Microdensitometer System A contract with General Aniline and Film Corporation provided a mirodensitometer system for the Foreign Technology Division. The system could record photometric and spatial distribution data from photographs and spectrographic materials in analog form for analysis or in digital format for computerized analysis. The contract was completed in March, although the contractor would be responsible for system maintenance until January 1971.

Program Assisted Console Evaluation and Review (PACER) In September, RADC selected the SAC intelligence data handling system, Program Assisted Console Evaluation and Review (PACER) as the Center's outstanding technological achievement for FY 1970. The development had been completed in February.

High Resolution Rear Projection Viewer In support of intelligence imagery analysis, RADC developed a high resolution rear projection viewer. This device featured direct viewing, the potential to annotate imagery film, and rapid printing capability.

SAC System 70 RADC provided a third-generation general-purpose computer system, known as SAC System 70, to the Strategic Air Command. The system provided automatic reduction, typing, locating, correlating, and data base maintenance of ELINT data.

On-Line Intelligence Data Processing System The Center deployed an on-line intelligence data processing system to the 67th Reconnaissance Technical Squadron at Yokota AB, Japan. This marked the first time that on-line terminals and computerized production methods were utilized in support of imagery intelligence production and analysis at the theater level.

Reliability and Maintainability

Integrated Circuit Screening Test In August, RADC initiated an integrated circuit screening test program to determine the vulnerability of microcircuits to damage from various electrical transients.

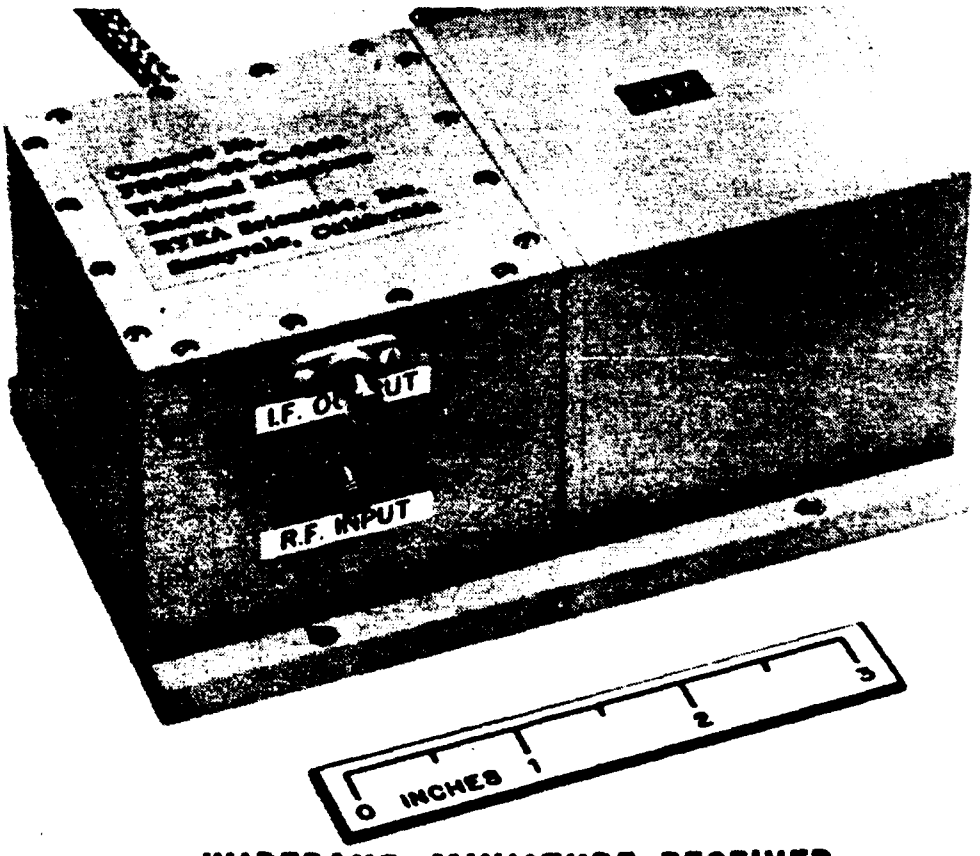
Radiation Hardened Zener Diodes RADC produced radiation-hardened zener diodes, which furnished the approved standard for hardened voltage reference.

Stress-Induced Intermittent Failure Detection In December, RADC developed a method of detecting periodic failures of plastic-encased microcircuits due to stress.

Bandpass Filter for AN/MPN-13 RADC developed a bandpass filter for the AN/MPN-13 ground-controlled approach radar. The purpose of the equipment was to eliminate interference from the German microwave system at an overseas location.

Other

Wideband Miniature Receiver In June, Ryka Scientific, Incorporated delivered an experimental model of a wideband miniature receiver to RADC. In order to reduce size and weight while enhancing reliability and maintainability, the technique selected utilized Yttrium Iron Garnets as an oscillator and preselector. The receiver weighed 29 ounces and took an electrical impulse of seven watts with 22 to 28 volts.



WIDEBAND MINIATURE RECEIVER

High-Gain 10-Watt S-Band Transistor Amplifier In March, TRW Semiconductors, Incorporated completed the development of a method for constructing a transistor 10-watt amplifier with a bandwidth of 2.2 to 2.3 GHz and 30 decibels of gain. Stripline techniques were used to achieve reduced size, with the resulting development of an amplifier about six cubic inches in volume and weighing under two pounds.

Radar Blanker Failure Alarm This RADC project was designed specifically with the safety of personnel in mind. The equipment activated an alarm whenever radio frequency blankers on two radar sets at MacDill AFB failed. The blanker failure could release high-power radio waves hazardous to humans into areas where people were working. In February, this low-cost system was delivered to MacDill AFB and provided satisfactory performance.

Defense Analysis Experimental On-Line Capability RADC demonstrated the Experimental On-Line Capability for defense analysis for the Pacific Air Forces PACAF on 27 July.

Special Flight Test Division Mission

Support to Rome City Officials The RADC Flight Test Division obtained aerial photographs from flights over Rome in a C-131B aircraft following a storm of hurricane strength on 18 June. The photographs provided city officials with damage assessment data.

Structure

Establishment of Intelligence Office Due to the RADC Commander's concern over the effectiveness of intelligence support to the mission divisions since the Foreign Technology Division had been abolished, the Intelligence Office was established on 1 April. It was part of the Deputy for Technical and Staff Support and was provided manning of five officers, four enlisted, and one civilian.

RESEARCH AND DEVELOPMENT ACTIVITIES

Support to Southeast Asia Operations

Decreased Manpower Support The support provided by RADC to operations in Southeast Asia was 67 man/years as of 30 June 1971, amounting to a decrease of 157.6 man/years from the same time in 1970. This was largely due to the changing complexion of the war itself and particularly to the further implementation of the Vietnamization program.

Base Security A significant portion of the developmental work in support of combat operations in Vietnam was dedicated to various projects forming part of the overall Air Base Defense System program.

Ground Based Sensor Techniques Studies and experiments accomplished under contract with Honeywell demonstrated the feasiblity of not only detecting the presence of an intruder, but also determining the type of subject detected, whether a person, a vehicle, or a nontarget. Effectiveness of classification was greater than 90 percent.

AF Manual 51-37 Translation As part of the overall "Vietnamization Program," RADC produced in May an automated translation from English to Vietnamese of AF Manual 51-37, Instrument Flying. The translation was accomplished using the LOGOS I System for English-to-Vietnamese machine translation.

English to Vietnamese Translator In September, the Center developed an English-to-Vietnamese automated translator. Designed to operate on the IBM 360/67 computer, the translation system had an output rate of 80,000 to 100,000 words per hour.

Surveillance

Three-Dimensional Radar Imaging In March, RADC personnel provided the first of its kind demonstration of an innovative technique for three-dimensional radar imaging.

Bulk Oscillator Phase Locked Array Radar On 5 January of the previous year, RADC had awarded a contract to ITT Gilfillan to develop a sixteen-element phased-array radar which would utilize

Gunn oscillators to provide microwave power. By Spring 1971, the first solid-state version fulfilling these requirements was demonstrated. As a result of the demonstration, RADC granted ITT a no-cost extension to configure the hardware into a bi-dimensional radar.

Seek Point RADC was tasked to provide technical support as part of an Electronic Systems Division-sponsored contract with Sierra Research Corporation for radar development. The contract had been let in August, and RADC was responsible for testing system accuracy. These evaluations subsequently demonstrated the Seek Point surveillance system capability to detect a strike aircraft with a circular error of probability of 215 feet.

Big Ear On 30 July, RADC negotiated a Military Interdepartmental Purchase Request (MIPR) contract through the Army with Zenith to modify an acoustic surveillance system known as the "Big Ear." This had followed an RADC-conducted in-house evaluation of the system, sponsored by the Army and the Advanced Research Projects Agency.

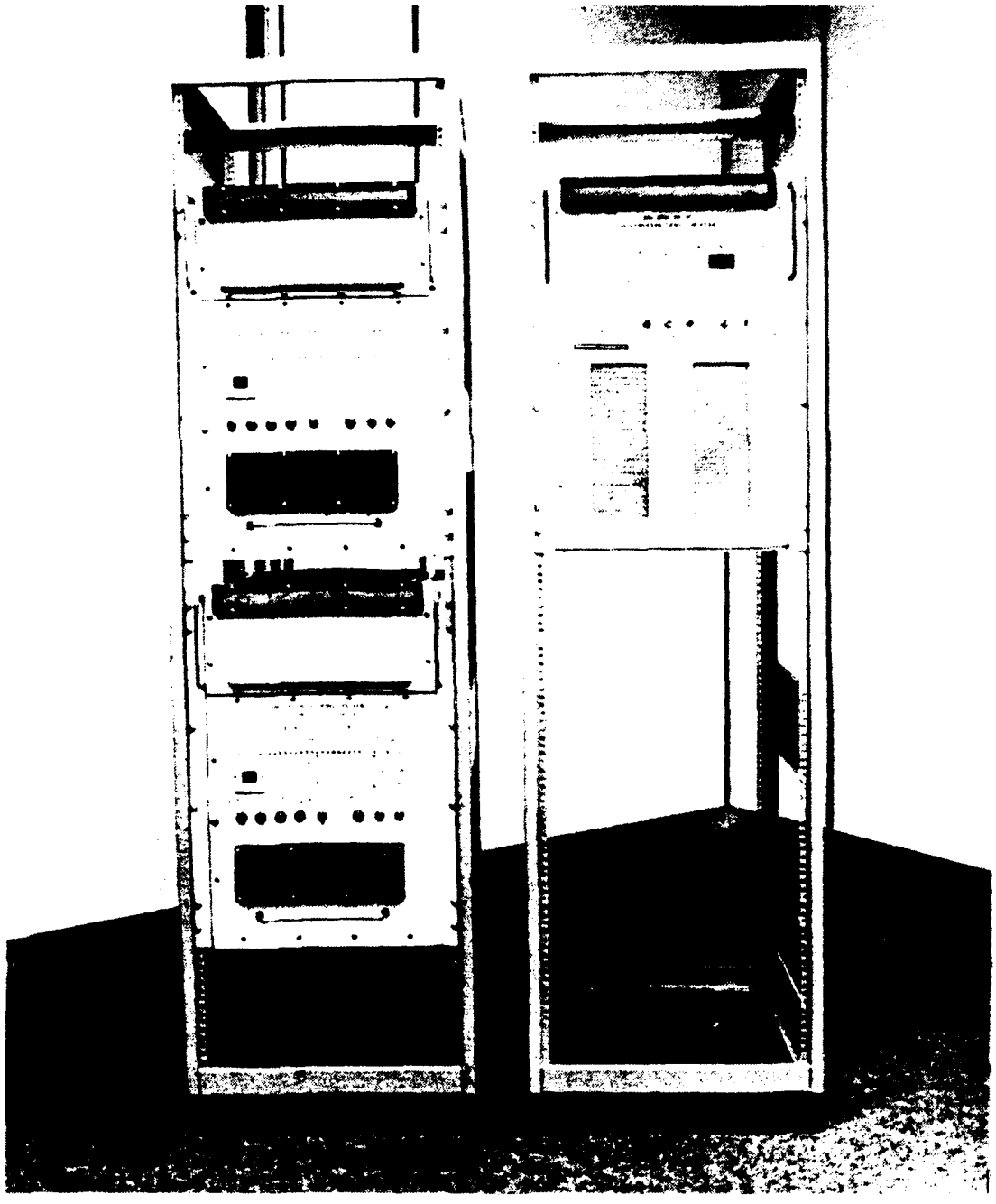
Beacon Transponder Set, AN/TRN-26 The first deployment of the Air Force's Beacon Transponder Set (AN/TRN-26) occurred in May, when the system was installed at Camp David. There it would support VIP helicopter approaches. With this lightweight system, a 10-to-1 weight reduction had been achieved when compared to the Tactical Air Navigation System.

Communications

Integrated Circuit and Message Switch In order to better meet the diverse communications needs of the Air Force, the Integrated Circuit and Message Switch Program was intended to provide a program-controlled switch, which could function as a circuit switch (analog and digital), a message switch, or a combination. Utilizing a feasibility model of the Integrated Circuit and Message Switch, RADC personnel automatically processed and routed both voice and message communications on 20 April. On 29 April, the Center achieved the first-ever simultaneous circuit and message switching controlled by a stored-program communications processor.

CONUS AUTOVON Evaluation From January to March 1970 and from October 1970 to April 1971, RADC conducted tests comparing digital data transmission over data grade and common grade AUTOVON trunks at baud rates of 2400, 4800 and 9600 bits per second. The results showed that common grade trunks performed satisfactorily at 2400 and 4800 rates and that transmission equipment in use did not support transmission rates of 9600 satisfactorily. Consequently, the Defense Communications Agency converted to the use of all common grade trunks, resulting in a yearly savings of approximately $2 million.

Asynchronous Time Division Multiplexer Critical design reviews of the Asynchronous Time Division Multiplexer were completed in February. This intention was the development of a device that would enable the Defense Communications Agency to transition from a predominantly analog system to a greater utilization of digital communications and would also be a part of the defense satellite communications system. Martin-Marietta was the contractor.



Asynchronous Time Division Multiplexer

Frequency Synthesizer-Controlled VHF Transceivers In February, the Center completed the development of the initial model of an upgraded frequency synthesizer-controlled VHF transceivers. This equipment was designed specifically for use by Security Police personnel.

Narrow-Band Voice Communication In December, RADC completed developmental work on a narrow-band voice modem, which would make it possible to transmit voice communications over channels which were previously too narrow to use for voice transmissions.

Navigation

Range Only Multiple Aircraft Navigation System (ROMANS) The Range Only Multiple Aircraft Navigation System (ROMANS) was developed to meet the need for a ground-based navigation/range instrumentation system for multiple aircraft. It was designed to support up to four aircraft at the same time. In March, RADC conducted tests on the ROMANS which would enable Center personnel to make a preliminary analysis of its accuracy.

Long Range Navigation (LORAN) In July, Sperry Gyroscope, under an RADC-sponsored contract, delivered a high-power Long Range Navigation (LORAN) D transmitting site to Gunter AFB, Alabama. The new LORAN equipment provided a 1000 percent increase in peak radiated power.

Command and Control

On-Line Pattern Analysis and Recognition System The goal of the On-Line Pattern Analysis and Recognition System (OLPARS) developmental program was to provide interactive software for a general-purpose computer to support data analysis for target recognition. Two steps toward the completion of a testbed model were completed. By 1 June, there was an on-line data structure and analysis package, a measurement compiler, and a capability for three-dimensional display. Also provided by a separate contractual agreement was a special capacity for discrete data handling.

Video Mapping Set (AN/GPA-131) Preliminary and Critical Design Reviews, as well as Category 1 acceptance testing was completed for the Video Mapping Set (AN/GPA-131). RADC tasking for this development had come from the Traffic Control, Approach and Landing System/Air Traffic Control Radar Beacon System, IFF/SIF, Mark XII, System (TRACALS/AIMS) Systems Project Office, and RADC had awarded the contract to the General Time Corporation in October 1969. The system would generate background displays for radar consoles depicting aircraft located in the area covered by the radar in order to help provide a geographic context for aircraft detected.

Tactical Air Control Systems Operations Center Under the Project 407L Tactical Air Control Systems program, RADC had been assigned the engineering responsibility for the AN/TSQ-91 Control and Reporting Center/Post element. Personnel completed Category II testing of the AN/TSQ-91 at Eglin AFB during the last quarter of the fiscal year.

Multiplexed Information and Computing RADC evaluated the Multiplexed Information and Computing System (MULTICS) after implementing it on the Center's Honeywell 645 computer. MULTICS provided simultaneous multiple access to a computer and furnished programming aids for the system and its applications which supported complicated programming tasks. The evaluation effort was documented in a technical report in May.

Plasma Display Panel In a contract with Owens-Illinois, Incorporated; the Control Data Corporation; and the University of Illinois, RADC sponsored the development of a plasma display panel, which was able to replace cathode ray tube (CRT) displays with flat plasma-driven panel. Although the CRT would continue to play a vital role, the cathode display had significant future potential. As a matrix display, the plasma tube enables the individual control of elements of a display and was ideally suited for digital computer displays.

Intelligence

Intelligence Information System Analysis and Design In January, RADC completed the development and evaluation for an advanced prototype engineering handbook and procedure for the design and analysis of intelligence information systems.

Input/Output Textual Console Subsystem Composed of a Communications Processor interfacing with an Input/Output Controller, two textual console controllers, and 32 textual consoles, this project was designed to provide inexpensive textual consoles for the Program Assisted Console Evaluation and Review (PACER) system in support of textual information needs of intelligence analysts. On 3 May, RADC installed the Console Subsystem at HQ SAC.

Voice Information Processing System As part of its R&D work in the area of artificial intelligence, RADC developed a voice information processing system. This equipment was designed to support an effort to teach computers to recognize individual human voices.

Side-Looking Radar RADC began development of a completely automated Side-Looking Radar (SLR) Exploitation and Targeting System. The Manual Radar Reconnaissance Exploitation Segment (MARRES) was part of the Tactical Information Processing and Interpretation (TIPI) system specifically designed to exploit SLR

imagery by comparative analysis of current imagery with previous missions.

Reliability and Maintainability

Semiconductor Processing Analysis System An analysis system for detecting impurities and residue produced by reactions in semiconductor processing environments was developed and constructed at RADC in January. A mass spectrometer and molecular beam enabled the detection process.

"Upside-Down Air Force" RADC established the "Upside-Down Air Force," mounted airframes positioned upside-down on an antenna range to reduce the time, complexity, and cost of measuring aircraft antennae.

Quick Fix Interference Reduction Capability The Air Force Communications Service requested RADC to develop a waveguide filter to prevent interference by the AN/MPN-13 ground controlled approach radar on a new system at Buckley ANG Base, Colorado. In response, the Center utilized Quick Fix Interference Reduction Capability procedures to produce the filter. The project began on 6 September and was completed on the 24th.

Radiation Hardened Transistors RADC's development of radiation-hardened power transistors delineated the trade-off between radiation hardness (which would remain a limiting factor) and breakdown voltage.

Moisture Measurement The Center devised the first system with the capability to measure accurately the moisture in microelectronic packages. With this, it would be possible to lower moisture levels significantly and reduce component failure rates in C3I systems developed by the Center.

Other

Tactical Alarm Display Sometimes RADC's support for operational uses required rapid turnaround. In February, the development of a Tactical Alarm Display, to be used overseas as an intrusion detection system, was completed. RADC accomplished the design, production, and delivery of this project in just 20 days.

Airport Surface Detection Equipment Transparent Dome RADC sponsored a contract to develop and produce an 18-foot diameter frame dome to protect the AN/FPN-31, Airport Surface Detection Equipment (ASDE), for the Federal Aviation Agency. The dome was installed at O'Hare International Airport, Chicago and was dedicated on 18 May. The framework was stainless steel, and the membrane was produced from the transparent thermoplastic polycarbonate.

Portable Format Converter In June, RADC developed a portable Format Converter. This converter could copy 16mm, super 8mm, or 8mm movie film in either black-and-white or color.

Foreign Disclosure Automated Data (FORDAD) System The Foreign Disclosure Automated Data (FORDAD) System was an automated information processing and handling system designed to assure that foreign disclosure met with National Foreign Disclosure policy for the release of classified information to foreign governments. It provided a DOD repository and supported decision-makers in this sensitive area. The software, developed under contract by the Control Data Corporation, was transferred to the US Army Computer Facility in January. Formal acceptance took place on 5 February.

Mass Spectrometer Atmospheric Sampling Probe The RADC-developed mass spectrometer atmospheric sampling probe became operational in January. This project was an analysis system able to detect a contaminant concentration of one part per billion at one atmospheric pressure.

AWARDS

Air Force Outstanding Unit Award In August, RADC received its third Air Force Outstanding Unit Award (AFOUA) because of the exceptional support it had provided to military operations for the period 1 March 1969 to 1 March 1971.

Watergate still hadn't developed into a household word, and "detente" was not yet the cautiously optimistic catchphrase it would become. The Vietnam War raged on, and the protests continued, but generally 1972 was like the year before and the one before that. The same could be said of RADC. Life continued, albeit at a frenetic pace, but it was pretty much business as usual. But like the events above which marked a period of great turmoil and hope, RADC was entering its own "calm before the storm."

SENIOR LEADERSHIP

Colonel John C. Toomay, the ex-National Basketball Association player from California, concluded his 16-month stint as RADC Commander on 22 May. Destined to reach the rank of Major General, Colonel Toomay accepted an assignment, and accompanying promotion, to the Pentagon. His replacement was Colonel Phillip N. Larsen, who began his career first as an RADC project engineer in 1953 and later as a pilot for the Center in 1958. Colonel Larsen left a position in Washington, DC to accept command of RADC. Highly decorated in Vietnam while Commander of the 12th Special Operations Squadron - Defoliation, Colonel Larsen held master's and doctorate degrees in Electrical Engineering. On 26 June, Colonel Larsen assigned Colonel William Metscher to the vacant Deputy Commander slot. Colonel Metscher, a Brooklyn native whose assignment prior to RADC was at the Pentagon, also retained his responsibilities as Chief of the RADC Operations Office.

Also on 12 June, Dr Irving J. Gableman was appointed Chief Scientist by Colonel Larsen. Dr Gableman, acting Chief Scientist since late 1971, worked at RADC since its inception 22 years before. Prior to that, he labored at the forerunner of RADC, Watson Labs, since 1945. Dr Gableman's educational background was in physics and electrical engineering. His professional efforts were varied, ranging from air traffic control and aircraft navigation, to communications, computers, and surveillance.

ORGANIZATION

Personnel and Facilities

Civilian Manning Reduction In April, the winding down of the Vietnam War and general financial restraints led to an Air Force Systems Command directive to reduce 100 civilian personnel by the close of the fiscal year (30 June). In addition, ten military authorizations were to be dropped by the end of the month, and ten more by April 1973. At the end of June, RADC had reduced civilian personnel by 104, leaving civilian strength at 1104.

Facility Closure RADC closed the 9.6 acre Dean Hill Test Site in North Osceola, New York. The test site, opened in 1956 and located about 25 miles northwest of Griffiss, had been used for microphone and infrasonic array testing.

Structure

Comptroller Moved RADC began the year with five technology and three support Divisions. The Surveillance and Control Division, Information Sciences Division, Communications and Navigation Division, Reliability and Compatibility Division, and Intelligence and Reconnaissance Division pursued advanced technology in their respective areas. The support agencies included the Comptroller, Procurement, and Flight Test Divisions. None of the research and development divisions underwent any substantial alterations, but by 1 October the Comptroller had been moved under the Directorate of Support Services, which included such functions as the security police and history office. The Flight Test and Procurement Divisions remained unchanged.

RESEARCH AND DEVELOPMENT ACTIVITIES

Southeast Asia Efforts

Manpower Support By the middle of 1972, RADC was expending 67 man-years of technical, scientific, and engineering support per year, about the same rate as in 1971.

English-Vietnamese Translator RADC sponsored an effort to translate English training manuals to the Vietnamese language. Although operational, the system proved to be cumbersome, and RADC modified the input method to allow use of a programmable computer terminal.

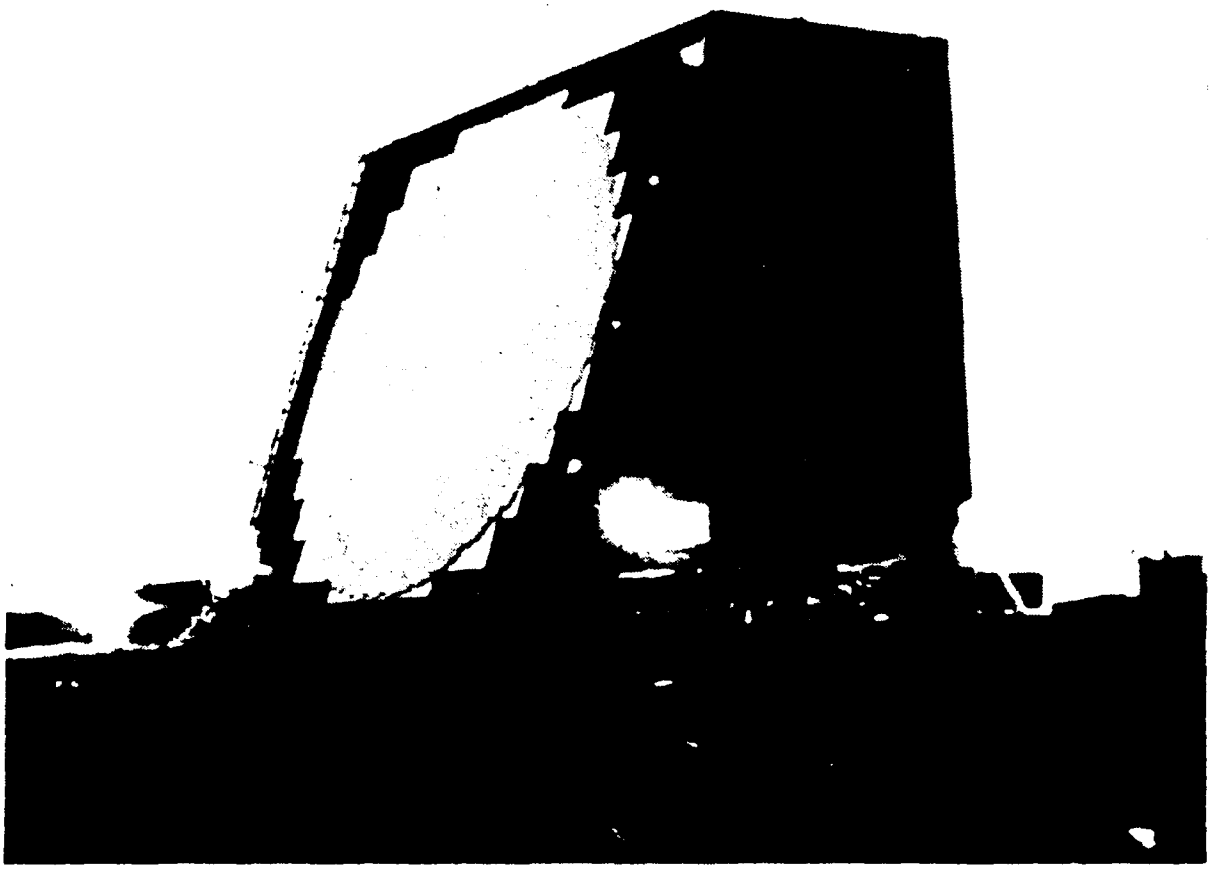
Fuel Transfer Pump Design RADC successfully tested a breadboard design of a fuel transfer pump the Center designed for CH-53 remote site refueling. Shipment of the design and parts followed to the Advanced Research Projects Agency's Combat Development and Test Center in Vietnam, where the units were fabricated on-site and passed all tests.

Big Ear RADC developed an acoustic-type detection transmitter to be deployed by helicopter on the tops of trees.

Modification of Dispenser System RADC completed tests in March of a system used to deliver tree-hugging relays. When dropped from an aircraft, the dispenser used a rotating turbine-type parachute with six-foot nylon cords to wrap around tree limbs. This ensured the relay stayed at or near the top of the trees.

Surveillance

COBRA DANE In February, Headquarters USAF assigned RADC responsibility for technical engineering of the COBRA DANE radar system in Shemya, Alaska. COBRA DANE was designed as an intelligence gathering radar capable of collecting data on Soviet missile launch tests into Kamchatka or the Pacific Ocean. In conjunction with the Electronic Systems Division, the Center worked on performance specifications and the Statement of Work for the system, and requests for proposals were sent to numerous companies. Raytheon eventually won the contract.



COBRA DANE Radar in Shemya, Alaska

Polar Cap III RADC assisted in the installation and operation of an experimental Over-The-Horizon Radar at a remote Canadian location in October. Polar Cap III detected aircraft targets.

Beverage Antenna Developed A limitation to the use of over-the-horizon antennas was the requirement for large expensive antennas to overcome weak target signals. To overcome this problem, RADC developed in-house the Beverage antenna.

SEEK POINT Radar, AN/TPB-1/A RADC developed a method for testing the accuracy of SEEK POINT, a helicopter-transportable radar system which was used to direct air strike missions. Using equipment aboard a B-57 aircraft and tracking from RADC's Verona site, the Center demonstrated that SEEK POINT was nearly twice as accurate as requirements called for.

Communications

AN/TRN-26 Testing RADC completed tests of the AN/TRN-26 lightweight beacon transponder in March 1972. Developed for the Air Force Communications Service, the AN/TRN-26 weighed one tenth that of the tactical aircraft navigation system it replaced.

AN/TRM-26 Development RADC delivered the AN/TRM-26 Radio Interference Measurement Set to Air Force Communications Service Headquarters in January. The set provided the capability to measure and predict electromagnetic interference. Designed under contract with the American Electronics Laboratory, the set was entirely self-contained and capable of worldwide deployment.

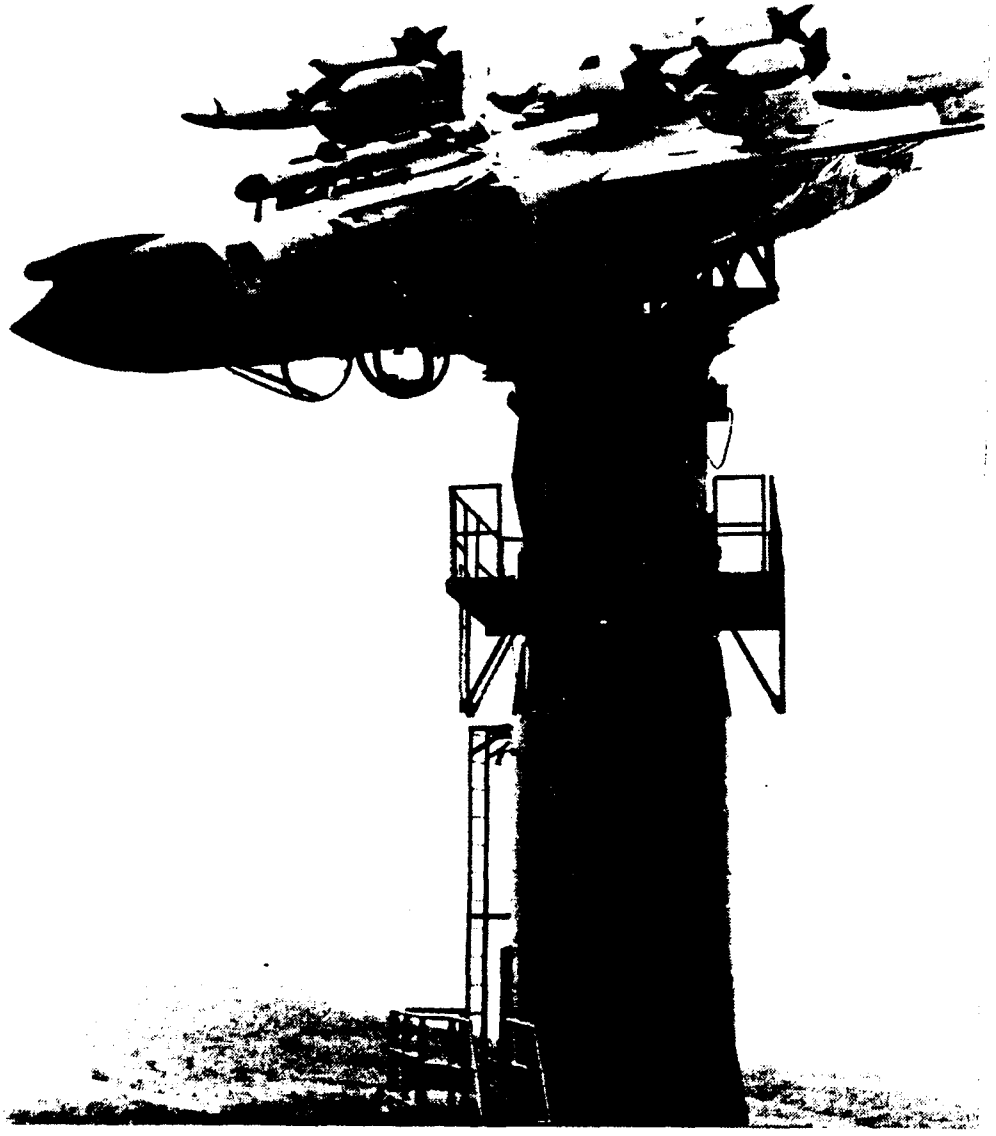
NORAD OPSTAR Demonstration The Center completed testing in July on a digital operational status reporting system for the North American Air Defense Command (NORAD OPSTAR). The demonstration consisted of two reporting activities, a processor-equipped regional terminal, and a simulated Cheyenne Mountain Complex communication processor. Initiated in May 1969, NORAD OPSTAR was designed to fully automate communications from reporting activities to the Cheyenne complex.

European AUTOVON RADC completed the European Automatic Voice Switching Network (AUTOVON) trunk test program for the Defense Communication Agency in October. The test program was to ascertain the reasons for phase jitters and noise within the system.

Reliability and Maintainability

ICBM and F-15 Integrated Circuits An RADC analysis of the nichrome-aluminum fusible link resistors used in ICBMs and for F-15 memories showed problems within the component. The presence of moisture on the chip accounted for the corrosion. RADC developed and applied a screening test to sift the bad integrated circuits from serviceable ones.

F-4 Electronic Countermeasures Pod Antenna Obstruction In April, RADC initiated efforts to investigate antenna measurement patterns of an ECM pod-equipped F-4 aircraft. Originally slated for the salvage heap, RADC mounted the aircraft upside down on a three axis pedestal at the Center's Newport Test Site to conduct the tests. Antenna coverage by the pod appeared satisfactory with the pod removed from the aircraft, but unacceptable when installed. By placing the aircraft with pod attached on the pedestal, the Air Force reduced the need for costly flight tests. During 1972 and 1973, RADC measured the effects of stores and the aircraft itself on antenna patterns. The Center produced 3400 measurements in all.



Mounted F-4 at RADC's Newport Test Site

Intelligence

Cartographic Plotter Development RADC continued its 15 year involvement with cartographic instrument development. In 1972, the Center produced automatic color separation devices which scanned color charts and digitized the data.

High Definition Video The Center evaluated two unique dielectric membrane light valve tubes designed by IBM. Among other characteristics, RADC demonstrated that the tubes possessed a resolution of 200 television lines per inch and a contrast level of greater than 30:1.

Command and Control

Mass Random Access Memory To overcome barely marginal operation by data processing systems in the field, air, or tactical environment, RADC developed the Mass Random Access Memory Module, AN/UYA-10. The prototype module developed by RADC in 1972 overcame extremely low reliability, excessive weight and power consumption, slow speed, and susceptibility to dust and shock in systems used at the time. A look at the module's performance showed it processed data 15,000 times faster, weighed 75 percent less, and required one twentieth the power to operate. Reliability improved nearly one hundred times.

Other

Heart Pacemaker Testing Personnel from RADC and the Air Force School of Aerospace Medicine conducted tests at the Georgia Institute of Technology on the effects of radio frequency pulses on heart pacemakers. Using dogs as subjects, the Center found that at frequencies varying from 427 to 450 megahertz, pacemakers started becoming vulnerable to the effects of radio frequency pulses starting at 36 pulses per seconds and lower.

Fantastic, sometimes unbelievable headlines rocked the country, from the end of a war to the beginning of the end of a presidency. Rumors flew that the end of RADC and Griffiss AFB was also at hand, but when the official DOD base-closing and consolidation announcement came in April, both remained untouched. Still, several significant events highlighted 1973, from numerous technological accomplishments to the naming of a new Center Commander.

SENIOR LEADERSHIP

Late in 1973, Colonel John W. Hepfer began a short-lived term as Center Commander, replacing Colonel Larsen. The out-going Colonel had received word of his promotion to Brigadier General earlier in the year, and had been assigned Vice-Commander of Electronic Systems Division at Hanscom AFB, Massachusetts. Colonel Hepfer came to the Center from Air Force Systems Command, where he had been Assistant Deputy Chief of Staff for Systems. Although he would finish out the year as Commander, the former Army Air Corps enlisted man would lead RADC for less than five months.

Colonel Metscher and Dr Gableman continued in their respective positions as deputy Commander and Chief Scientist throughout 1973.

ORGANIZATION

Personnel and Facilities

Civilian Hiring Freeze and Personnel Issues The hiring and promotion freeze imposed by President Nixon in December 1972 was lifted, but strict limits imposed by Air Force Systems Command on hiring had essentially the same effect. RADC also became concerned with its aging work force, noting that the last influx of young scientists came at the close of the 1968 school year.

High Power Lab The Center's High Power Laboratory spent the first part of the year providing electrical power to the base. Early in the summer of 1972, a catastrophic failure in Griffiss' power substation destroyed a transformer and switching cubicle, necessitating the need for another power source. Base engineers rigged lines from Building 3, home to RADC computer facilities, and other important loads to an old 4160-volt power line, which was energized by the Lab. The Lab itself continued operations without restriction.

Structure

Division Mission Change Responsibility for research and development of Identification and Point-to-Point Navigation Aids changed from the Surveillance and Control Division to the Communication and Navigation Division. Development of Ground Sensors for Tactical Interdiction and Physical Security became a duty of Surveillance and Control.

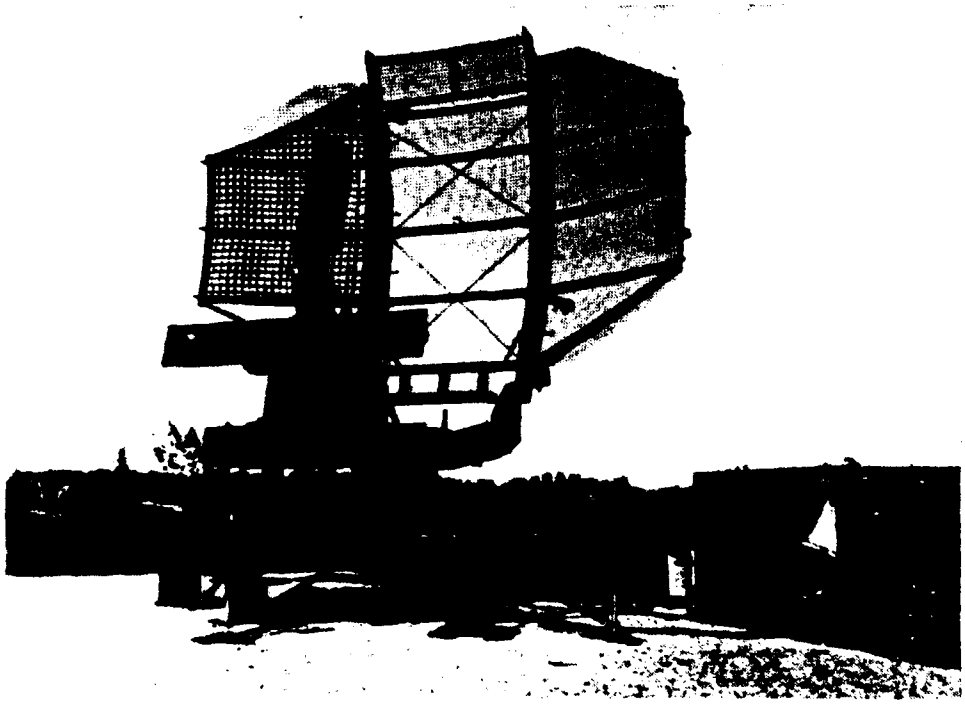
RESEARCH AND DEVELOPMENT

Surveillance

Wide Area Remote Surveillance Originally developed for use in Vietnam, Wide Area Remote Surveillance equipment proved its versatility by application to both the Army's Remote Battlefield Surveillance System and the Base Installation Security System (BISS). RADC delivered the completed model in February.

Over-The-Horizon Missile Detection RADC used its experimental over-the-horizon radar at the Ava and Dexter off-base sites to detect and extract information on missile launches.

AN/TPS-43 Radar Set On 6 April, RADC ended its involvement with the AN/TPS-43 tactical air control radar when it transferred its engineering records to the ESD program office handling the system. The Center provided engineering support during the design, development, and initial deployment of the radar.



AN/TPS-43 Radar

Experimental TACAN Antenna The Center designed, developed, fabricated, and tested an experimental, high performance, electronically modulated TACAN antenna.

Short-Range Radar Demonstrated RADC personnel successfully demonstrated the AN/TPS-60 (XW-1) short range radar at Nellis AFB, Nevada, in August. The Radar's significance lay in its ability to deal with a high-clutter environment.

Command and Control

SEMANOL Development The Center developed a method of eliminating multiple interpretations of computer higher order languages. The Semantics Oriented Language (SEMANOL) found several ambiguities within the JOVIAL programming language, and RADC developed plans to apply SEMANOL to COBOL and FORTRAN as well.

Intelligence

Autofocusing Camera RADC demonstrated the feasibility of developing a handheld, autofocus camera. Photograph quality using the autofocus was shown to be similar to that of a manually focused camera.

Language Recognition RADC's automatic language recognition project demonstrated an 85 percent success rate using five different languages and six different speakers. Recognition ranged from 60 to 96 percent, depending on speaker and language.

Human-Readable, Machine-Readable Memory Laser technology was used to record both human-readable and machine-readable data on standard-size microfiche in the RADC project. The HRMR eliminated two problems inherent to microfiche storage: editing difficulty and the inability to transmit electronically. Radiation Incorporated worked in conjunction with RADC on the project.

Automatic Speaker Verification Development of real-time speaker verification for access control culminated with a successful demonstration in May and again in July. RADC worked in conjunction with Texas Instruments on the system, which had an error rate ranging from 0.05 to two percent.

Photo Measuring Systems The Defense Mapping agency received nine TA3/P1 Stereo Comparators from RADC. RADC developed the large, three-stage photo measuring systems to improve the accuracy of maps and photography.

Lineal Input System In November, the Lineal Input System was developed by RADC to enter graphics in a computer-controlled data file. The system allowed maps and charts to be made from a variety of photographs. RADC delivered two LISs to the Defense Mapping Agency the following year.

Reliability and Maintainability

F-4 Rivet Gyro Program At the request of the F-4 program office at Wright-Patterson AFB in Ohio, RADC helped solve problems with the aircraft's inertial navigation system and scan converter display. RADC identified electrical overstress caused by stray voltage as the culprit, and provided recommendations which significantly improved the reliability of both systems. The Center's work lasted through November 1973.

Dormancy and On-Off Cycling Effects RADC's Reliability and Compatibility Division completed a study for the Space and Missile Systems Organization (SAMSO) on the effects of dormancy and on-off cycling on missile components. The Center produced failure rates for the integrated circuits used in these components during the 1967-1972 time frame.

Other

Pave Onyx Target Location In February, the conclusion of peace negotiations to end US involvement in the Vietnam War precluded deployment of the Pave Onyx Advanced Location Strike System. A combined RADC/Armament Lab effort, the ALSS resulted from an Air Force requirement to suppress enemy surface-to-air-missile sites. Testing of the system took place at RADC Det 1 at Holloman AFB in New Mexico. At one time the highest-priority short-term project in the Air Force, after February Pave Onyx continued as a technical development program. RADC's efforts earned the Center an Air Force Outstanding Unit Award in 1974.

Countermeasure Trainer In September, RADC developed and installed the AN/MLQ-T2 Countermeasure Trainer, which trained F-111 flight crews in the operation of terrain-following radar in a jamming environment.

It was high-noon for the Rome Air Development Center on 22 November 1974, when Secretary of Defense James R. Schlesinger announced that RADC would be disestablished in eighteen months, its mission and personnel transferred to Hanscom and Wright-Patterson Air Force Bases. New York in general and the citizenry surrounding the base in particular were appalled, as RADC, its Commander only on the job for ten months, and the community began the uphill battle to save the Center.

SENIOR LEADERSHIP

When Colonel Lloyd H. Geisy assumed command of RADC on 4 February 1974, he had no idea of the turmoil which lied ahead for him and the Center. In less than a year, he would be spearheading the RADC effort to maintain its very existence. Colonel Geisy came to the Center from Electronic Systems Division, where he directed development of an aircraft identification and traffic control system. Assigned to command RADC the previous Fall, Colonel Hepfer's abrupt departure in January was credited to his selection for promotion to Brigadier General. He moved on to the Space and Missile Systems Organization, as Deputy for the Minuteman missile development.

Dr Gableman continued on in the capacity of RADC Chief Scientist until his retirement from 29 years of federal service on 31 December, and Colonel William Metscher, RADC Deputy Commander, retired from the Air Force on 1 September. Three weeks later, Colonel Geisy appointed Communication and Navigation Division Chief Colonel Harry L. Winberg to that position. No replacement for Dr Gableman was announced.

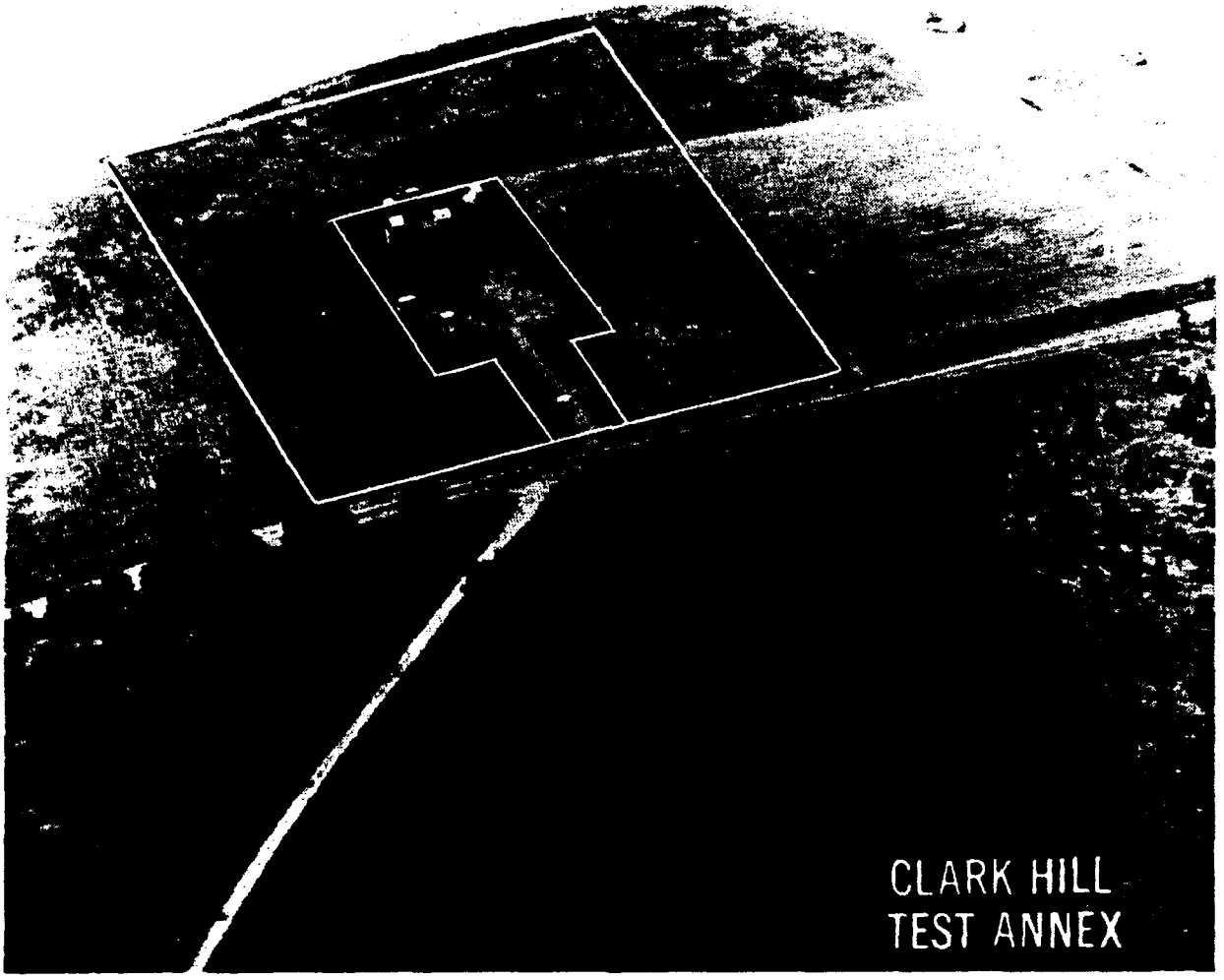
ORGANIZATION

Despite the call for the Center's disestablishment, its impact on RADC in 1974 was minimal, primarily because the announcement came so late in the year. Not until 1975 would the full effects of the decision take place.

Personnel and Facilities

Construction Begins on Laboratory Construction began in August for a new $2.8 million communications research laboratory in Building 3. Completion was estimated in January 1976.

Three Annexes Deactivated Originally purchased in 1956 to support the Navarho communications system, RADC declared the 475-acre Camden Annex excess to mission requirements (8 March) and officially deactivated the site on 30 June. Located about 25 miles northwest of Griffiss AFB, the site was equipped with three 625-foot antennas fed by three AN/FTR-19 transmitters. Meanwhile, effective 1 October, the Center declared its Clark Hill Annex excess. Purchased from the state in 1957, Clark Hill had been used for studying electronic and communications intelligence. RADC closed part of the annex in 1965, returning the land to the state. The rest of the site survived a recommended closure in 1969 and remained open until this year. The last Center site closed during the year was Model City in Ransomville, New York. Closed in June, RADC employed the 120-acre annex for experimental troposcatter communications. The site was subsequently transferred to the US Department of Labor in Summer 1976. No personnel were assigned to any of the sites. The deactivations reduced to nine the number of active sites under RADC control.



Clark Hill Test Annex

Military, Civilian Manning Reductions A projected cut of 60 civilian personnel stopped upon the announcement of RADC disestablishment, but the Center nevertheless absorbed a substantial loss during the year. Through attrition, RADC cut 26 civilian authorizations from its rolls at the end of June. In addition, 48 military positions were lost from RADC's Holloman AFB location, although this was offset somewhat by an increase here at RADC. Despite these instances of losses, RADC authorizations actually increased by 50 positions from June 1973 to the end of 1974.

Structure

Comptroller Moved Up In the Fall, the Comptroller regained status as a separate entity when it broke from the Directorate of Support Services, which it had been under since 1972. Organizationally, this placed the Comptroller on equal footing with that Directorate, as well as the Procurement and Flight Test Divisions. A new head of the Comptroller Division, Alex Sisti, was also named.

RESEARCH AND DEVELOPMENT ACTIVITIES

Surveillance

Compass EARS On 28 March, the Surveillance and Warning Central system, a major subsystem of Compass EARS -- Emergency Airborne Reaction System --, transitioned to the Security Service. It culminated a 3 1/2 year, $3.5 million RADC effort.

Project Peace Crown At the end of the year, RADC completed a radar study in support of Project Peace Crown, an air defense automation study for the Iranian Air Force. The general objective of the program was to automate the Imperial Iranian Air Defense System. Among other things, RADC recommended resiting of Iranian radars at higher elevations.

War On Drugs The USAF and RADC received orders to investigate the possibility of using multispectral reconnaissance techniques to locate opium poppy fields. Dubbed COMPASS TRIP, RADC investigated spectral reflectance curves of the poppies and other agricultural crops grown in association with the plant.

Communications

Compass EARS In August, RADC demonstrated air-to-ground and ground-to-air capabilities of Compass EARS Communications Central (AN/USC-31) developmental model.

Group Data Modem Phase I of the Group Data Modem (GDM) continued during the year. The GDM was envisioned to permit the transmission of digital data at rates varying from 19.2 to 153.6 kilobits per second with an error rate of less than one in one hundred thousand. Four engineering models of the modem (AN/USC-26)

were in service in 1973, providing significantly improved secure voice communications between Europe and the United States. By 1974, the $1.2 million program had been transitioned to a production program which met Defense Communication Agency requirements.

Asynchronous Time Division Multiplexer In January, prototype development and testing was completed on the Asynchronous Time Division Multiplexer, or AN/GSC-24. Later in the year, RADC transitioned the prototypes to various Department of Defense agencies for further testing. Developed at the request of the Defense Communications Agency, the AN/GSC-24 enabled its users to efficiently and effectively transition from an analog to digital technology. A contract for production of 72 of the units was awarded in September.

Automated Technical Control On 3 April, Air Force Systems Command transferred the Automated Technical Control (ATEC) program responsibility from ESD to RADC, marking the first time RADC had a Systems Program Office and acquisition-phase responsibilities. ATEC was a program to provide computer assisted capability to the Defense Communication Agency's Technical Control Facilities. Honeywell was the contractor for the three-phase effort.

Command and Control

Advanced Airborne Command Post RADC continued support of the Advanced Airborne Command Post, a modified Boeing 747 aircraft designed to be operable in the pre-, trans-, and post-attack phases of a nuclear war. Support included work in the fields of computer tradeoff studies, graphic displays, command and control, and communications. Over the next several years, RADC continued to support the AABNCP in these fields and in reliability and maintainability.

JOVIAL Compiler Delivered The JOVIAL Compiler, a software system which generated computer language compilers automatically, was delivered to the North American Defense Command. NORAD still uses the system today.

Reliability and Maintainability

F-111 Rivet Gyro RADC designed an electronic detector which shut down F-111's attack radar in the event of circuit overload. Previously, such overloads caused the cockpit to fill with smoke. The design was submitted to the F-111 program office for use in production procurement.

B-52 Protective System Test Range Center personnel designed and constructed a test range at the Stockbridge site as part of an effort to modernize the B-52 aircraft's electronic warfare system. The site was declared operational 4 September. Using a salvaged B-52, the test-bed provided precise antenna pattern data and eliminated the need for expensive and extended flight testing. During 1974, the Center took over 4000 high resolution antenna patterns from the AN/ALQ-117 and QRC-515 systems. Each pattern represented twelve hours of B-52 flight time saved.

B-52 Mounted at Stockbridge

Intelligence

VP-8 Image Analyzer In April, the Foreign Technology Division received from RADC the VP-8 Image Analyzer System, which rapidly calibrated the density bands of photographic images.

Other

Lost F-106 In March, RADC participated in search efforts of a lost Air Defense Command F-106 by processing and interpreting photos from recon missions.

RADC C-131B Located Downed Civilian Aircraft RADC's Flight Test Division located a downed civilian aircraft and its two occupants on 15 July. The Center had answered a request from the New York Air Route Traffic Control Center.

F-15, C-5, AWACS Support RADC Divisions ranging from Reliability and Maintainability to Surveillance provided development support to this wide variety of aircraft throughout the year. Center responsibilities included failure analysis of hybrid microcircuits on the C-5 and F-15, and engineering support for computer validation and displays on the AWACS. RADC also supported AWACS flight testing beginning 29 July.

AWARDS

Air Force Outstanding Unit Award RADC won its fourth outstanding unit award in eight years on July 1. Colonel Geisy accepted the award which covered the time period 15 February 1971 through 15 February 1973. RADC was cited for its efforts in enemy air defense suppression.

The big story, of course, was whether the Center would become a fond memory or continue on; and if it did continue, in what form? The year 1975, the twenty-fourth anniversary of RADC's establishment, promised to hold the answer.

SENIOR LEADERSHIP

Under the cloud of inactivation, Colonel Geisy carried on with his duties as Commander at RADC throughout the year. Although having retired in 1974, Dr Gableman received an appointment as part-time, acting Chief Scientist. He would work at the post throughout 1975. Colonel Winberg also continued as Deputy Commander. The position would later be renamed Vice Commander.

DISESTABLISHMENT

19 July 1974 Although rumors had been flying the past several months, the first tangible evidence that the Department of Defense was contemplating a restructuring of RADC occurred. Major General Kenneth R. Chapman arrived at RADC in connection with Secretary of Defense James Schlesinger's request for a lab utilization study. In a report released a few months later, General Chapman asserted that the "present Air Force laboratory system operates well," and cited RADC as one of two labs which performed best. The report did advocate, however, a closer association between product divisions and the labs, whether through "organizational integration," or "a less radical realignment (which) would assign laboratories directly to systems divisions..." For RADC, one way or another, it appeared closer official ties with Electronic Systems Division were in the offing.

22 November 1974 Announcement to disestablish RADC. The Department of Defense based its decision on a desire to improve lab utility and productivity. Secretary of Defense James Schlesinger cited the Chapman report as a basis for the decision.

27 November 1974 Secretary of the Air Force John L. McLucas agreed to take another look at the decision.

17 December 1974 Congressman Donald J. Mitchell, representing the 31st District of New York, released a gloom-and-doom economic impact report to the Secretary of the Air Force. Although short on specific numbers, the seven-page report predicted "economic disaster" for the area, with the "City of Rome to suffer the greatest hardship."

On the same day, Congressman Mitchell proposed in a report an alternative to the proposed disestablishment. He advocated the establishment of a C3 technology center at Griffiss to be comprised of RADC and relevant Air Force Cambridge Research Laboratory resources, which were then located at Hanscom.

20 December 1974 Taking another route, the New York Congressman requested a General Accounting Office (GAO) investigation of the Air Force disestablishment plan. A team from the GAO arrived at the Center a month later, but their final report would not be released before the disestablishment decision seven months later.

30 January 1975 Secretary of Defense Schlesinger informed Congressman Mitchell that unless the disestablishment of RADC produced major savings, he would not give the go-ahead for the move. In the original announcement in November, Mitchell noted, cost did not appear to be a factor; only mission enhancement was at issue.

10 February 1975 As part of the announced re-examination of the disestablishment, Assistant Secretaries of the Air Force Walter B. LaBerge and Frank A. Schontz, along with Brigadier General Gerald K. Hendricks, visited RADC. Although not committing himself to which way he thought the battle was headed, Congressman Mitchell appeared for the moment placated, saying he was convinced that the Air Force was conducting a very thorough review.

25 February 1975 A four-member team from Battelle-Columbus Laboratories arrived to investigate the socio-economic impact to the local Utica-Rome area of RADC disestablishment.

12 March 1975 Secretary McLucas appointed a study group, headed by Lieutenant General John W. O'Neill, to investigate current and projected Air Force capabilities for research, development, and acquisition of Command, Control, and Communications. In light of the committee's formation, Air Force System Command directed that all actions relative to RADC's disestablishment go no further than the planning stage. One exception to this policy was the planned transfer of RADC Flight Test Division aircraft to Wright-Patterson AFB in Ohio. Another AFSC message on 9 June reiterated the 'planning-stages-only' directive, again with the exception of the Flight Test Division transfer.

9 April 1975 Having already visited Wright-Patterson and Hanscom AFBs, the O'Neill study panel arrived at RADC to continue its investigation. The following day, the panel met with a local delegation, headed by Congressman Mitchell, supportive of RADC at Griffiss. Congressman Mitchell led another delegation to meet the O'Neill panel on 14 May.

15 April 1975 The Battelle Lab released its report on the socio-economic effects of the RADC disestablishment. This report, requested by Secretary McLucas at the urging of Mitchell and local Rome leaders, was considerably more thorough than the Congressman's effort four months before, but reached basically the same conclusions.

28 May 1975 The O'Neill report was released to Secretary McLucas. It outlined seven different C3-development alternatives, ranging from the original disestablishment plan to moving Electronic Systems Division to Griffiss AFB. It seemed the report leaned toward the former. This was evidenced by its description of "severe" socio-economic impact and "significant" skilled personnel losses in moving ESD to Griffiss, while "some" negative personnel and economic impact would occur with an RADC move to Hanscom. It went on to argue that "support of Electronic Systems Division systems is best done if the personnel providing systems engineering are collocated with Electronic Systems Division" and "Hanscom... is a logical location for the focus" of an Air Force C3 center of excellence. Finally, "in any alternative considered by the Air Force, the AFSC assets at Griffiss should report to Electronic Systems Division..."

31 July 1975 A collective sigh of relief emanated from the Mohawk Valley when Secretary McLucas announced his decision "...not to move major elements of RADC away from Griffiss Air Force Base." The Secretary also declared, however, "...so that we can move toward a better C3 management system, RADC will be assigned.... to the Electronic Systems Division." He agreed with the O'Neill report's conclusion that the original disestablishment plan was sensible, but additional factors such as personnel turbulence and economic impact weighed in his decision not to move RADC.

Also on 31 July, the first of RADC's seven flight test aircraft departed to Wright-Patterson AFB.

1 September 1975 RADC assigned to ESD. Despite the reorganization, and except for some minor changes, RADC's mission essentially stayed the same.

1 November 1975 ESD Commander Lieutenant General W.L. Creech prepared a management plan which called for the Air Force Cambridge Research laboratories at Hanscom to become a Division level operating element and report to RADC.

30 December 1975 HQ AFSC Special Order G-158 issued which activated and assigned the Deputy for Electronic Technology at Hanscom to RADC. The order became effective 1 January 1976.

ORGANIZATION

Personnel and Facilities

Personnel Reductions The loss of the Flight Test Division accounted for a reduction of 155 manpower authorizations during 1975. This loss was only slightly offset by the addition of 14 civilian authorizations in support of the Foreign Military Sales Program. By the close of the year, the Center was authorized 1280 positions, of which 1265 were filled.

Annex Transfer and Closing First used as a geodetic survey site and later to test electronic countermeasures, RADC vacated its Star Hill Annex in February. RADC had leased the site from New York since 1954. Upon the Center's departure, the Federal Aviation Administration became the primary user of the property. Located in Steuben, New York, 18 miles northeast of Griffiss, Starr Hill was also used in testing the guidance and control system for the Atlas, the nation's first intercontinental ballistic missile. On 30 June, RADC discontinued use of another off-base site, its West Lee Annex. The Center used this 486-acre site for intrusion detection and equipment testing. It had been open since 1969.

Structure

Division Realignment To more appropriately portray their assigned responsibilities, in the Spring of 1975 the RADC Communication and Navigation Division became Communications and Control, while the Surveillance and Control Division evolved into the Surveillance Division.

Flight Test Division Reassigned An era came to an end at RADC on 22 September when the last Flight Test Division aircraft departed Griffiss on its way to Wright-Patterson AFB, Ohio. Since its inception in 1951, RADC had maintained in-house flight testing capability of one sort or another. The Division was officially disestablished on 30 Sept 75. As of 30 June, the Division had flown 85,922 consecutive accident-free hours; its last major accident occurred in March 1958.

RESEARCH AND DEVELOPMENT ACTIVITIES

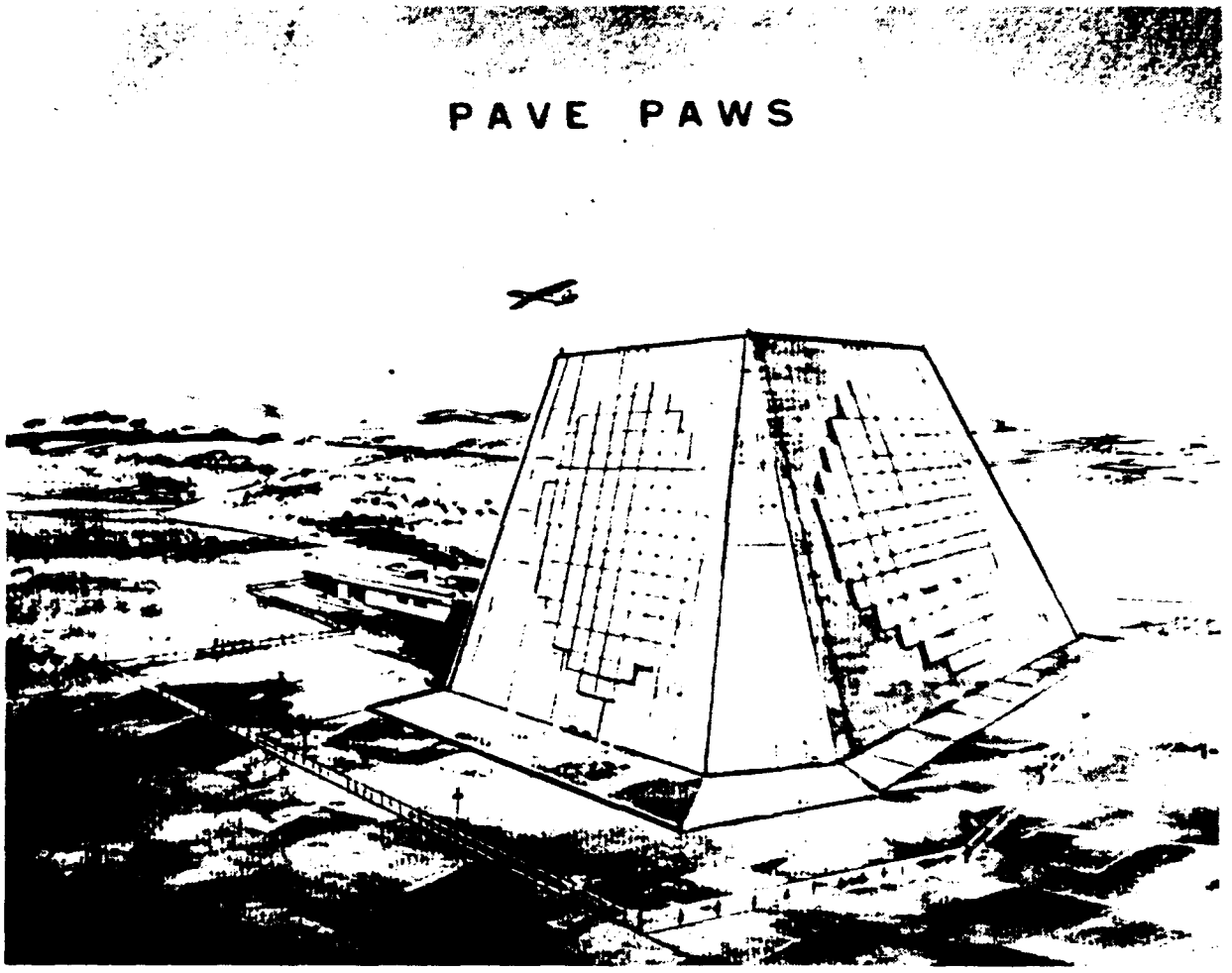
Surveillance

TOPSEA Radar RADC held engineering responsibility for a joint US/United Kingdom high-frequency surface wave radar program entitled TOPSEA. Based at Sugarloaf Key, Florida, the experimental radar's primary advantage was its ability to scan closer to the surface than conventional radars, thus providing earlier warning of low flying aircraft targets. RADC collected data over a nine-month period during the year.

Traveling Wave Tube Milestone RADC designed and fabricated a 94 GHz, 1 kilowatt travelling wave tube radio frequency power amplifier, which enabled radar amplifiers to be located near the antenna feed point. The new tube also allowed for the use of solid-state driving circuitry.

SEEK SCREEN In an in-house study entitled SEEK SCREEN, RADC determined that tactical radars lacked sufficient electronic counter counter-measure (ECCM) capability. This launched the Center's ECCM Antenna Development Program.

PAVE PAWS A Request for Proposal was submitted to industry 13 Jun 75 for PAVE PAWS, a long-range, phased-array radar system. Designed to detect and characterize a sea-launched ballistic missile attack against the United States, RADC was responsible for the design, fabrication installation, integration test, and evaluation of the system.



PAVE PAWS Concept Drawing

Communications

AN/MRM-14 Transitioned The Radio Frequency Interference Measurement Set (AN/MRM-14), developed by RADC, was accepted by the Air Force Communications Service.

Intelligence

Chinese-English Translator RADC completed a prototype Chinese-to-English machine translator, the QUINCE. This system was unique in that it was based primarily in sound linguistic theory.

German-English Translator Work on a third generation of machine translators continued. Translation of scientific and technical literature from German to English, and vice versa, was the goal of the program. It incorporated improvements to second generation translators, such as the Chinese-English machine.

AS-11B-X Transitioned The AS-11B-X provided automated capability to produce terrain elevation. Unlike its predecessors, which generated analog information, this system provided the same material in high-speed, high-accuracy digital form. The RADC-developed system was transitioned to the Defense Mapping Agency/Aerospace Center.

Reliability and Maintainability

SAMSO Support Support continued for the Space and Missile Systems Organization at Norton AFB, California. Five new methods were developed by the Reliability and Maintainability Division at RADC to provide for testing SAMSO and NASA microcircuits. In addition, RADC tested complementary-metal-oxide semiconductor-silicon-on-sapphire (CMOS/SOS) which SAMSO wanted for MX applications. From August through October, the Center accumulated more than 100,000 part-hours of test data in 160 CMOS/SOS circuits and determined that CMOS/SOS technology was not mature enough to support SAMSO's stringent reliability requirements.

While the country celebrated the 200th anniversary of its Declaration of Independence, RADC observed a slightly more modest 25th birthday. The year also marked the first since narrowly escaping disestablishment in 1975. RADC maintained its work on a variety of technical programs during the year, establishing a reputation as the Air Force center of excellence for C3I. By doing so, it continued to contribute to the US defense as the nation entered its third century.

SENIOR LEADERSHIP

After guiding RADC through some of the most turbulent times of its existence, Colonel Lloyd Geisy moved on to Fort Monmouth, New Jersey, where he would become Vice Commander for the Joint Tactical Communications Office. Taking over for Colonel Geisy on 13 June was Colonel John Z. Dillon, a former executive officer to the Commander of Air Force Systems Command.

Dr Gableman finally got to really retire from RADC in 1976, when Dr John S. Burgess returned to the Center from an assignment in the Netherlands. Dr Burgess, the RADC Chief Scientist from 1960-1971, resumed duties on 19 July. Colonel Winberg continued his duties as RADC Vice Commander.

ORGANIZATION

Personnel and Facilities

<u>RADC Authorizations Rise</u> Two significant events occurred during the year which affected Center manning. First, the addition of the Deputy for Electronic Technology (formed when the C3 aspect of the Cambridge Research Laboratories came under RADC) added 220 authorizations to RADC rolls. Several months later, however, a reduction in force at the Center eliminated 144 positions. All told, RADC's authorizations rose from 1280 at the end of 1975 to 1357 in December 1976.

<u>Ipswich Field and Prospect Hill</u> Because of the addition of a new Deputy, RADC gained jurisdiction over two off-base experimentation sites. Ipswich, located about 20 miles northeast of Hanscom, contained several technology development facilities. The 65-acre site, established in 1946, became RADC's oldest off-base facility. Prospect Hill, only five miles south of Hanscom, was used for tropospheric propogation research. Its relatively high elevation (478 feet above sea level) offered a direct line-of-sight path to the base, as well as to many other points in Eastern Massachusetts.

Building 3 Labs Readied for Move-In In March, the Communications and Control Division moved from Building 106 to its present location in Building 3. Construction on the new facilities in Building 3 took 20 months.

Facility Master Plan A four-phased master plan to consolidate RADC in its main facilities and vacate small, outlying areas was adopted during the year. As part of this plan, the Center's Procurement Division moved from Building 102 to its present location in 106. Building 102 was returned to the base.

Structure

"RADC East" The Deputy for Electronic Technology was formed at Hanscom by AFSC SO G-158, effective 1 January. It comprised the command, control, and communications elements of the Air Force Cambridge Labs, and reported to RADC. Later dubbed "RADC East," the Deputy was divided into two Divisions, Electromagnetic Sciences and Solid-State Sciences.

Operating Location Established In May, the Center opened an operating location at the ARPA Maui Optical Station (AMOS) in Hawaii. Responsibility for AMOS had been transferred from the Space and Missile Systems Organization to RADC in April. At the time, the station consisted of a 60-inch telescope, two 48-inch telescopes, and a laser director.

Judge Advocate Established On 1 July, RADC established its own judge advocate's office, responsible for reviewing contractual documents, agreements with other agencies, patents, and other matters related to procurement. Previously, the Center used the base judge advocate for these purposes.

RESEARCH AND DEVELOPMENT ACTIVITIES

Surveillance

Radar Prediction System RADC developed an experimental Radar Prediction System for Tactical Air Command (TAC). TAC, Strategic Air Command, and the Navy all expressed interest in the system, of which Electronic System Division directed further development.

COBRA DANE RADC completed technical assistance and engineering support for installation and testing of the COBRA DANE radar system. COBRA DANE was subsequently accepted from its contractor, Raytheon.

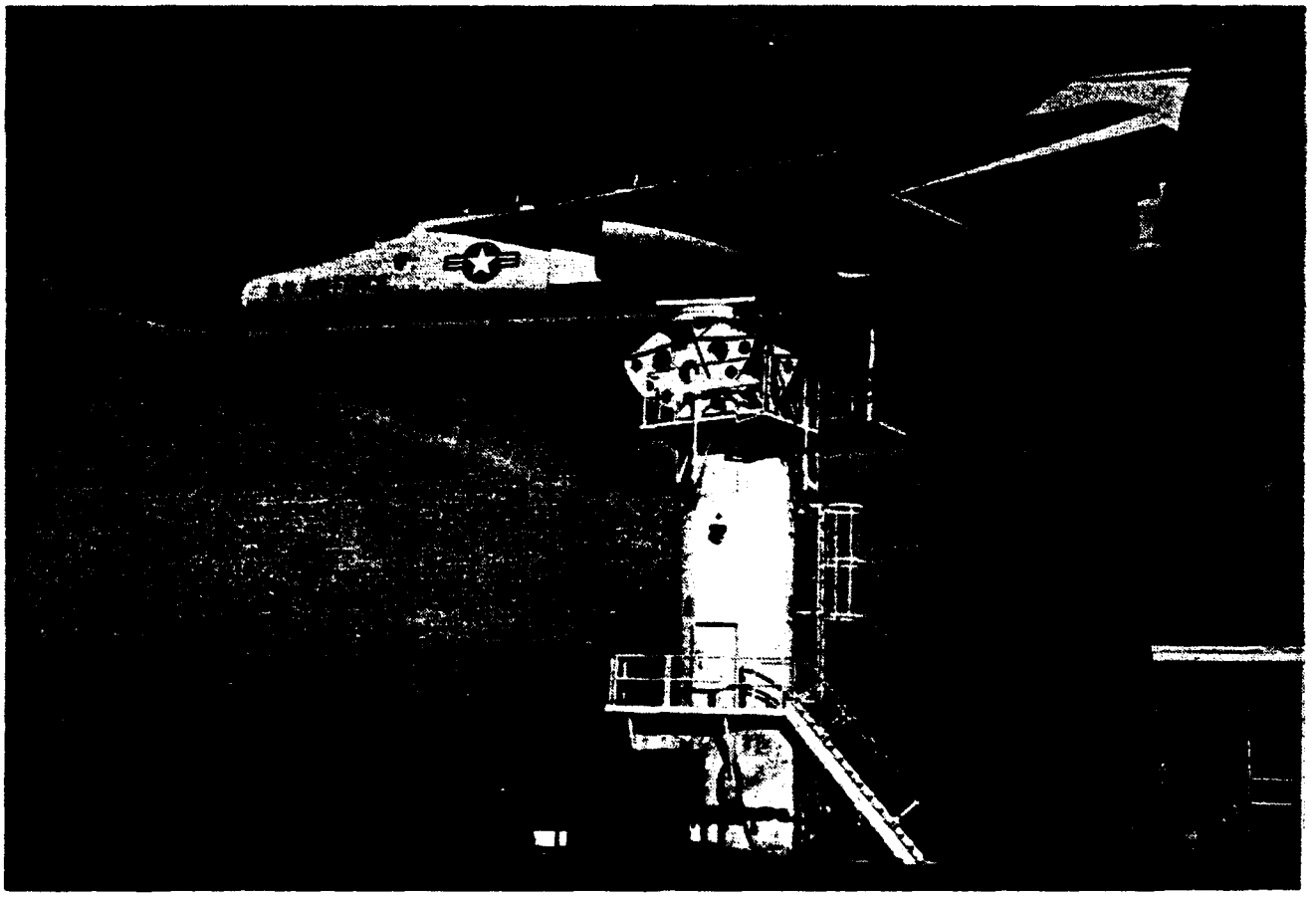
Space-Based Radar Program Initiated To support the Advanced Space Defense Program at SAMSO, RADC began a new exploratory program for development of space-based radar. Initially, the program concentrated on antenna development, clutter measurement and characterization, and signal processing.

Reliability and Maintainability

B-1 Defensive Avionics RADC uncovered three potential reliability problems during the B-1 Critical Design Review. The Center found that the contractor was using unrealistically optimistic failure rate estimates for both non-standard microcircuits and newly developed travelling wave tubes, and the design used relatively unreliable potentiometers.

F-16 Avionics At the request of the F-16 System Program Office, RADC performed a review and critique of Reliability Analysis/Prediction Reports. The Center was tasked with validating the reliability characteristics developed by various contractors of several components, including Flight Control Computers and the Fire Control Radar.

F-111 Testing In March, RADC recorded an antenna pattern from a pedestal-mounted F-111 at the Newport Test Site.



F-111 on Pedestal at Newport Site

Intelligence

Cartographic System for Italian Ministry of Defense RADC oversaw delivery and installation of an advanced, digitized cartographic system in Italy. The first system began successful operation at the Instituto Geographico Militare in November.

Other

Laser Guided Bomb Support Under the HAVE NOTE Project, RADC research produced major alterations to the electromagnetic shielding and filtering systems in a laser-guided bomb being developed by the armament laboratory.

Human Intruder Detection The Center continued its support of ESD's Base Installation and Security System (BISS). RADC's Electromagnetics Division discovered a relationship between signal-loss in buried cable and water content of the soil. Demonstrations by RADC showed how this problem could be overcome using a radiating antenna to protect the area.

Microform System An RADC-developed microform became the standard for Air Force personnel records in June.

Project Peace Owl RADC developed an Electronic Warfare training facility for the Iranian government. Initial operational capability was reached on 13 September.

It was the year of the distinguished visitor at the Rome Air Development Center in 1977. In June, County legislators from Oneida, Herkimer, Madison, and Onondoga visited the Center, as did congressional representatives and area newspaper, radio, and television editors and reporters. Lieutenant General Robert Marsh, Commander of ESD, also visited RADC for briefings in June. Civic leaders from Boston toured the Center two months later, and Utica-Rome community leaders reciprocated with a visit to Hanscom. Chairman of the Joint Chiefs of Staff General George Brown arrived in September. Capping off the year was a December stopover by General Lew Allen, Commander of Air Force Systems Command.

SENIOR LEADERSHIP

Colonel Dillon entered his second year of command in 1977; his Vice Commander, Colonel Winberg, completed his third at that position. Already by far the longest-serving Chief Scientist at RADC, Dr Burgess finished his twelfth year as the Commander's technical advisor.

ORGANIZATION

Compared with years past, 1977 could be viewed as a relatively stable one. No major structural changes took place within the organization, and manning remained relatively stagnant. The year did mark the institution of one practice still enjoyed by the laboratory's personnel today: flexitime. Initiated by Colonel Dillon, it was implemented 1 November.

Personnel and Facilities

Personnel An AFSC-directed reduction in civilian manpower authorizations translated into a loss of 22 authorizations during the year. Only seven were direct reductions, however. Fifteen Foreign Military Sales authorizations were also slashed, due to workload completion. At the end of 1977, Center manning stood at 143 officers, 88 enlisted, and 1108 civilians; 1139 total.

Floyd Annex Declared Excess, Vienna Placed on Standby Two long-time RADC off-base sites became inactive in 1977. The Center placed Vienna on standby status in October, then declared its Floyd site excess a month later. The reductions brought to nine the number of off-base sites under RADC control.

RESEARCH AND DEVELOPMENT ACTIVITIES

Surveillance

COBRA DANE The COBRA DANE radar system was completed and turned over to the Air Defense command in July. The Center had participated in the system's development since 1972. RADC work on technology used in COBRA DANE began as early as 1955 with SARAC, the Steerable Array Radar and Communications program. In 1978, the Center's Cobra Dane Program Director's Office would be awarded an Air Force Organizational Excellence Award for its efforts.

AWACS Tactical Air Command received its first "production" Airborne Warning and Control System aircraft. RADC "overland" technology, developed in the 1960s, was the enabling technology for AWACS' "lookdown" radar. Lookdown radar allowed the aircraft to detect airborne targets against a cluttered background.

AWACS

HALO Breadboard mirrors were demonstrated for the High Altitude Large Optics program. HALO had direct application to the Space and Missile Systems Organization's Teal Ruby program. Teal Ruby envisioned Spaceborne Optical Systems for detection of air vehicles.

SEEK IGLOO RADC conducted preliminary data gathering for the SEEK IGLOO (AN/FPS-117) Program. SEEK IGLOO was designed to modernize the Alaskan Air Command surveillance system. It reached full operational capability in 1983 after completion of test and evaluation.

Three-Cavity Gyrotron In January, RADC demonstrated the feasibility of high-power millimeter amplification using a three cavity Gyrotron. Studies were being pursued in this area under RADC's Surveillance Electronic Counter-Countermeasures effort.

More War on Drugs In February, US and Mexican officials agreed on the need to evaluate RADC's Multispectral System for locating opium poppy plants in Mexico.

Communications

Group Data Modem On 3 January, RADC transitioned to the Sacramento Air Logistics Center the AN/USC-26 Group Data Modem. The modem tripled the data handling capacity of standard 60-108 kilohertz frequency division multiplex group circuits.

AN/ARC-164 Field reports showed that the mean-time between failure rate of the AN/ARC-164 averaged 992 hours, ten times that of the model it would be replacing. For five years, RADC had provided reliability support to the Aeronautical System Division program.

Communications Switching Using the Automated Data Processor-Telecommunications Program, in February RADC demonstrated an advanced technique in communications switching.

Fiber Optics The Center developed a secure communications system using fiber optics. The typical limitations of high-cost and limited capacity for classified transmissions were eliminated using the fiber optic communications link.

Reliability and Maintainability

GEMACS RADC completed a three year effort to develop tools to support the electromagnetic fields analysis program. The result was the General Electromagnetic Model for the Analysis for Complex Systems, a method of moments (MOM) technique. It had major advantages over MOM techniques in use at the time.

"RADC Road Show" A presentation to AFSC and ESD kicked off the "RADC Road Show," a presentation describing the Center's Reliability and Maintainability efforts. RADC is still active in Road Show presentations.

New Failure Analysis Test Applied to Microcircuits RADC developed a test whereby failed microcircuits could be inspected and tested inexpensively and through non-destructive means. The test, developed in-house, used a liquid crystal to generate a visual display of the microcircuit. This permitted the observer to actually follow the voltage flow through the circuit during operation. Any break in the flow, such as would be caused by a defective circuit element, could then be pinpointed exactly.

Other

Indium Phosphide Development The Center produced the highest purity single crystal of Indium Phosphide ever grown. It was designed for advanced electro-optical and microwave semiconductors.

High-Power Laser Windows In conjunction with Raytheon, RADC developed highly purified ingots of calcium and strontium fluoride for use in high-powered laser windows. The Center transitioned its findings to the Air Force Materials Laboratory for scaling-up and manufacturing technology.

AWARDS

Technical Support Division For its efforts from 1972 through 1975, the Center's Technical Support Division received the Air Force Organizational Excellence Award in February. The award cited major advancements in the accurate and economical measurement of complex antenna systems.

Two events identified with RADC up to the present day began in 1978. The year marked the inauguration of the "Industry Looks at RADC" program, sponsored by the Armed Forces Communications and Electronics Association. Industry Looks consisted of a series of technical briefings on RADC programs to several hundred industry representatives. The program's format remains much the same today. Also during the year, the predecessor to what is now known as Heritage Day began, an event designed to recognize individual outstanding performance of RADC personnel. The awards ceremony and luncheon was renamed Heritage Day in 1983. Both enjoyed their 14th anniversary in the summer of 1991.

SENIOR LEADERSHIP

Colonel John Dillon left RADC to assume the Chief of Staff position at the Electronic Systems Command, paving the way for recent Air War College graduate Colonel Donald J. Stukel to become the Center's 15th Commander on 14 July. The West Point graduate held a doctorate degree in physics from the Air Force Institute of Technology. Colonel Stukel's other assignments included a stint as assistant to Dr Henry Kissinger in 1972 and as a member of the President's national security council.

After four years and two months on the job, longer than any other RADC Vice Commander, Colonel Harry L. Winberg retired. The former F-80 and F-86 pilot's last day was 30 November 1978. No replacement was named before the end of the year. Another long-time Center leader, Dr Burgess, extended his tenure as RADC Chief Scientist through its 13th year.

ORGANIZATION

Personnel

Gains and Losses The Center's gain of fifteen manpower slots on 1 January slowly eroded throughout the year and by the end, RADC was authorized only three additional positions than at the close of 1977. Losses were due to the deletion of Foreign Military Sales and Intelligence Data Handling Systems slots, and AFSC-mandated reductions.

Structure

Communications Security Engineering Office Electronic Systems Division's Communications Security Engineering Office was assigned to RADC's Deputy for Electronic Technology in January. The Office was staffed by 15 personnel.

Reporting Changed The RADC Headquarters Squadron Section began reporting directly to the Command Section on 24 November. Less than a week later, the Security Office did the same. Both were formerly part of the Support Services Division.

RESEARCH AND DEVELOPMENT ACTIVITIES

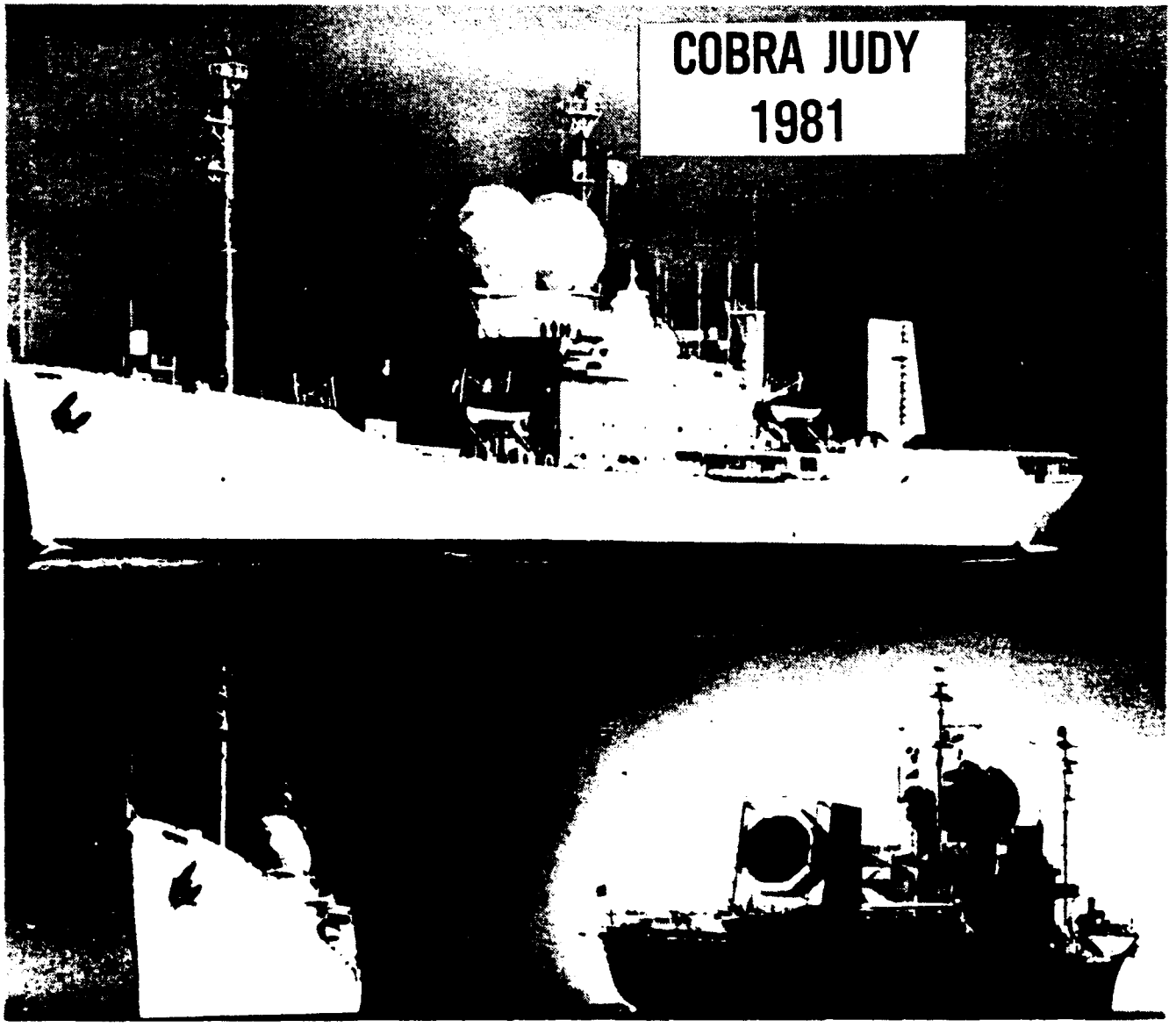
Surveillance

Compass EARS The first production model of the RADC-developed surveillance and warning central for the Compass EARS program completed acceptance testing, including a reliability and maintainability demonstration. Following certification, it would be ready for operational use.

Operator Stations for Compass EARS S&W Central

PAVE PAWS In January, the first 300 production models of the RADC-developed solid-state transmit/receive modules for the PAVE PAWS radar system were built.

COBRA JUDY RADC assisted the Electronic Systems Division System Program Office develop the final procurement package for COBRA JUDY, a phased array radar system to be installed on the USS Observation Island. COBRA JUDY would become operational in 1981.



COBRA JUDY on the USS Observation Island

SEEK FROST Based on the Center's earlier success with clutter measurements for the SEEK IGLOO program, ESD tasked RADC with a similar effort for SEEK FROST. This program intended to replace

the obsolete DEW Line radar in the Canadian Arctic with 57 unattended and 13 minimally attended radars. RADC's Reliability and Maintainability Division also assisted in SEEK FROST support.

MRS RADC successfully demonstrated the Multilateration Radar Surveillance Strike System at the Stockbridge Test Annex. Center personnel tested the system against tanks and armored personnel carriers in the 25 October demonstration.

Peace Edge The Center developed, delivered, and installed four air defense radars in Taiwan. Known as Peace Edge, the program upgraded Taiwan radars used for detecting and tracking aircraft. Specifications developed from evaluation of existing Taiwanese radars enabled RADC personnel to modify the country's AN/FPS-88 radars into AN/FPS-110 radar systems.

Intelligence

COMPASS PREVIEW RADC delivered COMPASS PREVIEW to Strategic Air Command. COMPASS PREVIEW was the first system to use all digital methods and display technology for strategic imagery interpretation.

COIC The Combat Operations Intelligence Center Network Processor, developed by RADC, was successfully installed and tested at the Headquarters for the United States Air Forces in Europe (USAFE).

SITS In November, the Secure Imagery Transmission System was installed and successfully tested at the Defense Mapping Agency. SITS transmitted imagery at up to 9600 bits per second, with 125 lines per inch resolution and 16 shades of gray definition.

Reliability and Maintainability

TRI-TAC RADC saved the Air Force over $750,000 by determining that the TRI-TAC interface board could be tested by a commercial tester rather than a dedicated system. RADC verified its finding using a computer program which compared the characteristics of the board with the capabilities of the test unit.

Other

Acid Rain The Brookhaven National laboratories requested information regarding an RADC-developed technique for the remote detection of acid bearing clouds. RADC published a technical paper and successfully demonstrated the technique in 1975.

CREEK ROCK/CREEK FIRE The Center completed a study enabling USAFE to choose a replacement or upgrade system for their CREEK ROCK and CREEK FIRE antennas. The study resulted in definition of six systems which met USAFE requirements.

New York Congressman Donald Mitchell (R-31st District), one of the people most instrumental in ensuring RADC's survival four years earlier, visited the Center on 23 March to tour facilities and receive various briefings. The Congressman was a regular visitor to RADC and Griffiss AFB. His last visit to the Center had been in May 1978, when he attended RADC's inaugural awards ceremony at the Officer's Club.

SENIOR LEADERSHIP

Colonel Peter R. Worch filled a vacant Vice Commander position on 1 January. The Binghamton, New York native previously served at RADC from 1970 to 1973, his last Center assignment as head of the Communication and Navigation Division. Colonel Stukel and Dr Burgess continued as RADC Commander and Chief Scientist, respectively.

ORGANIZATION

The major Divisions of RADC's organizational structure remained unchanged, and no significant activity occurred in the Center's manning status. In addition, RADC continued to occupy buildings at both Griffiss and Hanscom AFBs, and operate nine off-base test sites. Although nothing concrete was ever outlined, the RADC facility plan advocated classifying "Buildings 106 and 240 as antiquated and no longer economically maintainable," and replacing both by 1990.

RESEARCH AND DEVELOPMENT ACTIVITIES

Surveillance

Ultra Low Sidelobe Antenna Developed Development of the Ultra Low Sidelobe Antenna by RADC provided improved electronic counter counter-measure and anti anti-radiation missile capability. Although developed for the AN/TPS-43 radar, it was also installed in the AN/TPS-75.

MOTIF Transitioned The AMOS 1.2m telescope complex was officially turned over to Air Defense Command by RADC on 15 September. RADC-developed technologies provided multiband infrared satellite detection and analysis, and photometric signature collection and analysis. MOTIF was capable of detecting an object the size of a softball at an altitude of over 20 miles.

CIS In February, development of the Compensated Imaging System proved an adaptive optics theory. The CIS permitted viewing of operationally significant space objects without atmospheric distortion.

AMOS and SKYLAB RADC's AMOS facility provided laser illuminated and daytime images of SKYLAB in April to the National Aeronautics and Space Administration and Air Defense Command. The images helped NASA and ADC determine the orbital decay of SKYLAB.

Communications

COMPASS EARS On 26 June, RADC transferred responsibility for the COMPASS EARS Communications Central Ground-Wideband (AN/TSC-98) to the Air Force Logistics Command. The AN/TSC-98 uplink provided a two-way radio link between airborne data collection systems (airplane, remotely piloted vehicle) and the ground control, processing, and reporting system. It operated at ten gigahertz.

Killer Kat RADC developed the first operational DOD digital troposcatter communications system. Dubbed Killer Kat, the system was built to replace an aging and poorly performing analog system in USAFE. It began operation in June.

Command and Control

JOVIAL/J73 RADC produced an updated and improved JOVIAL/J73 computer programming language. Later in the year, the USAF determined that JOVIAL/J73 would be the "only approved version of JOVIAL to be used in developing new weapons and defense systems."

JOVIAL Facility On 8 January, the prototype JOVIAL programming language control facility began operation at RADC. The facility was scheduled for transition to the Aeronautical Systems Division in FY81.

Intelligence

PAVE MOVER Support RADC began cartographic data base support to the PAVE MOVER program, the forerunner to JOINT STARS. Technology aboard the JOINT STARS aircraft permitted detection of ground-based military assets.

Reliability and Maintainability

AMaRV The Center recorded measurements of two SAMSO Advanced Maneuvering Reentry Vehicle antennas. The AMaRV was installed on a tower at the Newport facility.

Heart Pump Reliability AVCO Corporation of Woburn, Massachusetts requested information from RADC TR 78-55, "Electronic Equipment Screening and Debugging Techniques." AVCO wanted to apply the information to the electronic controls used in heart pumps.

For the first time in its twenty-nine year history, Rome Air Development Center hosted representatives from the People's Republic of China. The 13 May tour lasted three hours, and included an examination of the RADC High Power Lab. Liu Huaquing, Chinese Vice-Chief of the General Staff, headed the 16-member delegation. The visit was at the invitation of Secretary of Defense Harold Brown.

Liu Huaquing (center) on Tour of RADC

SENIOR LEADERSHIP

Dr John S. Burgess' retirement on 30 June ended a long and distinguished government service and RADC career. He served over 15 years as RADC Chief Scientist alone. No replacement was named. Center Commander Colonel Donald Stukel stayed at his position throughout 1980, as did Colonel Peter Worch, RADC Vice Commander.

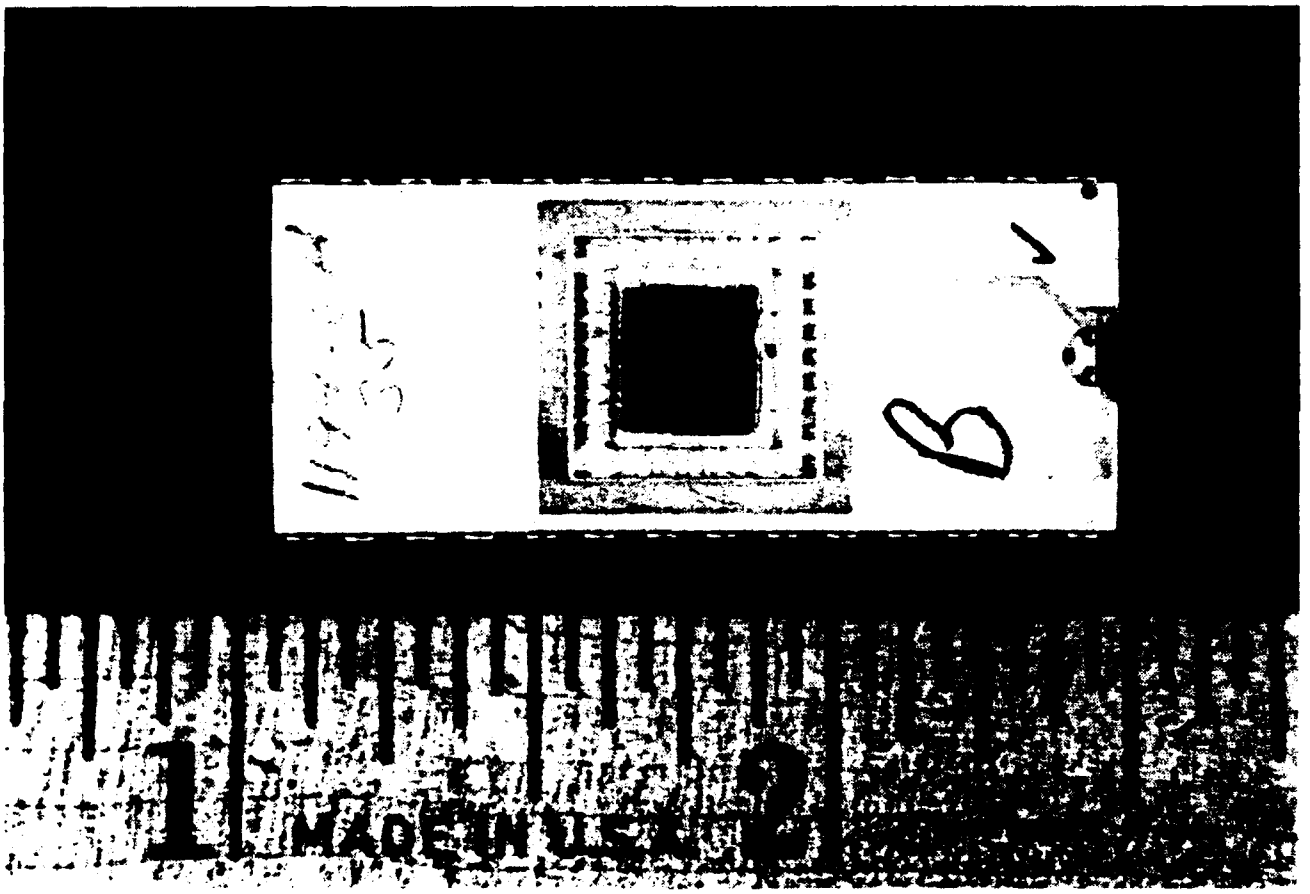
ORGANIZATION

No significant activity occurred in relation to personnel, facilities, or organizational structure.

RESEARCH AND DEVELOPMENT ACTIVITIES

Surveillance

Infrared Television In March, RADC introduced a new technology, a state-of-the-art focal plane sensor, which reduced the cost of infrared television cameras from $100,000 to $10,000. The price decrease resulted from a reduction in the camera's complexity and elimination of mirrors typically in use at the time.



Focal Plane Sensor

PAVE PAWS In October, support provided to PAVE PAWS by the Center was terminated. Since beginning work on the system, RADC contributed technology in the areas of phased array radars, solid-state module transceivers, and structured programming. PAVE PAWS reached initial operating capability 4 April 1980 at Otis AFB in Massachusetts, and 15 August at Beale AFB, California.

Communications

Fiber Optic Communication System From 11-19 August at Otis AFB, RADC demonstrated a fiber optic communications system which could replace conventional cable used in 407L Tactical Air Control System. A month later in Germany, RADC again demonstrated the system. The new link was used during actual air operations. It replaced 300 pounds of cable with 20 pounds of fiber optic line, and improved signal-to-noise ratio in the process.

Around-the-World Measurements The high frequency receiving system at Verona performed around-the-world propogation measurements on transmissions via the polar route. The transmissions originated at the Ava Test Annex.

Strategic Communications Uplink Program In October, RADC's Strategic Communications Uplink Program demonstrated ability to transmit laser beam through turbulent atmosphere.

Digital Telephone System RADC designed and tested a digital telephone system for use in tactical communications. The system used two wires instead of the conventional four, and could be used for transmitting classified information.

Command and Control

Looking Glass RADC developed and delivered the ROLM1666 Cross Compiler for Strategic Air Command's EC-135C Looking Glass program, SAC's Airborne Command Post.

Reliability and Maintainability

ORACLE In March, RADC made ORACLE available to DOD and contractors. The Optimized Reliability and Component Life Estimator computer software enhanced reliability prediction.

Intelligence

METAL Machine translation efforts at RADC concluded on 27 October upon completion of a German/English translation system, dubbed METAL. Developed in conjunction with the University of Texas at Austin, the third-generation machine translated with an accuracy rate of 83 percent. From its beginnings 25 years before as an in-house research and development project, translation machines were designed by the Center for Russian, Chinese, and Vietnamese languages.

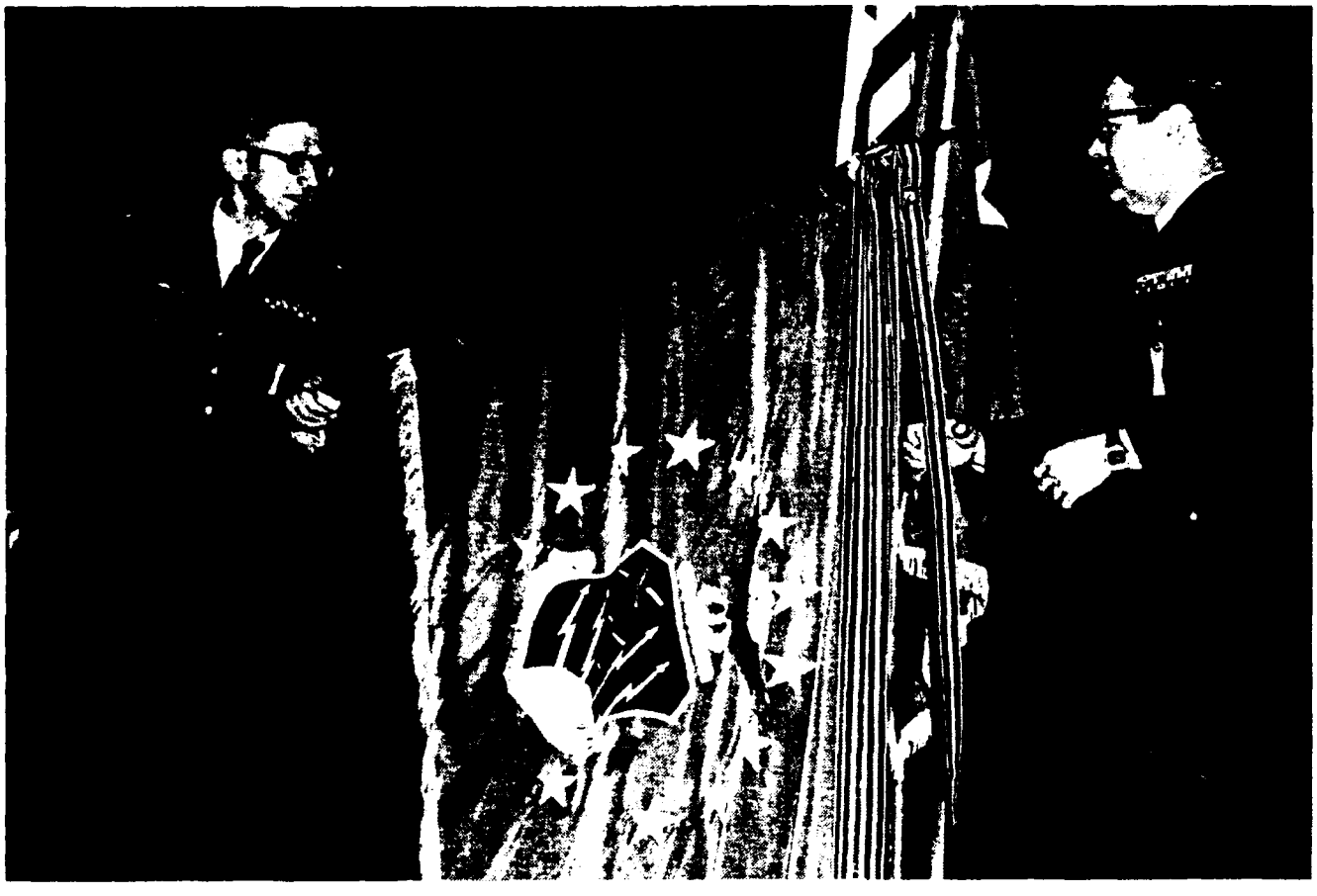
SPANS The Foreign Technology Division received the Spectral Analysis Processing System (SPANS) in July. RADC designed, constructed and installed the system for FTD at Wright-Patterson AFB in Ohio. SPANS analyzed foreign missile launches.

Other

MX Site Security The prime contractor for the MX ICBM met with Center, Air Force, and contractor personnel regarding the RADC-developed Remote Site Security Sensor System. The system was being developed by RADC for ESD.

AWARDS

Fifth Outstanding Unit Award Lieutenant General Robert T. Marsh, Electronic System Division Commander, presented RADC with its fifth Air Force Outstanding Unit Award on 10 January. The Center was cited for outstanding contribution to solid-state device reliability and maintainability from 1 January 1977 through 31 December 1978. RADC previously received the award in 1965, 1969, 1972, and 1974.



Colonel Stukel Receives AFOUA Streamer

Nineteen eighty-one witnessed RADC's continued pursuit of excellence in the area of C3I technology. But like years past, some of what set the year apart from its predecessors was not what the Center did, but who visited and toured RADC and Griffiss AFB. Two of the more significant visitors arrived in the Fall. On 5 October, former Technical Sergeant Forrest Vosler, a Medal of Honor recipient during World War II, spoke at the Griffiss AFB Officer's Club. The visit was sponsored by the RADC Company Grade Officers Council. Six weeks later, also in a visit sponsored by RADC, former Chief Master Sergeant of the Air Force Richard Kisling spoke at the Base Theater on the history and development of the NCO corps.

SENIOR LEADERSHIP

Wholesale change to the command section occurred in 1981, as all three senior leadership positions changed hands. Air Force Systems Command and RADC completed a swap of Colonels in the summer, when Brigadier-selectee Stukel left RADC to assume the Deputy Chief of Staff position for Plans and Programs. His replacement, Colonel Phillippe O. Bouchard, left AFSC's Manpower and Personnel division. Upon Colonel Stukel's departure, he reinstituted a tradition of RADC commanders leaving with promotion in hand; not since Colonel Hepfer left in 1974 had that transpired. Colonel Stukel's three-year reign as Center commander was the longest since Brigadier General Culbertson completed a three-year tour in July 1967. The new RADC Commander, the last West Point graduate to command the Center, was a former Air Force Academy instructor and pilot in Vietnam, where he earned 14 Air Medals.

Dr Fred Diamond, an employee first of Watson Labs in 1950, then RADC, officially assumed the Chief Scientist position on 19 April, ending a nine month vacancy in that position. He had been acting Chief Scientist since February. Throughout his 30-year career, Dr Diamond had specialized in signal processing for radar and communications. A graduate of Syracuse University with a doctorate in Electrical Engineering, his last assignment prior to becoming chief

scientist was as Technical Director of the Communications and Control Division. In the Vice Commander slot, Colonel Owen R. Lawter replaced a retiring Colonel Worch on 1 August.

ORGANIZATION

The relative calm of the years since the end of the Vietnam War and near-disestablishment of RADC continued in 1981. The Center's manning remained stable. One interesting personnel-related note took place in January, when Technical Sergeant Donald St. Jean of RADC's Security Office received Master Sergeant stripes. The promotion was significant because it was part of the then experimental Stripes for Exceptional Performers program, now a permanent feature of the enlisted promotion system. Organizational changes occurred, but were generally intra-Divisional and considered minor. Two exceptions were the creation of operating locations at Space Division in Los Angeles and at ESD's Det 2 in Colorado Springs. Finally, RADC facility improvements continued, although no new buildings or sites were acquired or shut down. One of the more significant facility-related developments at the Center took place in July, when RADC's card entry system was activated in all major Center facilities -- except for Building 3, which would have to wait until later in the year. In a letter concerning the use of access cards in the new system, Security Chief 1Lt P.S. Richard urged Center employees to take good care of their cards, and particularly "not use them to scrape ice from windshields..."

RESEARCH AND DEVELOPMENT ACTIVITIES

Surveillance

Space-Based Radar Test sections of a lightweight radiating membrane antenna for space deployment were built and structurally tested. The Center also measured the antenna's radio frequency patterns. All tests met or exceeded design goals.

Enhanced Defense Early Warning The Center developed unattended short-range radar sensors to improve cruise missile detection capability.

Anti-Radiation Missile Sensor This sensor detected ARM activity in the area it was deployed. Developed for the AN/TPS-75, it also was applied to and enhanced survivability of the AN/TPS-43 tactical radar.

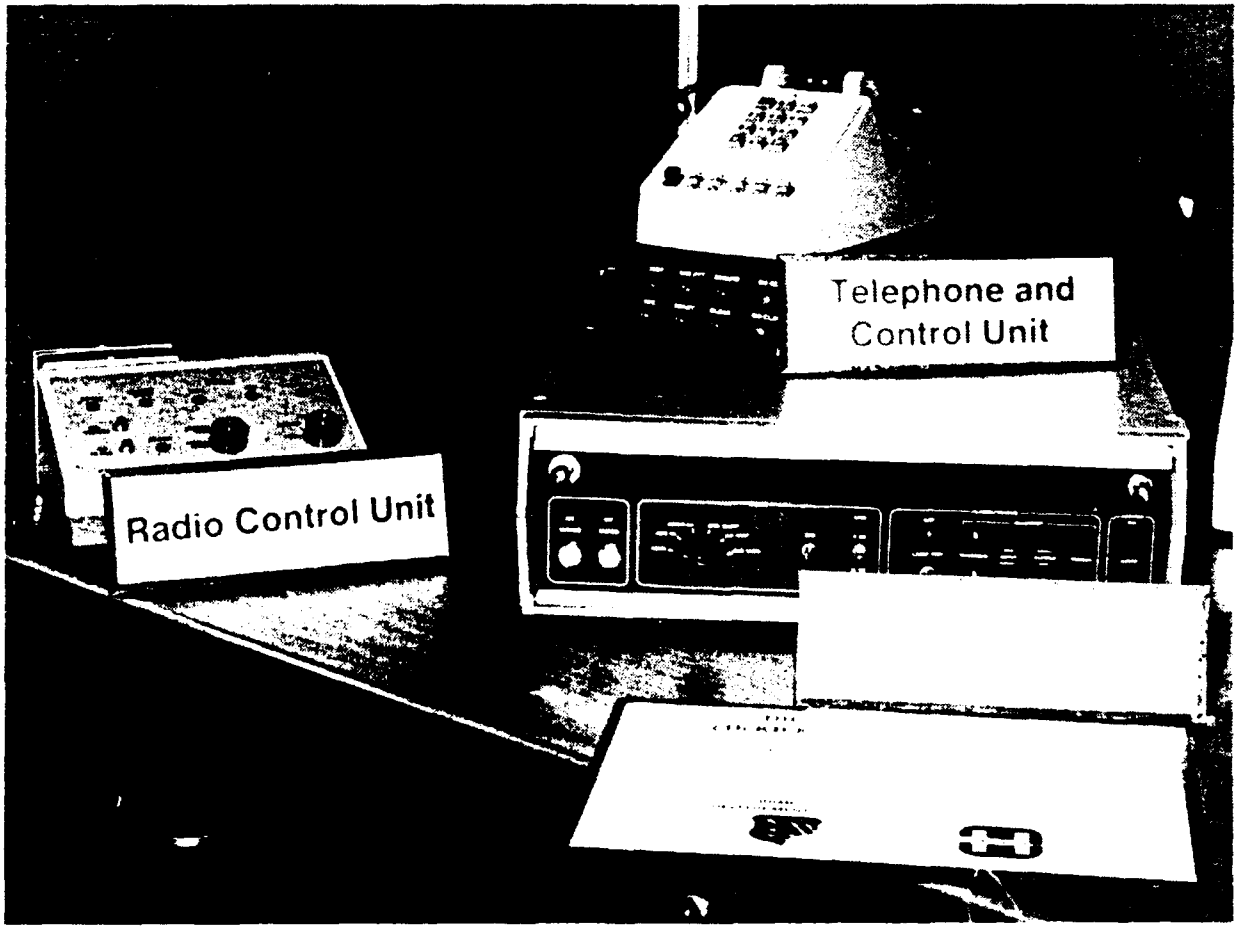
PAVE MOVER On 8 October, contractors Grumman and Hughes performed flight testing of the PAVE MOVER radar and command and control systems at the White Sands Missile Range in New Mexico. The initial tests were anything but auspicious, as technical difficulties and mud dauber nests in the aircraft's pitot tube prevented the systems from meeting performance objectives. Later tests proved successful.

Communications

ASOC OTS RADC delivered eight Air Support Operations Center Optical Transceiver Systems to the 601st Tactical Control Wing in Europe. The system connected shelters to transmitters using fiber optic cable, enhancing tactical C3I.

SEEK TALK In May, the Center successfully completed field testing of two SEEK TALK Tactical Radio System advanced development models. SEEK TALK enabled interference-free voice communications among pilots and command and control stations in a jamming environment. The system was later transitioned to ESD.

SPEAK EASY RADC developed and certified SPEAK EASY, a secure voice, digital communications system for use over standard telephone lines. The Center began work on the system in 1975. SPEAK EASY's high data-rate performance was consistent with encryption devices of the period. Initially tested and evaluated in March 1981, the 16 kilobit/second modem/VINSON Secure Voice Terminal was transitioned to ESD in June -- whereupon it became known as "SPEAK EASY."



SPEAK EASY Under Development in 1978

Tent Array A pup-tent shaped antenna for use as an airborne satellite communications terminal was developed by the Center. It consisted of four flat phased arrays; two long arrays giving maximum gain at the array sides, and two smaller arrays producing reduced gain toward the aircraft nose and tail.

Patent Awarded Marvin Clinch of RADC's Intelligence and Reconnaissance Division received a patent for developing a communications technique employing changing frequencies. Unlike other forms of modulated communications, the system had the capability to communicate on high frequency and low power.

Intelligence

Korean Air Intelligence System The RADC-developed Korean Air Intelligence System, dubbed Constant Watch, reached baseline operational capability at the end of January.

Reliability and Maintainability

Newport Site Work Acquisition of F-15 and F-16 airframes allowed RADC to test and evaluate the MARK-XII IFF. The Center also measured ALR-69 Radar Warning Receiver antenna patterns aboard the F-16.

Microcircuit Analysis Answering a request from the North American Defense Command, RADC began analyzing microcircuit failure thought to be the cause of an alarm system incident at NORAD's Cheyenne Mountain Complex in June 1980.

Failure Analysis Techniques Guide In September, RADC published the "Microelectronics Failure Analysis Techniques Procedural Guide." The manual was a joint effort between RADC and General Electric.

Other

Infrared Intrusion Detection Sensor RADC began testing of an infrared intrusion detection sensor designed and built by the Center's Solid State Sciences Division at Hanscom. Tested at Griffiss AFB during both snowy and normal conditions, the sensor detected 146 penetration attempts without a miss.

Awards

Small Business Award For the fourth consecutive year, the Secretary of the Air Force honored RADC's small business program for outstanding achievement.

Seventeen Congressional Medal of Honor winners gathered at the Rome Air Development Center and Griffiss Air Force Base in September, both to be honored and to mark the 35th anniversary of the Air Force. The event, conceived by the Center's company grade officers council, marked the first time since 1948 that the Air Force formally honored Medal of Honor holders. A parade through Rome featuring flyovers by Griffiss B-52s and KC-135s concluded the four-day event.

SENIOR LEADERSHIP

Colonel Bouchard remained RADC Commander throughout the year, and Dr Diamond entered his second year as the Center's Chief Scientist. Colonel Lawter, meanwhile, relinquished his position as Vice Commander to Colonel David C. Luke, former RADC Reliability and Compatibility Division Chief, on 1 October.

ORGANIZATION

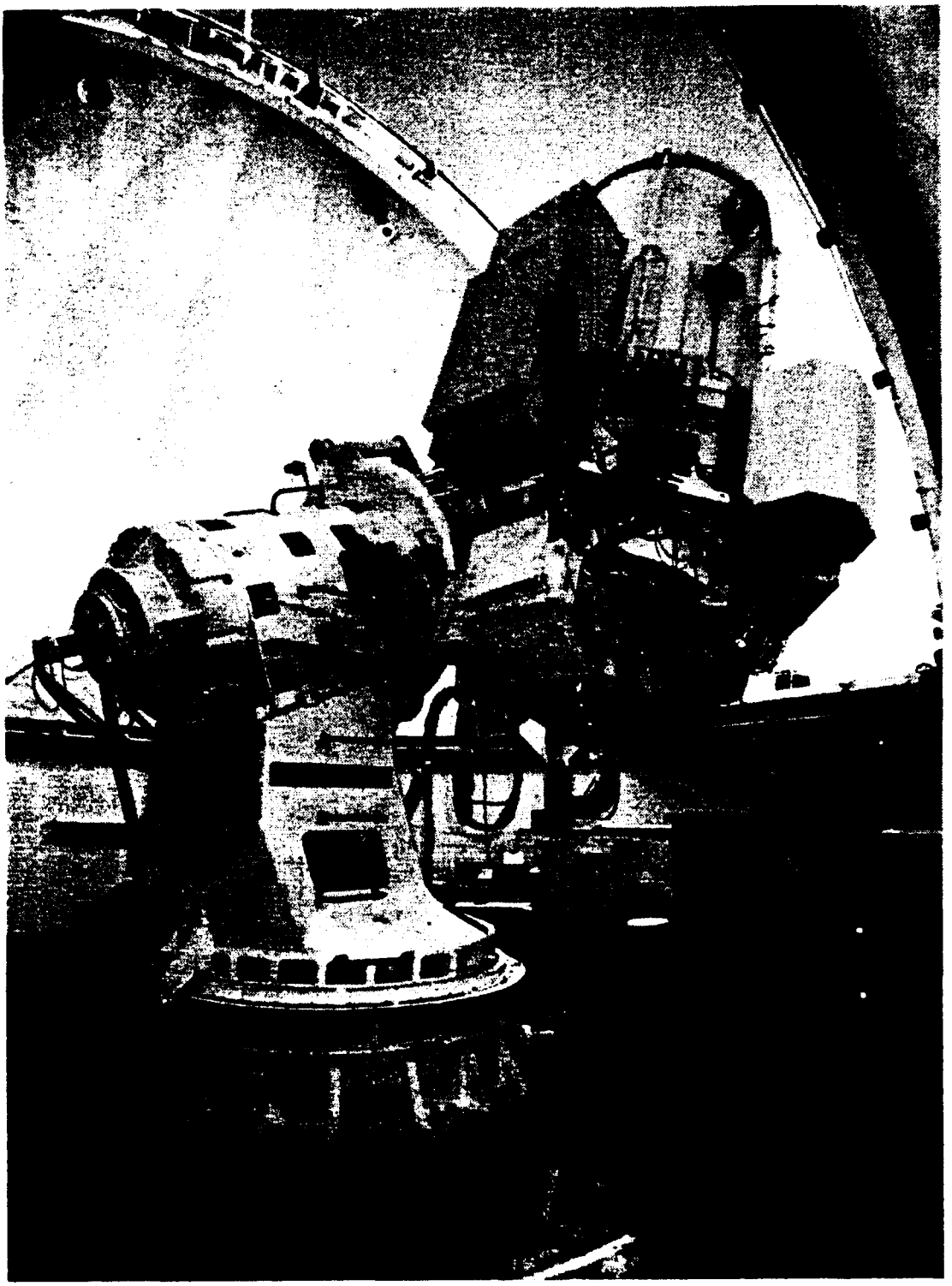
Personnel and facility changes were virtually non-existent during the year, but the Center did experience two significant structural alterations. In January, RADC established its first new Division since the 1976 disestablishment-inspired creation of "RADC East" at Hanscom. Foundation of the Command and Control (C2) Division, however, meant the end of the Center's Information Sciences Division. Two of the three branches which composed the latter became part of C2. In addition, C2 picked up some of the functions of the Communications and Control Division, renamed simply the Communications Division. Meanwhile, the Deputy for Electronic Technology, established at Hanscom right after RADC survived disestablishment, was disestablished itself. The two Divisions directly under it, Electromagnetics and Solid State Sciences, now had one less layer of organization between them and the Commander.

RESEARCH AND DEVELOPMENT ACTIVITIES

Surveillance

Surface Acoustic Wave Surface Acoustic Wave technology, under development at RADC for over a decade, was transitioned to the B-1 program. The technology enhanced the aircraft's electronic countermeasure capability.

Advanced Tactical Radar The Center awarded a contract to Sperry on 13 August to produce an advanced development model of the Advanced Tactical Radar. Relying on phased array technology, RADC envisioned the ATR to replace the aging AN/TPS-43 radar.



The AMOS 1.6m Telescope with
Compensated Imaging System

Compensated Imaging System In March, RADC technicians and contractor personnel installed the Compensated Imaging System to the 1.6m telescope at the AMOS facility in Hawaii. The CIS improved resolution of space objects by overcoming atmospheric distortion. In the photograph on the opposite page, the large boxes and jumble of wires on the left side and bottom of the upper part of the telescope comprise the CIS.

Communications

Adaptive Antenna Receive System RADC completed very-low and low frequency acceptance testing of the Adaptive Antenna Receive System (ADARS), an electronic counter countermeasures tool. The tests, performed at the Verona test facility, showed the system performed significantly better than required specifications. ADARS nulled enemy jamming systems and atmospheric distortion, permitting pilots to receive friendly transmissions.

MILSTAR RADC began work on airborne satellite communications terminals for the MILSTAR program. Although long involved in research on 20 and 44 gigahertz frequency band technology, specific application to MILSTAR for this work did not begin until now.

NEW LOOK Begun in 1975 as part of Strategic Air Command's Minimum Essential Emergency Communications Network (MEECN), Project NEW LOOK expanded to include development of high frequency, anti-jam systems for voice, data, and teletype transmissions. The Center evaluated two high frequency radio terminals during the year.

Command and Control

Knowledge Based System The first demonstration of artificial intelligence for Air Force Mission planning took place during the year. Called Knowledge-Based Systems, or KNOBS, RADC applied the system to the development of an Air Tasking Order.

Intelligence

Intelligence Handling System The Center delivered the Deployable Intelligence Data Handling System to the Rapid Deployment Joint Task Force (RDJTF). The DIDHS automated intelligence data handling and was compatible with existing intelligence communications networks. Developed and delivered on time and within budget, the DIDHS was a hodgepodge of hardware and software already in use, from an Army AN/TSQ-130 Shelter to an RADC computer program developed for the Korean Air Intelligence System. The RDJTF, based at MacDill AFB in Florida, would later become the United States Central Command.

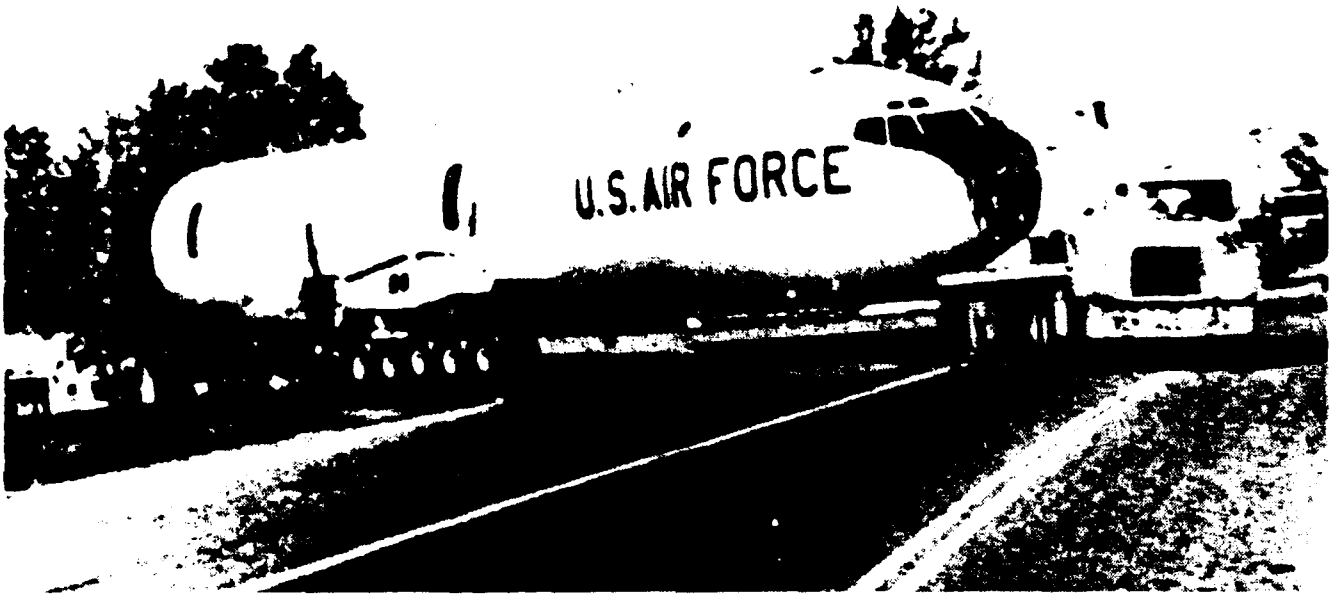
COMPASS JADE Operational tests demonstrating the COMPASS JADE signal intelligence processing system were successfully completed

from May through July in Central Europe. Designed for use by NATO, COMPASS JADE provided real-time air situation displays.

PACOM Data Systems Center In September, RADC completed a four-year effort to upgrade the Pacific Command's Intelligence Center. Additional data bases which PACOM gained access to included the Advanced Imagery Requirements Exploitation System (AIRES), the DIA On-Line System (DIAOLS), the Community On-Line Intelligence System (COINS), and data bases of SAC, Space Command, and the NSA.

Reliability and Maintainability

KC-135 to Stockbridge A fire-gutted KC-135 at Plattsburgh AFB was moved to RADC's Stockbridge facility in July. The Center had searched for such an aircraft for many years. Once it was dismantled, transported, then reassembled at the site, the aircraft was subjected to antenna pattern measurement tests by RADC scientists and engineers.



KC-135 Fuselage Departs Plattsburgh AFB

The executive branch of the United States government had its greatest impact on RADC since Harry Truman directed Watson Laboratory personnel to Griffiss back in 1950. On 16 March, President Ronald Reagan announced his hope for protection against intercontinental ballistic missiles, the "Star Wars" defense. Strategic Defense Initiative funding was destined to become, if not dominant, a major provider for RADC research. Only two weeks later, in an unrelated event, Vice President George Bush visited the Center and was briefed on several RADC technology programs.

SENIOR LEADERSHIP

Newly-promoted Brigadier General Phillippe Bouchard accepted an assignment at Air Force Systems Command, and his successor, Colonel Charles F. Stebbins, assumed command of the Center on 6 October. Colonel Stebbins, the first RADC Commander to be a graduate of the Air Force Academy, arrived from the Plans and Programs division at AFSC. The Chief Scientist post remained in the hands of Dr Diamond.

One change took place at the Vice Commander position when Colonel Alan J. Driscoll assumed the post from outgoing Colonel David Luke. Prior to accepting the position, Colonel Driscoll was head of the Center's Intelligence and Reconnaissance Division.

ORGANIZATION

Typical of the past several years, personnel levels remained stable and miscellaneous facility improvements continued. Structurally, the Center experienced minor changes within the Command and Control Division, and in May Public Affairs became a separate staff office, reporting directly to the Vice Commander. It had been under the Support Services Division.

RESEARCH AND DEVELOPMENT ACTIVITIES

Surveillance

Advanced Tracking System In conjunction with US Army Patriot missile testing, RADC integrated its Advanced Tracking System with the AN/TPS-43 radar system at Hollomon AFB, New Mexico. The June tests verified ATS automatic detection and tracking capability under operational conditions. The system was capable of storing and displaying up to 1000 tracks.

Advanced Onboard Signal Processor Demonstrated This highly reliable, high speed processor, with applications to space-based radar or communications systems, had the capability to reconfigure individual computing elements in the event of partial computer failure. In April, RADC demonstrated an experimental network of nine array computing element nodes, an integral part of AOSP development.

Anti-Radiation Missile Decoy RADC developed a lightweight, tunable magnetron which imitated the AN/TPS-43E and AN/TPS-75 radar signals. The decoy, balloon-tested at the Naval Weapons Center during the summer, would be used to attract enemy anti-radiation missiles. Project responsibility was transferred to Electronic Systems Division on 14 July.

AN/FPS-117 Radar On 29 and 30 September, RADC completed acceptance testing of the computer displays and indicator modifications on the AN/FPS-117 radar. Originally selected for the SEEK IGLOO project, the radar was also picked to replace the AN/FPS-67 radar at Berlin's Tempelhof Central airport.

Project Birdwatch RADC engineers helped install a short-range Army radar at Dover AFB in Delaware. The radar became necessary because of a perennial problem at the base -- flocks of geese flying into the flight path of landing C-5A cargo planes. The issue came to a head following a birdstrike in late January. RADC's Surveillance Division located the radar and provided technical assistance for its installation in March.

Communications

Echo I Commemorated Twenty-three years after the fact, the state of New York dedicated an historical marker at the site of the world's first satellite transmission reception. The 12 September dedication at the former RADC Floyd site annex commemorated the reflected transmission of a message from the Center's Trinidad test site, nearly 3000 miles away, to Floyd.

MILSTAR Travelling Wave Tube RADC developed and demonstrated a 43.5 to 45.5 gigahertz travelling wave tube for the MILSTAR satellite system. The TWT development had the potential to substantially improve satellite communications at a reduced cost.

Fiber Optics Communications Link In July, an RADC-managed program reached fruition when the Intrusion Resistant Fiber Optics Communication Link Test Bed was installed at Andrews AFB. After successful completion of tests, two of the links were activated in September to carry live traffic. Besides managing the program, RADC also evaluated the system and contributed to vast improvements in some of its components.

Module Developed for Automatic Antenna Alignment RADC developed, fabricated, and tested an automatic troposcatter antenna alignment module. The device sampled level and fade rates of incoming signals and adjusted antenna alignment accordingly.

Air Force Academy Signal Processing Lab The Communications, Intelligence and Reconnaissance, and Reliability and Compatibility Division all contributed to development of a new signal processing laboratory for the US Air Force Academy.

Command and Control

USAFE Warrior Preparation Center As part of the on-going PAVE MOVER Program, major components of the VAX 11/780 computer arrived at the USAFE Warrior Preparation Center at Ramstein AB, Germany, for installation. RADC bore responsibility for the upgrade of the WPC.

Intelligence

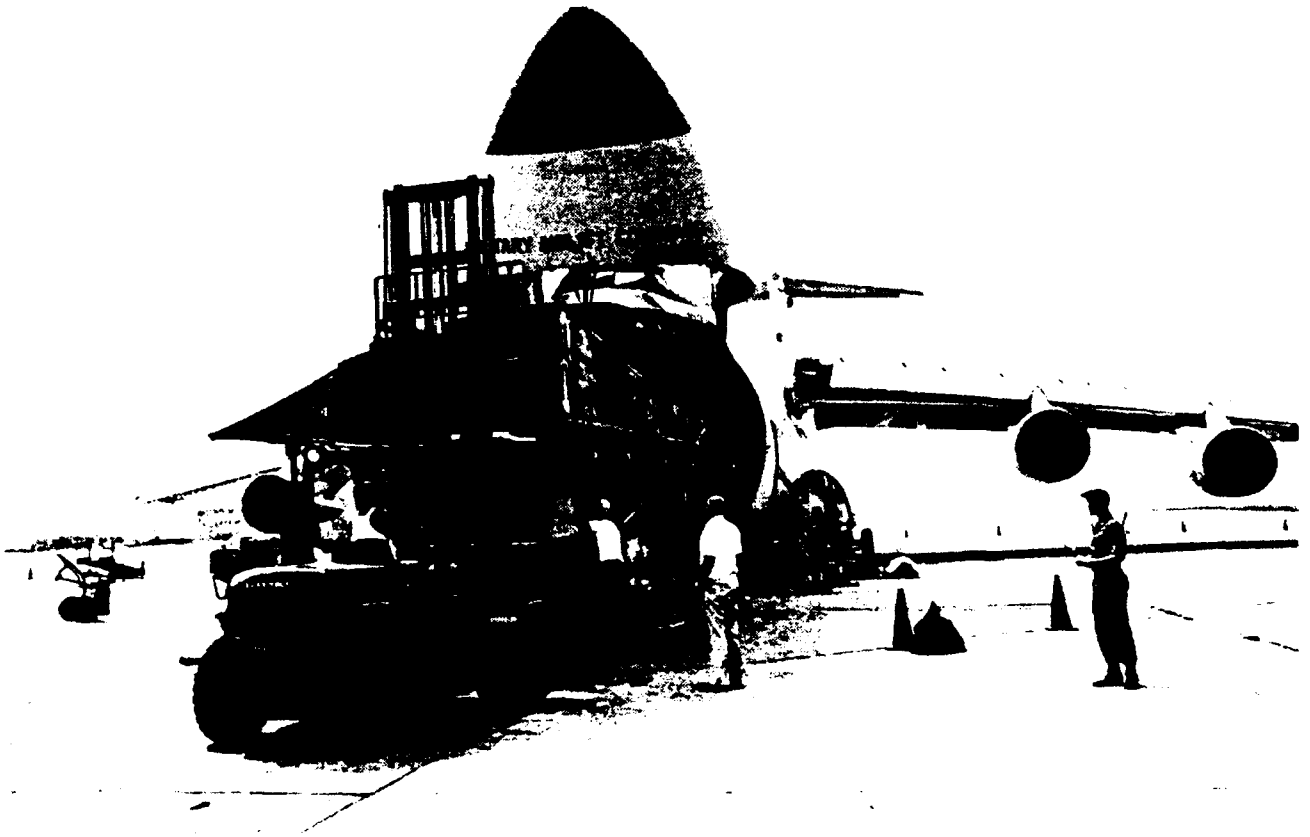
Data Handling/Recording System RADC developed a mobile data handling and recording system to enable ground and air forces to detect, evade, and destroy enemy ground targets. Transported in a large van, the rapidly deployable DH/RS used infrared sensor imagery from reconnaissance aircraft, which then fed into an automatic target detection and classification system. It was delivered in April.

JUKEBOX Fabrication continued on the On-Line Digital Disk (JUKEBOX), an automated mass data storage and retrieval system employing digital optical disks. Built for NASA, it would pass acceptance tests the following year.

CAVS Installation at two Defense Mapping Agency locations completed the COBOL Automated Verification System program. CAVS was part of an ongoing RADC effort to develop automated testing tools for high order computer languages.

Reliability and Maintainability

Stockbridge B-52 Saves the Day -- and $13 Million The Air Force realized a substantial savings when a serviceable left wing from RADC's Stockbridge site was removed and delivered to Mather AFB, California. A ground refueling operation there caused a B-52's wing to fracture -- RADC's pedestal bird had the only serviceable "G" model wing in the Air Force inventory. If not for RADC's B-52, the Air Force would have been required to purchase a new wing from the Boeing Corporation, at a cost of at least $13 million. RADC replaced its missing wing with a "D" model from Davis-Monthan AFB in Arizona. To provide for accurate antenna measurement testing, RADC reconfigured the dissimilar "D" wing to approximate its predecessor.



RADC Receives its New "D" Wing

Edward "Pete" Aldridge, then Undersecretary of the Air Force, praised various RADC programs in a visit here 23 March. Aldridge, later named Secretary of the Air Force, was the highest-ranking Air Force official to visit the Center since its inception 33 years before.

SENIOR LEADERSHIP

After only one year as Center Commander, Colonel Stebbins moved on to a position at Air Force Systems Command, where he would be notified two months later of his selection for promotion to Brigadier General. Colonel Carl G. O'Berry, a former enlisted communications specialist, took over the reins of command at the Center on 11 October 1984. Among his many assignments, Colonel O'Berry served as commander of the 2019th Communications Squadron at Griffiss AFB. Prior to coming to RADC, the Colonel worked at AFSC.

The RADC Vice Commander position experienced much activity during 1984. No less than four people held, or were supposed to hold, that position. First, incumbent Vice Commander Colonel Alan Driscoll departed RADC early in May for a position at Air Force Systems Command. Colonel Robert L. Janzen, RADC Chief of Operations, assumed the role of Vice Commander on 14 May while awaiting AFSC's pick for the slot. Initially, Colonel-selectee William E. Gernert was that choice, but the position subsequently went to Colonel William E. O'Brien on 4 September. Prior to arriving at the Center, Colonel O'Brien directed the Commander's Action Group at AFSC.

In this year marked by great turnover, Dr Fred Diamond remained a constant, completing his third year as Chief Scientist.

ORGANIZATION

Mission On 15 November 1984, the RADC mission changed for the first time since coming under the wing of Electronic Systems Division back in 1975. Unlike those mission changes, which essentially placed the Center under ESD control, in 1984 RADC's technical mission area responsibilities were altered. It was still C3I, but with a slightly different focus. In 1983, "The principal technical mission areas (were) communications, electromagnetic guidance and control, surveillance of ground and aerospace objects, intelligence data collection and handling, information system technology and propogation, solid state sciences, electromagnetics,

electronic warfare and electronic reliability, maintainability, compatibility." In November, a less-wordy but equally broad mission statement called for technical competence in the areas of "communications, command and control, battle management, information processing, surveillance sensors, intelligence data collection and handling, solid-state sciences, electromagnetics and propogation, and electronic maintainability and compatibility."

Structure Like the old saying, 'where the head goes the body must follow,' a change in an organization's mission is often followed by structural alterations. RADC was not an exception -- but would wait until the following year before those changes would be implemented.

Personnel The Center experienced a slight dip in assigned personnel during the year, dropping from 1339 to 1276. Civilian losses accounted for the majority of the decrease. Authorizations also fell off in 1984.

Officers from the RADC Company Grade Officer's Council dressed up as Santa Claus to cheer about 90 children at the Oneida County Head Start Program. The assist for old St. Nick took place 19 and 20 December.

Facilities Construction of a battle management laboratory culminated in a 16 July dedication presided over by Lieutenant General James Stansberry, Commander of Electronic Systems Division. The lab integrated hardware and software configurations to demonstrate a realistic environment for testing RADC's C3I systems. Work had begun in the summer of 1983.

RESEARCH AND DEVELOPMENT ACTIVITIES

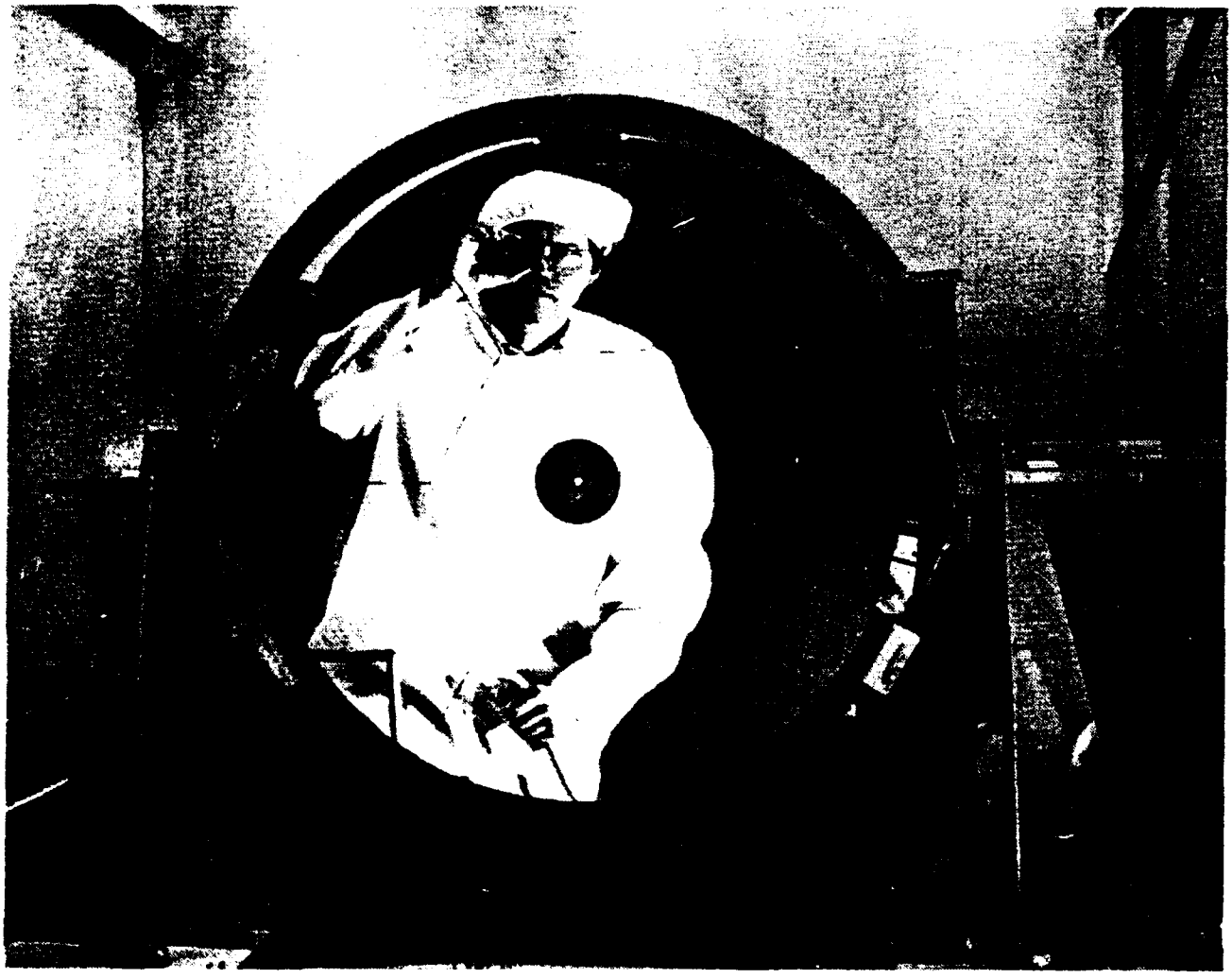
Surveillance

AMOS Infrared Imaging Sensor RADC patent #3,902,066 provided the technology for construction of an infrared imaging sensor using a platinum silicide photodiode focal plane array. Personnel from "RADC East" and AVCO Corporation installed the sensor at the Center's AMOS facility in Hawaii.

Drug War Support Responding to a United States Custom Service request, RADC provided contractual and technical support in obtaining a low-cost, short-range, ground-based radar. The Center responded by modifying a radar system RADC originally developed for a high-velocity, high-altitude missile threat. RADC demonstrated the system to the USCS in August.

Advanced Tactical Radar Initiated to replace the venerable TPS-43 radar, the Advanced Tactical Radar was canceled in December. The original $24 million estimated development cost had risen to $91 million.

LAMP Design Phase Completed RADC completed the design phase for the LODE Advanced Mirror Program. Mirror fabrication would be completed in 1989. The program's goals included the development and demonstration of large, high performance mirror optics with application to a space-based laser system. LAMP was actually seven separate mirrors operating in concert to act as one. RADC and its contractor built it in this manner so it would be scalable in later years to even larger sizes required for space-based lasers. LODE (Large Optics Demonstration Experiment) was RADC's large optics program prior to LAMP. LAMP, in turn, would not be an end in itself, but a transition to an even larger mirror design begun in 1990.



LODE Advanced Mirror Program

Communications

Digital Channel Efficiency Model RADC demonstrated the Digital Channel Efficiency Model at four separate locations. The

DCEM made possible a substantial increase in the channel capacity of Department of Defense digital transmission links without substantially modifying the existing equipment. Agencies interested in applying the DCEM to their communications channels included the Army, Air Force, and Defense Communications Agency.

AUTOVON Network Controllers In October, the Center transitioned to the Sacramento Air Logistics Center an AUTOVON Network Control System for use overseas. The ANCS provided semi-automated assistance to controllers and technicians at AUTOVON switching sites. Field testing of the system had been completed in June at Vaihingen and Feldberg, Germany, where it proved extremely effective.

Command and Control

CRONUS Distributed Operating System RADC engineers implemented a prototype of the CRONUS distributed operating system. CRONUS tied together several different computer systems in such a way that they appeared to be one to the user. CRONUS represented a benchmark in distributed operating systems.

TISSS Initiated Funded by the Very High Speed Integrated Circuit program, the Center began work on the Tester Independent Support Software System. TISSS was envisioned to automate the burden of preparing electrical test specifications and generating test programs for automated microcircuit test equipment. Efforts under TISSS continue today.

Reliability and Maintainability

Space Shuttle Integrated Circuit Failure A failure analysis of certain space shuttle integrated circuits by the Center's Reliability and Maintainability Division revealed the man-made cause of the failures.

High Purity Quartz Motorola Corporation employed RADC-developed techniques to produce quartz crystals containing only 200 parts per billion of aluminum, a significant decrease of aluminum impurities previously obtained. RADC began working on quartz purification methods about five years earlier.

AWARDS

Air Force Outstanding Unit Award RADC received its sixth and final AFOUA on 19 July. The accompanying citation recognized the Center's contributions in developing a secure voice terminal, a fiber optics remoting system, and the development of a radar capable of tracking enemy tanks and armored vehicles 100 miles behind front lines. The award covered the years 1982 and 1983.

The Rome Air Development Center's first annual Commander's Cup Chili Cook-Off took place in October. This culinary delight, sponsored by the Company Grade Officer's Council, drew 61 contestants. Helen Singh of the Plans and Programs Division walked away with the Commanders Cup, and Fred Moulter won the "People's Choice" prize. The Center's Operation's Division earned the "Best Theme Decorations" award. One of the most popular Center-wide events, the cook-off regularly draws over 50 entrants each year, and in 1991 nearly 250 chili connoisseurs enjoyed the feast.

SENIOR LEADERSHIP

After experiencing a high degree of change the preceding year, RADC senior leadership positions remained the same throughout 1985.

ORGANIZATION

Personnel The Center rebounded from last year's drop in assigned personnel, with over twenty more people in the RADC workforce for 1985. Most of the new hires were civilian. Overall authorizations for the Center remained nearly constant.

The enlisted corps, however, continued a ten-year trend by losing five more personnel. The seventy airmen and non-commissioned officers working for the Center at the end of 1985 represented the lowest total since 1975 -- when the enlisted force from "RADC East" were not yet officially on the RADC rolls. The following is a breakdown of the enlisted strength since the attempted disestablishment.

Date	Personnel	Date	Personnel
31 Dec 75	60	30 Sep 81	77
31 Dec 76	89	30 Sep 82	75
31 Dec 77	88	30 Sep 83	84
31 Dec 78	87	31 Sep 84	75
30 Sep 79	87	30 Sep 85	70
30 Sep 80	77		

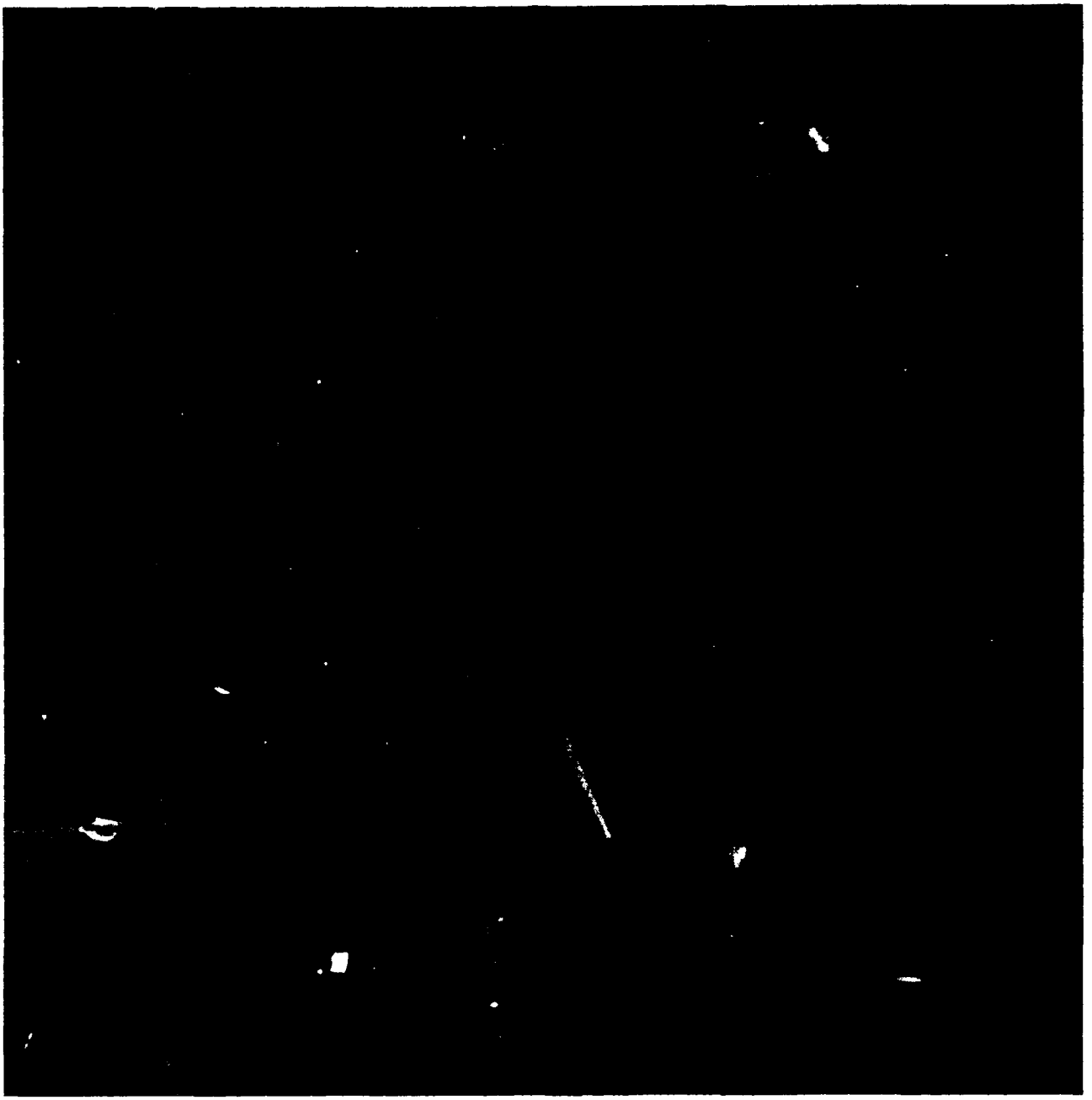
Facilities RADC dedicated a speech processing laboratory in April. Housing computers, array processors, and recording and analysis equipment, the facility enabled engineers to test and evaluate speech processing hardware and software before they were deployed for Air Force operations.

Structure Several minor realignments took place throughout the first part of the year, but the Center underwent a major structural reorganization in October. First, the Plans Office merged with some elements of the existing Operations Division to form the Plans and Programs Division. The Operations Division then picked up several of the staff agencies which previously had belonged to no separate division. The move was partly to consoli-

date the number of support functions under one division, and partly to lessen the number of individual offices reporting directly to the Commander.

RESEARCH AND DEVELOPMENT ACTIVITIES

Surveillance



Low-Powered Laser Beamed from AMOS

Shuttle/Sounding Rocket Experiments In the High Precision Tracking Experiment and the Atmospheric Compensation Test, RADC demonstrated the capability to track the space shuttle or sounding rockets using low-powered lasers. Both were conducted from RADC's AMOS facility in Hawaii.

Minuteman Missile Tracked Using a platinum silicide infrared camera, the Center tracked a Minuteman missile after launch from Vandenberg AFB in California. The camera employed an infrared focal plane array, an RADC invention.

Dual Band Array for Advanced Airborne Surveillance Radar Under contract to RADC, Boeing built a laboratory demonstration model of an array antenna. The antenna was unique because it operated at two frequencies simultaneously.

Communications

Monolithic Microwave Integrated Circuit RADC demonstrated the use of monolithic microwave integrated circuit (MMIC) technology for a phased array antenna with application to MILSTAR airborne terminals.

Light Reaction Communication System Built for US Central Command, RADC designed and tested the highly-mobile Light Reaction Communications System to provide USCENTCOM with communications capability to and among its deployed forces. The system provided secure voice, data, and facsimile communications using off-the-shelf equipment.

Intelligence

Launch Assessment Expert System RADC completed the Space Foreign Launch Assessment Expert System prototype. Part of the Center's effort to utilize artificial intelligence, the prototype demonstrated the technical feasibility of differentiating between actual or potential threats and benign launch activity.

More Intelligence for USCENTCOM In August, RADC delivered the Intelligence Communications Processing Shelter for the United States Central Command. Among other functions, the ICPS served as a back-up for the RADC-developed Deployable Intelligence Data Handling System, first delivered in 1982.

Command and Control

Mobile Battle Management Laboratory RADC developed a Mobile Battle Management Laboratory demonstrating capability. The MBML was equipped with militarized computers, color graphic displays, and support equipment. Pictured below is an MBML with a satellite communications terminal to provide for communication with RADC's Battle Information Management Laboratory.

Mobile Battle Management Laboratory

Other

Hound Dogs Two RADC "Hound Dog" air-to-ground missiles (AGM 28) stored at the Center's Stockbridge site became an official part of Air Force history in May. The world's first nuclear-capable cruise missile, the Air force removed the Hound Dog from active service in 1979. Very few remained intact by 1985, when the 8th Air Force museum went searching for Hound Dogs for its collection. RADC agreed to part with its missiles, used for antenna measurement testing since the 1960s, since it no longer needed the missiles.

More Pure Quartz RADC grew crystal quartz to be used in precision clocks and timing devices. The purity of the quartz was such that timing circuits using it would lose no more than one second every 275 years.

Where SDI provided a catalyst to much of the Center's space-related efforts, the Air Defense Initiative took up the issue of defending the United States from cruise and stealth missiles and aircraft, and other low-observable, air-breathing threats. Primarily from its Surveillance, Communications, and Command and Control Divisions, RADC had long studied the issues surrounding these types of threats, but the individual programs now became an integrated effort under the umbrella of ADI.

SENIOR LEADERSHIP

RADC Commander Carl O'Berry earned a promotion to Brigadier General 30 May and within a week was settling into a new position at Headquarters Air Force in Washington DC. His promotion continued a tradition at the Center; of the seventeen men to serve as RADC Commander to that point, fourteen reached the grade of general officer. On July 14 Colonel Charles E. Franklin assumed command of the Center after arriving from Electronic Systems Division, where he had served as Deputy Commander for Joint STARS. The Alabama native had also served in various capacities for development of the B-1 and A-10 aircraft.

Colonel William O'Brien completed his second year as Center Vice-Commander, then marched off to command the Armament Laboratory at Eglin AFB, Florida on 31 August. Colonel Richard J Stachurski, a Little Neck, New York native, replaced Colonel O'Brien 23 October. Prior to coming to RADC, he commanded the 487th Tactical Missile Wing at Comiso Air Station, Italy.

The final senior leadership post, Chief Scientist, remained filled by Dr Diamond throughout the year.

ORGANIZATION

The Rome Air Development Center marked its thirty-fifth anniversary during the year with a wide variety of events. The renaming of the microcircuit reliability lab was but one (see next page), and the Center congratulated itself on many jobs well done with its eleventh annual heritage Day Celebration 19 and 20 June. In addition, Oneida County declared 20 June as "RADC Day in Oneida County." Also on 20 June, former commanders made up a full house at one of the Heritage Day events, a cake cutting ceremony.

(L to R) Commanders Larsen, Toomay, Mathis, Stebbins, and O'Berry Cut the Cake

Personnel and Facilities

Significant manning level changes did not occur during the year, and Center facilities, like years past, continued to receive funds for general improvement.

Naresky Reliability Laboratory RADC renamed its microcircuit reliability lab on June 19 as the Joseph J. Naresky Reliability Laboratory. Naresky, a transfer from Watson Labs back in 1951, headed RADC's Reliability and Compatibility Division before retiring in 1979. He died unexpectedly in 1982. Work at the Lab during the year included the development of reliability standards for very high speed integrated circuits. VHSICs used interconnected elements as small as 1/100th the width of a human hair.

Structure

RADC underwent no major structure alterations during the year, although on 20 August the Center redesignated its mission and operations divisions as "Directorates," ostensibly to delineate a

higher level of responsibility. The 35-year old organization had used the term "Division" since late 1963. In a case of what goes around comes around, before then the different RADC organizational mission areas were referred to as, you guessed it, "Directorates."

RESEARCH AND DEVELOPMENT ACTIVITIES

Surveillance

Space Based Radar RADC developed a multi-beam feed assembly for space-fed radar lenses. In future space-based radar systems, the new lens would improve electronic counter counter-measures.

AMOS In August, technicians at the AMOS facility tracked a US Navy Trident missile. Multispectral images of the deployment and mid-course phases were studied.

Communications

Meteor Burst Communications RADC efforts helped establish a diagnostic link between Sondestrom and Thule Air Bases in Greenland using meteor burst communications. The link, accomplished for the Alaskan Air Command, established the viability of meteor burst communications. MBC was to be used for emergency warning messages.

Strategic C3 Experiment Using packet switched networking, RADC demonstrated post-nuclear survivability of distributed communications and processing in the Strategic C3 Experiment.

Griffiss' 485th Helps Out The 485th Engineering Installation Group helped out its fellow tenant unit by installing communications antennas on Building 3 at Griffiss and on a 250-foot tower at the Center's Verona test site. The Group's eight-man team saved RADC about $3,000 and three weeks time if the Center would have had to hire a private contractor. RADC required the antennas for testing a new radio system.

Command and Control

"The Computer Chronicles" The Public Broadcasting System spent 21 March taping at RADC's Battle Management Laboratory for a PBS series entitled "The Computer Chronicles." PBS interviewed Center researchers for the two-part program. Portions of the interviews were included in the segment "The Government Role in High Technology Research and Development."

Intelligence

SAC IDHS RADC developed an intelligence data handling system for the Strategic Air Command. The computer data processor allowed SAC to process greater amounts of data in a shorter time.

Reliability and Maintainability

Stockbridge Gets C-130 After a month of disassembly work, on 3 August crews hoisted a C-130 fuselage onto a pedestal at RADC's Stockbridge site. Performed at the request of the Aeronautical Systems Division, the subsequent antenna measurement testing supported Combat Talon II, a program involving special operations around the globe.

C-130 Arrives at Stockbridge

Other

MIRACL In tests at New Mexico's White Sands Missile Range, RADC used its platinum silicide infrared camera to determine the uniformity and density of the Mid Infrared Advanced Chemical Laser. MIRACL was being tested as a ground-based system for SDI.

Heavy Metal No, not the obnoxiously loud, wall-crumbling variety. Instead, RADC developed new techniques which permitted production of larger quantities of Heavy Metal Fluoride Glass. HMFG was used for more efficient fiber optic and photonic system.

During the year, the Center participated in a number of military exercises, to include Tactical Air Command's Blue Flag and Green Flag. The Center also took part in Team Spirit, the annual US-Korean exercise. Green Flag, held at Nellis AFB in Nevada, tested electronic combat capability, while the Hurlburt Field-based Blue Flag was a command and control readiness exercise. Over the years, RADC tested and demonstrated equipment, aided crews in operation of RADC-developed systems, and provided general support to a wide spectrum of world-wide exercises.

SENIOR LEADERSHIP

Only the Vice Commander position changed hands during 1987, but the announcement of a promotion set the stage for another change the following year.

Colonel Stachurski, Vice Commander for slightly over a year, retired on 28 December, opening up the Vice Commander position for Colonel Robert L. Rhame to assume two days later. Unlike recent history, Colonel Rhame's selection for the Vice Commander position reflected an internal advancement. Colonel Rhame's last assignment was as Communications Directorate Chief, a position he had received only the year before. Two weeks earlier on 15 December, Center Commander Colonel Charles Franklin received notification of his impending promotion to Brigadier General, setting the stage for announcement of a new Commander sometime in 1988. Meanwhile, Dr Diamond completed his sixth year as RADC Chief Scientist.

ORGANIZATION

Personnel and Facilities

No significant change.

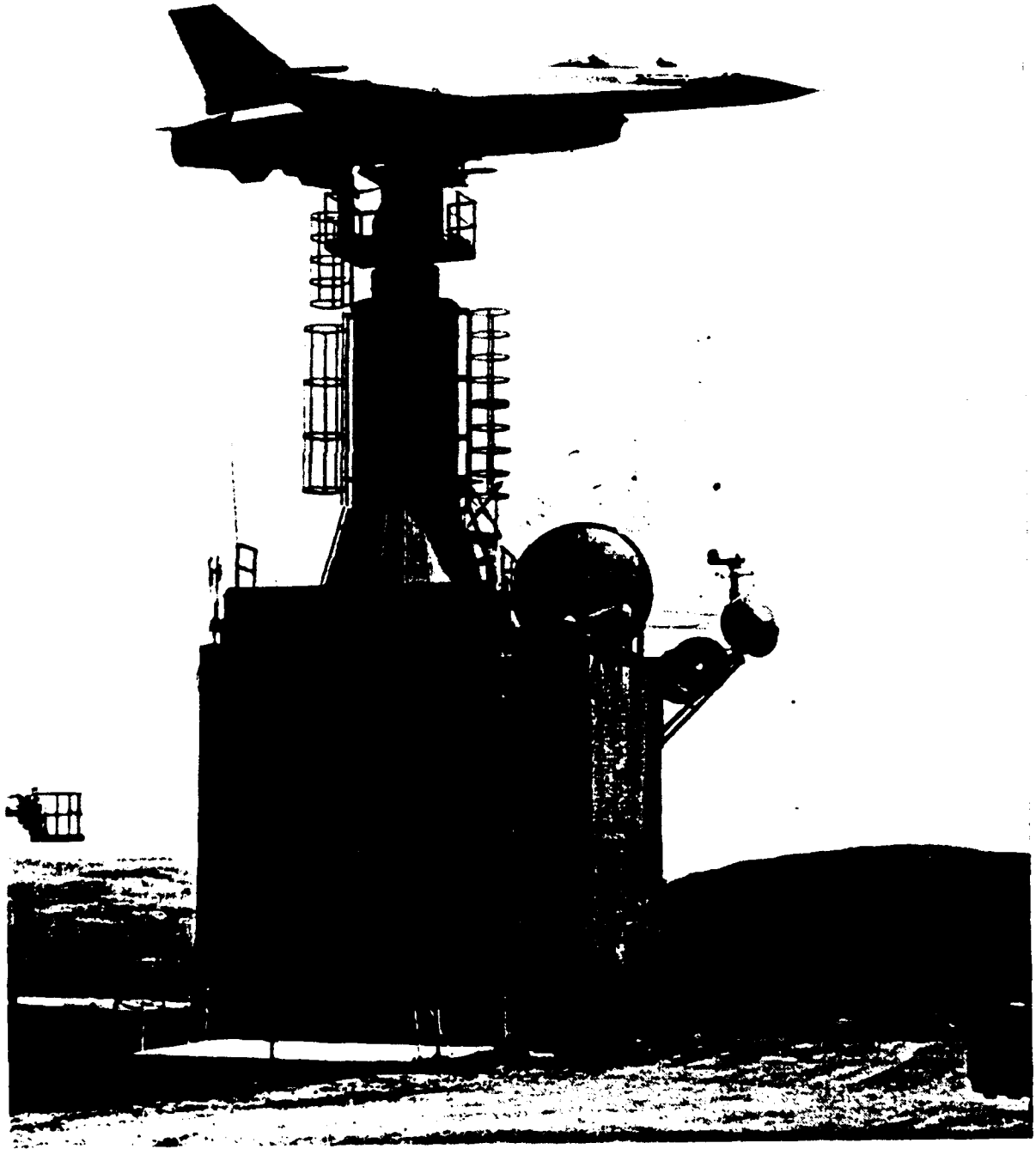
Structure

Augmenting the typical minor structure changes which took place during the year were two major additions to RADC's organization. Having been designated the lead laboratory for photonics, and having built a photonics lab and staffed it, RADC added a Photonics Directorate responsible for developing new photonic materials, devices, and processes. The addition brought to eight the number of Center mission directorates.

The Center also increased its support directorates. RADC formed the Information Resources Management Office to manage computer-related issues. Previously, this function had primarily been controlled by the Comptroller.

RESEARCH AND DEVELOPMENT ACTIVITIES

Surveillance



Pedestal-Mounted F-16 at Newport

F-16 Radar Warning Receiver At the Newport site, RADC completed the F-16 Radar Warning Receiver Competition Program. The Center's efforts provided direction finding performance data to the RWR Program Office.

SATKA Under the Surveillance, Acquisition, Tracking, and Kill Assessment Experiment, RADC developed sophisticated optics for attachment to telescopes. Sponsored by the Strategic Defense Initiative Organization, the SATKA work answered the requirement for tracking objects in space.

Beam Director/Tracker Installed The newly installed Beam Director/Tracker at RADC's AMOS facility provided space object illumination and range information on selected targets.

Communications

MILSTAR Hybrid Scan Antenna Tested Using the C-130 it received only the year before, RADC tested and evaluated a developmental model extremely high frequency Hybrid Scan Antenna System for the MILSTAR program. It was the first evaluation of this technology on a full-size aircraft.

EHF Antenna Developed Under RADC sponsorship, General Electric produced an advanced development model of the EHF Satellite Adaptive Array Processor. Conceptualized in 1961, the antenna distinguished between authorized and unauthorized users by the direction from which the signal arrived. The goal remained elusive until RADC/GE demonstrated the ESAAP in September.

Team Spirit James Findley from the Center's Communications Directorate headed an 18-member team tasked with disrupting US-South Korean communications networks during the annual Team Spirit exercise. The goal of the effort was to test Allied communication techniques to overcome the jamming. Findley, in his third year at the exercise, was caught in the act by the authorities -- but several members of his team eluded capture.

Command and Control

Green Flag During a six week deployment, RADC's mobile Battle Management Decision Aid -- a van stuffed full of computers and software -- provided enhanced electronic warfare strategies during the Green Flag exercise at Nellis AFB, Nevada. "Green Flag '87" concentrated on the use of electronic combat to aid in the undetected penetration of enemy air space. The Center's efforts aided crews from the 9th and 12th Air Forces, and the 65 Air Division.

CRONUS RADC developed the CRONUS Simulated Battle Management Exercise. CRONUS, a distributed processing computer system, showed enhanced survivability of battle management systems through decentralization.

Automated Measurement System RADC completed the first automated tool to assess the quality of software programs written in FORTRAN.

Ada Compiler The Center performed planning, requirements, design, code, and test program analyses on the Ada Integrated Environment compiler system. The completed compiler was the first capable of maintaining thruput and optimization strategies for the larger Ada programs.

Intelligence

Terrain Perspective Viewer The terrain perspective viewer became the first product delivered under the Cartographic Applications for Tactical and Strategic Systems program. The Center's Intelligence and Reconnaissance Directorate used terrain elevation data compiled by the Defense Mapping Agency to produce a computer-generated view of terrain anywhere in the world from ground level up to 100,000 feet.

Other

Niobium Superconductivity The Center performed superconductivity experiments on niobium to provide data on thin-film superconductors.

The RADC volleyball team won its seventh straight intramural volleyball championship in May. Unfortunately, the Center finished the season with "only" a 14-2 mark, and had its winning streak, spanning five seasons, halted just short of 100 consecutive matches. RADC, and later Rome Laboratory, would complete two more undefeated seasons comprising over 50 straight contests before losing another match in 1991. In the last fourteen years, RADC/Rome Lab won the base championship twelve times and finished second twice, including the current run of ten straight base titles. The Center also won base championships in 1972 and 1974.

SENIOR LEADERSHIP

After receiving word the previous year of his upcoming promotion, Colonel Franklin accepted the directorship of the Advanced Medium Range Air-to-Air Missile program at Eglin AFB. Colonel Raymond A. Shulstad, formerly of the Aeronautical Systems Division in Ohio, took command of the Center 12 July. Colonel Franklin moved on to his new position the following day.

Dr Diamond continued at his position, and at the end of the year passed Harry Davis as the second-longest tenured Chief Scientist in Center history. Davis spent seven and a half years at the post. Vice Commander Colonel Robert Rhame also continued his duties.

ORGANIZATION

Personnel and Facilities

The Center's manpower dropped significantly from 1283 at the end of 1987 to 1203 a year later. The majority of reductions were civilian personnel. Many of the civilian reductions took place 30 December, when sixteen RADC employees, accounting for 567 years of federal service, retired. The enlisted manning also continued to fall, down to 56 assigned. RADC continued to occupy the same buildings at Griffiss, but upgrades continued, to include completion of the video teleconferencing center. The VTC was capable of transmitting and receiving classified and unclassified video, audio, and graphic signals. Another significant improvement to RADC facilities occurred in the Fall, when a $1.8 million renovation project at the Center's Newport site reached completion.

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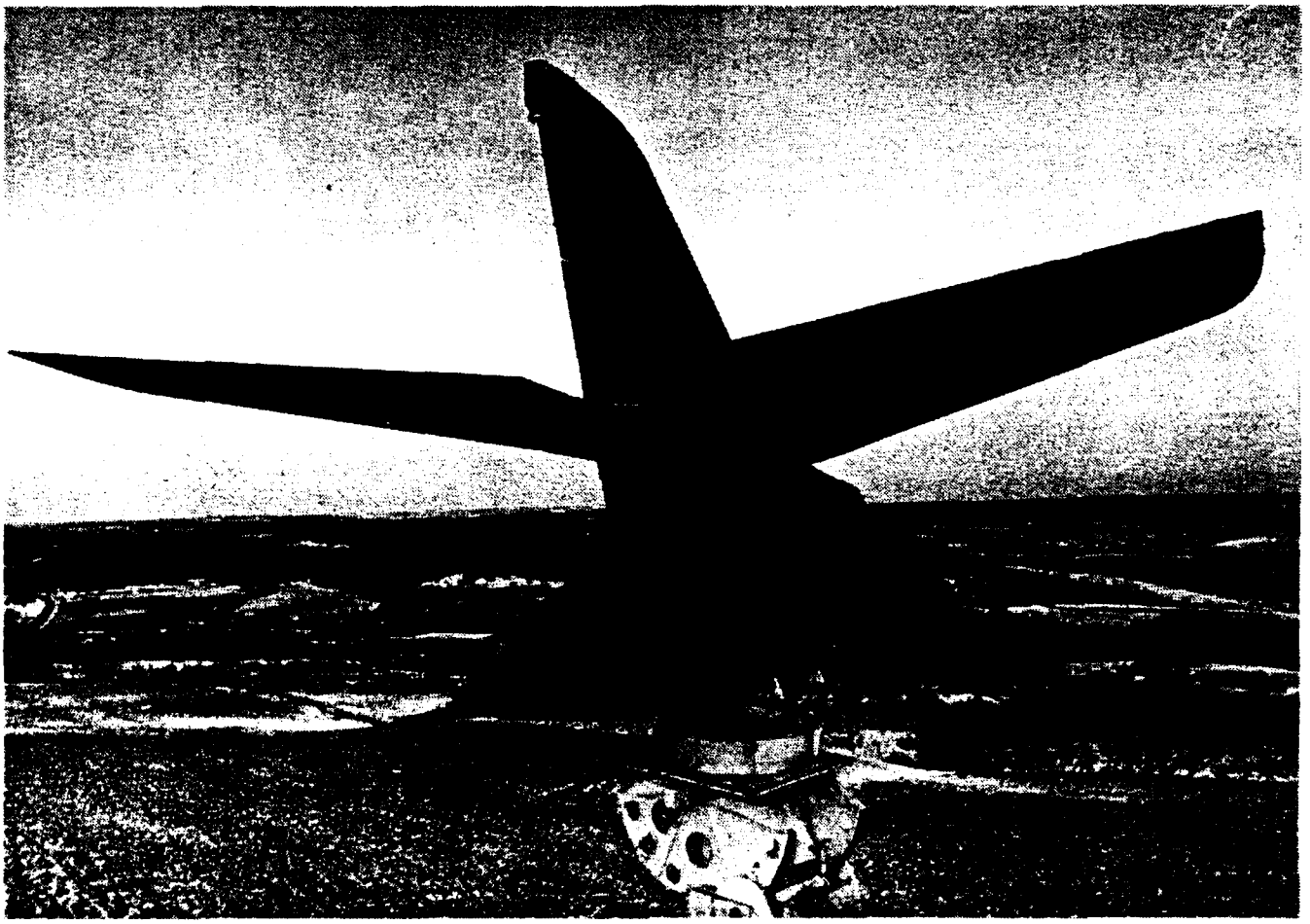
Reliability and Maintainability

B-1 To Stockbridge; Tail Tested at Newport Beginning in February and lasting through July, RADC conducted antenna measurements on the tail section of a B-1 bomber. The tests provided data for the B-1B's Tail Warning Function (ALQ-161) program. More tests on the B-1's tail section would be conducted in 1989. Meanwhile, construction of facilities needed to accommodate the aircraft's airframe at Stockbridge continued.



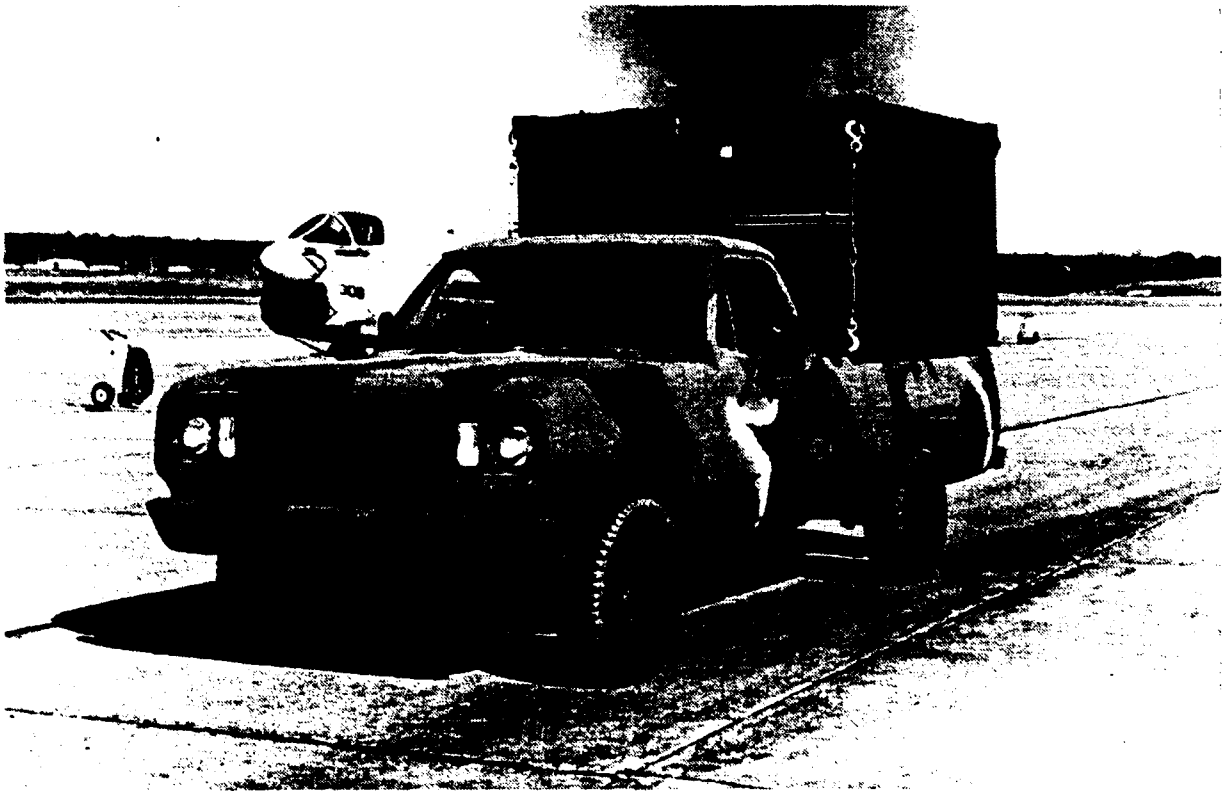
B-1 Tail Section at Newport

Command and Control

Red Flag On 17 November, RADC turned over the Red Flag Scheduling System to Tactical Air Command. An "expert system," the RFSS enabled a scheduler to automatically build an error-free Red Flag schedule with constraints, such as unit availability and exercise requirements, met. In addition, as changes to the schedule occurred, the RFSS ensured constraints were not violated and units continued to meet training requirements. With the RFSS,

scheduling time would be reduced from three days to half an hour.

Korean Mobile C2 Processor Using primarily off-the-shelf technology, RADC delivered the Korean Mobile Sub-Host Processor. It served as an intermediary between the Hardened Tactical Air Control Center and its deployed units.



Korean Mobile Sub-Host Processor

Other

More and More Crystal Scientists at the Center's Solid State Sciences Directorate successfully grew a crystal of barium titanate, a photonic material with applications to electro-optic switching and modulation. Later in the year, Center personnel grew single crystal bismith silicate, also for use in optical systems.

Heavy Metal Breakthrough RADC developed a heavy metal fluoride glass which became partially or completely crystallized (while maintaining transparency in the visible and infrared range) when heat treated. Potential applications included optical devices for high speed computing, switching, and multiplexing.

Fiber Optic Guided Missile The US Army Missile Command picked RADC's 244x400 platinum silicide infrared focal plane array as the primary "seeker" for use in its FOG-M program. High sensitivity, low cost, and outstanding reliability were the motivating factors.

Many of RADC's milestones during 1989 supported two programs coming under increasing scrutiny in Congress -- the Air Defense Initiative and Strategic Defense Initiative. Congressional funding for SDI programs was destined to become more restricted; support to RADC's ADI programs was slashed by $15 million in 1990. Despite the looming funding problems, the Center continued to make significant advances in technologies whose primary application was space and air defense.

SENIOR LEADERSHIP

Colonels Shulstad and Rhame, and Dr Diamond continued duties as Commander, Vice Commander, and Chief Scientist, respectively.

ORGANIZATION

Personnel and Facilities

The Center's manning rebounded from last year's drop, with 1243 personnel on the RADC rolls.

The Photonics Laboratory moved from Building 3 to Building 104. Full operation of the lab was restored by the end of July, and officially dedicated by AFSC Commander General Bernard P. Randolph in October. In another facility related development, the Center completed a $1.25 million expansion on its Command and Control Lab. Constructed in 1985, the renovation added 9000 square feet to the original 5000 square-foot lab.

RESEARCH AND DEVELOPMENT ACTIVITIES

Surveillance

Transmit/Receive Module Testing RADC conducted a multitude of experiments on its T/R modules for space-based radar, including life-cycle and high and low temperature tests. Performance of the T/Rs exceeded that required for SDI.

AMOS Tracks F-18s The Center's AMOS facility gathered infrared signatures and data sets from F-18 aircraft in support of the Air Defense Initiative. The data was obtained at ranges from 50 to 150 miles on a single plane and from 16,000 to 25,000 feet on two aircraft in formation.

Starmate In spite of technical problems associated with the targets, equipment at RADC's AMOS site acquired, tracked, and obtained data on two SDI-related Starmate missions. Later in the year, the Center obtained similar visible and infrared data on a Navy Trident C4 missile launched from a submarine.

Photonic Signal Processor RADC developed a photonic signal processor to provide enhanced anti-jam capability for radar. The

new processor worked by improving antenna sidelobe cancellation.

Multispectral Fusion Tracker Installed in RADC's Surveillance Lab the previous year, the Multispectral Fusion Tracker received improvements in 1989 ranging from expanded sensor suite selectability to improved handling capability for more complex fusion algorithms. Multispectral fusion was the process of combining data from different detection sources into one display.

SHARP RADC conceptualized an ultra-wideband radar called the Super High Accuracy/Resolution Processing radar. Its primary feature was the ability to scan long ranges while overcoming various jamming techniques, and avoid attracting anti-radiation missiles.

Communications

EHF Airborne Radio RADC produced an advanced development model of an extremely high frequency air-to-air radio for the Wright Research and Development Center. The radio's primary advantage over other models was its low probability of communications interception.

Command and Control

Blue Flag and TEMPLAR Tactical Air Command tested the Tactical Expert Mission Planner, developed by RADC, at its Blue Flag exercises in January. TEMPLAR demonstrated the use of artificial intelligence for automating of air tasking orders. During the exercise, TEMPLAR cut the time necessary to generate an ATO in half. The system eventually became operational at 9th Air Force.

Ada Test and Verification System In June, RADC demonstrated a software tool which tested and verified programs written in Ada language. Plans included introducing the ATVS into the public sector.

Advanced Spaceborne Computer Module Support The ASCM, under development by the Air Force Space Technology Center, incorporated the requirements of two RADC programs in the statement of work. AFSTC also requested RADC participate in the source selection process to ensure the requirements of the Tester Independent Support Software System and Generic Qualification program were adequately addressed.

Intelligence

5 1/4" Optical Disk Flight Tested The RADC-developed 5 1/4" Tactical Optical Disk System (TODS) was flight tested on an F-16 at Eglin AFB, Florida. The system performed flawlessly in each of the first three tests, but aircraft subsystem failures prevented a successful fourth test until flight number six. TODS was the only DOD program which exploited rewritable optical disk storage for a high-stress, airborne environment. The following year, TODS program responsibility would be transferred to Wright Laboratory. in support of the F-16 Close Air Support Program.

F-15 Support Using an advanced development model of its Digital Target Locations System, RADC's Intelligence and Reconnaissance Directorate supported testing by an AFOTEC F-15E Operational Test and Evaluation Team. RADC provided coordinates for the Fort Drum area where the F-15's LANTIRN system was being tested in overflights.

CATIS IOC On 21 January, the Computer Aided Tactical Information System reached initial operational capability at six Air Force and Naval Intelligence Centers worldwide. CATIS provided an increased imagery dissemination and exploitation capability.

RAAP in WINTEX and DETERMINED Again applying artificial intelligence to tactical battle management, RADC's Rapid Application of Air Power software program underwent operational testing during the WINTEX and DETERMINED exercises. Based on data inputs, RAAP predicted Soviet Army operations in an attempt to increase the effectiveness of Allied air interdiction. In July 1990, the US Pacific Command J-2 recommended that a field demonstration of RAAP be set up for the Pacific Theater.

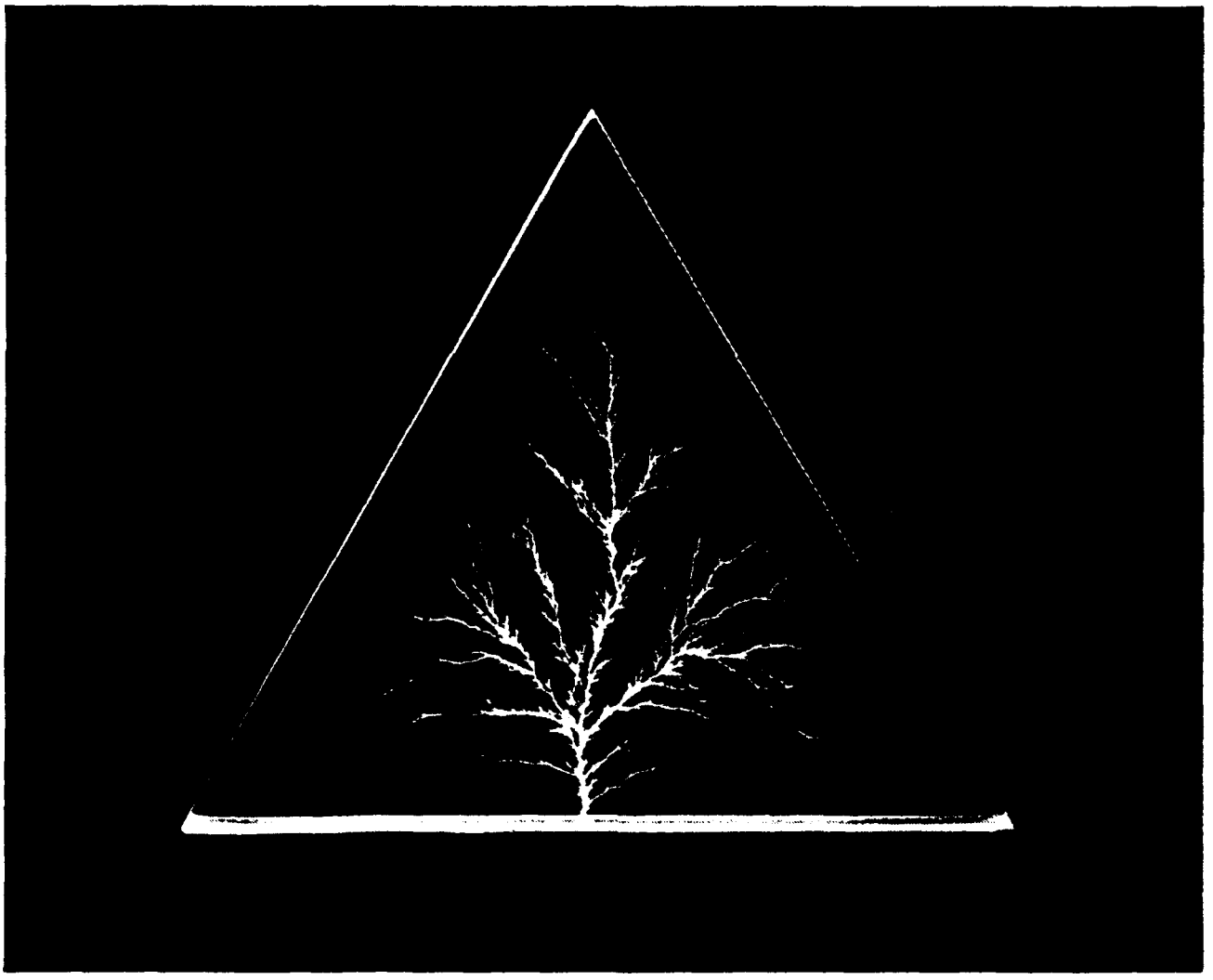
CAEWIS RADC completed final acceptance testing of the Computer Aided Electronic Warfare Information System in January. The system, which later became operational, provided threat analysis capability to the major commands.

Reliability and Maintainability

Graphics Aid for GEMACS Aiming to simplify the development of computer-generated models, the Center designed graphical aid software for users of the GEMACS system. GEMACS, the General Electromagnetics Model for the Analysis of Complex Systems, was a system which aided users in the design, development, and modification of antennas and their platforms. Twenty copies of the Graphical Aids for the Users of GEMACS (GAUGE) program had been delivered to various DOD agencies by the close of the year.

Other

Frozen Lightning For its patent on "Frozen Lightning," it was announced that RADC would begin to receive royalties under the terms of the Technology Transfer Act of 1986. It marked the first time the Center was to receive royalties under the law. Frozen lightning, formally referred to as the Lichtenberg Tree or Lichtenberg Pattern, occurred naturally when dielectric discharge aboard spacecraft broke down insulating material. RADC replicated the phenomenon in a laboratory setting by passing currents of five to ten million volts through lucite.



Lichtenberg's Tree (Frozen Lightning) in Triangular Section of Lucite

Total Quality Management, a management philosophy emphasizing customer service and continuous improvement in business-related processes, continued to be implemented throughout Air Force Systems Command and RADC. After TQM was initiated at the Center in 1989, RADC formed several process improvement teams to improve the Center's business methodologies. In September 1990, RADC published the RADC Guide to Basic Training in TQM Analysis Techniques. This hugely successful pamphlet was subsequently requested for use by several organizations, including the Air Force Institute of Technology, AT&T, Texas Instruments, Westinghouse, and elements of the Army and Navy.

SENIOR LEADERSHIP

Not since 1984 had the Center experienced such a wide range of senior leadership changes during a year. On 24 May, Colonel Shulstad, who would receive his first star in 1991, moved on to Air Force Systems Command. His replacement was RADC Vice Commander, Colonel Robert L. Rhame. Colonel Rhame's assumption of command marked the third time in RADC history a Vice Commander moved up to the top spot. Slightly less than four months later, on 11 September, Colonel John M. Borky succeeded Colonel Rhame, who had accepted a position at the Defense Logistics Agency in Philadelphia. Colonel Borky, like Colonel Shulstad before him, came from Aeronautical Systems Division in Ohio, where he had worked in the Advanced Tactical Fighter System Program Office. The twenty-first Commander in the Center's (renamed Rome Laboratory late in the year) 40-year history, Colonel Borky began his Air Force career in the RADC Surveillance Division in 1969. During that assignment, one of his duties included work on the development of the Pave Onyx Advanced Location Strike System.

A couple of months before Colonel Borky accepted command, Colonel John E. O'Pray moved in as RADC Vice Commander. The position had been empty since a vacancy was created in May, when Colonel Rhame moved up to the top spot. Before assuming the number two position at RADC, the Cal Tech grad

was program manager of the Directed Energy Weapons System Program Office and a graduate of the Air War College. Meanwhile, in the time a total of sixteen Commanders and Vice Commanders had come and gone, Dr Diamond carried on as RADC's fifth Chief Scientist.

ORGANIZATION

Personnel and Facilities

Through normal attrition, the Center experienced a slight dip in assigned personnel during the year. In anticipation of Defense Management Review cuts, RADC did not fill the vacated positions.

RADC continued to occupy seven buildings at Griffiss AFB, sixteen at "RADC East" at Hanscom AFB in Massachusetts, and managed seven off-base research sites near both bases. It was announced that jurisdiction over the AMOS facility, where the Center maintained an operating location, would transfer to Space Division's Air Force Space Technology Center, later Phillips Laboratory, during 1991.

Structure

No major structural changes took place during the year, but RADC's renaming in December to "Rome Laboratory" was a relatively minor manifestation of the implementation of the "superlab" structure, a restructuring of Air Force laboratories in general. This new "vision" for the service's labs promised significant organizational alterations for all those affected, including Rome Lab.

RESEARCH AND DEVELOPMENT ACTIVITIES

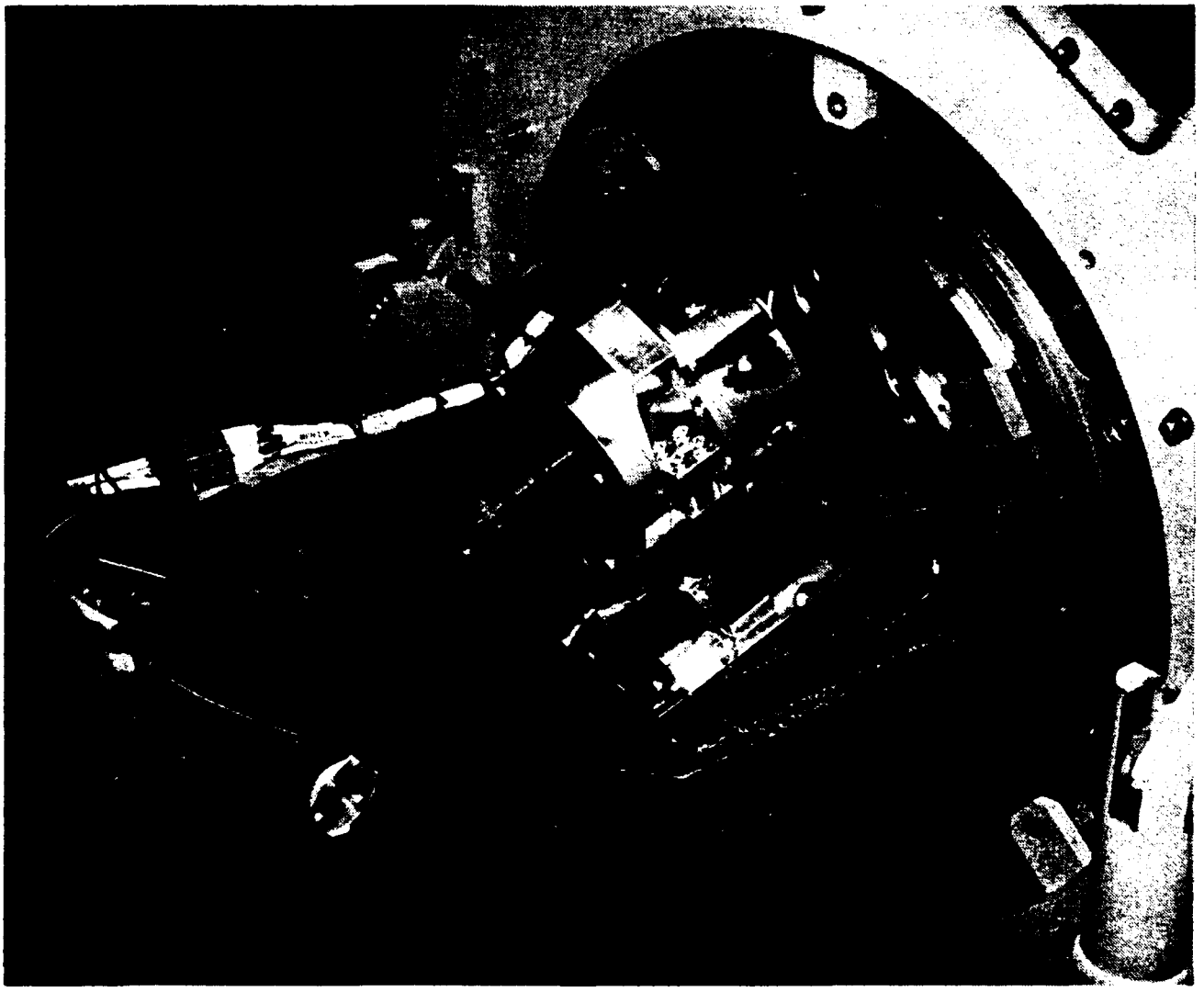
Desert Shield

DART Less than a month after USTRANSCOM requested accelerated development of the program for use in Desert Shield, an RADC-managed team released an operational version of the Dynamic Analysis Replanning Tool. DART enabled USTRANSCOM planners to change and analyze deployment plans about eight times faster than other automated systems.

Patriot Corrosion RADC began investigation in August of a corrosion problem involving Patriot missile electronics. By October, RADC identified the problem and recommended actions to limit future corrosion while the missile batteries were deployed in support of Desert Shield.

Surveillance

B-52 Infrared Camera On 13 and 14 September, Center personnel demonstrated the form, fit, and function of the B-52 Forward-Looking Infrared Camera. Developed at "RADC East," the camera utilized platinum silicide technology, first patented by RADC back in 1984.



B-52 Infrared Camera

More Platinum Silicide Fairchild Imaging Systems used platinum silicide focal plane array fabrication technology to develop a sensor used in the interception and destruction of a test missile. The experiment was funded by SDI's Arrow Missile program.

In addition to supporting the B-52 and SDI, platinum silicide technology would later be shown to have infrared surveillance applications to RADC's work for the Air Defense Initiative.

Final LAMP Using a Polarization Phase Sensor, Itek Corporation successfully completed the Absolute Phasing Demonstration of the LODE (or Large) Advanced Mirror. The demonstration effectively ended the program, and RADC began working on the next step in large Directed Energy Weapon optics, the Large Optical Segment program. In 1991, Phillips Lab in New Mexico would take over the effort.

AMOS, RME, and LACE In February, a Delta rocket lifted off from Cape Canaveral in Florida. It carried satellites which would be used in the Relay Mirror Experiment and the Low-Powered Atmospheric Compensation Experiment, AMOS efforts funded by SDI.

Contamination Control Using SDI funding, RADC continued work on space optics contamination control. During the year, the Center examined laser, ion beam, and jet spray cleaning techniques.

Communications

Project ENDRUN Final acceptance of Project ENDRUN, an RADC program to provide secure, high-speed, wideband, digital communications to meet USAFE C3I requirements, was reached on 1 September. Installation had begun in USAFE's Central Region in 1988.

Sentry Husky '90 Sentry Husky '90, a demonstration of the defense establishment's ability to switch from dedicated communications systems to public-switched networks, took place. In the exercise, a simulated earthquake in the northwestern US destroyed dedicated communications. Part of Sentry Husky's success was due to RADC's Digital Interface Device.

MOCTR In August, Eastman Kodak delivered the Multichannel Optical Communications and Tracking Receiver to RADC. MOCTR demonstrated that a high-speed array could simultaneously track and communicate with many other laser communication platforms. The work was sponsored by SDI.

Command and Control

USAFE Tactical Fusion Center The Center concluded four and a half years of effort when the Tactical Fusion Center Information Processing System achieved initial operational capability. Installed at Boerfink, Germany, the new system replaced USAFE's outdated Kaleidoscope system.

Advanced Planning System Standardization of tactical battle management processes was the aim of the Advanced Planning System. A specific goal of the program was automation of the Air Tasking Order, which could cut planning time 75 percent. In 1990, RADC continued investigating five existing systems for potential application to APS.

Survivable Adaptive Planning Experiment Initiated in 1988, SAPE attempted to reduce the complex procedures necessary to make changes to the Single Integrated Operations Plan. Phase II of the project was scheduled to end in 1992.

Intelligence

Korean Combat CATIS Combat CATIS reached initial operational capability 26 July. A down-sized version of the Computer Aided Tactical Information System, Combat CATIS was used by the 6th Tactical Intelligence Group at Osan AB, Korea. It supported both Korean and American forces, and greatly enhanced joint theater intelligence analysis.

Deployable Intelligence Data Handling System USCENTCOM's DIDHS successfully completed TEMPEST testing on 28 April. With the completion of this milestone, the system could now be deployed as an SCI-approved facility for communications and data processing. The DIDHS, a version of which the Center developed in 1982 for USCENTCOM's predecessor, the Rapid Deployment Joint Task Force, was used to link the Command's deployed forces with national intelligence data bases. Later in 1990, it would become operational at USCENTCOM, where it would be evaluated for possible deployment to Southwest Asia.

ELINT Expert Tutor The Center delivered the ELINT Expert Tutor to the Foreign Technology Division. The tutor provided an interactive, computerized method of instructing new employees in the specifics of radar operations and Electronic Intelligence analysis.

Other

USAFE Tactical Deception RADC installed the Tactical Deception Planner at USAFE Headquarters. The software tool permitted the officer responsible for tactical deception to create cohesive deception plans. Additionally, the planner facilitated the training of new tactical deception officers.

Egyptian R&D Dr Osama El-Bayoumi of RADC's Solid State Sciences Directorate participated in a Department of Defense team which evaluated Egyptian defense-related research and development and proposed cooperative research between Egypt and the US.

Crystals The Magnetic Liquid Encapsulated Kyropoulos Growth Technique, developed by RADC to grow indium phosphide, produced crystals of unprecedented uniformity. The technique could provide higher-yield high-density electronic and optoelectronic integrated circuits.

AWARDS

Air Force Organizational Excellence Award RADC added the Air Force Organizational Excellence Award to its six Outstanding Unit Awards on 15 August (RADC received the AFOEA instead of the AFOUA due to an administrative change in eligibility requirements, but the awards were essentially the same.) Unlike many of its previous awards, which cited one particular area of achievement, this award was for many specific accomplishments and general technology advancement. The award covered the period from 1 January 1988 through 31 December 1989.

The land war in the Persian Gulf ended more quickly than most had anticipated, and air power was the reason. By the time the Allied land offensive began, the thousands of Allied combat sorties had taken their toll; Iraq's vaunted army lasted less than a week, and Kuwait was once again controlled by its own government.

Technology developed at Rome Laboratory played its part in the air war. In an interview by the NBC Nightly News in May, Commander John Borky talked about the Lab's role in developing just one of the many technological heroes of the war, Joint STARS. As discussed later, it was just one of many weapon systems containing Lab-developed technology.

SENIOR LEADERSHIP

No changes occurred within Rome Lab during the first six months of the year, although one significant milestone was reached. Rome Laboratory Chief Scientist Dr Fred Diamond marked the completion of his tenth year as chief technical advisor to the Commander.

ORGANIZATION

Facilities

ELINT Development Facility Electronic Systems Division Commander Lieutenant General Gordon Fornell and AFSC Deputy Chief of Staff for Technology Major General Robert Rankine dedicated the Lab's new Electronic Intelligence Development Facility in a 6 June ceremony. The facility provided Rome Lab the subsystems and engineering tools to develop new ELINT signal recognition, identification, and processing technology.

Structure

Mission The Lab's mission did not undergo any formal changes during the first half of 1991, but as part of the Vision for Air Force Laboratories (discussed below), efforts were made to define and focus the various responsibilities of all the Air Force labs. Among the items discussed were corporate responsibilities, formerly known as enabling technologies. For Rome Lab, corporate responsibilities included the pursuit of advanced technology in electromagnetics, photonics, computational science, signal processing, reliability science, and superconductivity.

The "Vision"

The Lab began implementation of the "Vision" during the year. Originated by the AFSC Deputy Chief of Staff for Technology Major General Robert Rankine, the Vision for Air Force Laboratories included the steps of consolidating the twelve Air Force labs into four "superlabs," and radical restructuring within each of the four

laboratories themselves. Rome Lab was not affected by the former; it was the only lab not to have others merged into it. However, the Lab's internal structure underwent major revisions during the year. Its eight technical directorates were consolidated into four, and some support directorates were integrated as well.

The "VISION" at Rome Lab

Before	After
Technical Directorates	**Technical Directorates**
Communications	Command, Control, and Communications
Intelligence and Reconnaissance	Intelligence and Reconnaissance
Reliability and Compatibility	Electromagnetics and Reliability
Command and Control	Surveillance and Photonics
Surveillance	
Electromagnetics	
Solid State Sciences	
Photonics	
Support Directorates	**Support Directorates**
Plans and Programs	Plans and Programs
Comptroller	Comptroller
Contracting	Contracting
Operations	Operations
Computer Information Management	

AMOS Transferred As part of the Vision, Rome Lab turned over responsibility for the AMOS site to the Phillips Lab, formerly the Space Technology Center. The Lab continued to use the facilities, now as a tenant, for its surveillance experiments.

RESEARCH AND DEVELOPMENT ACTIVITIES

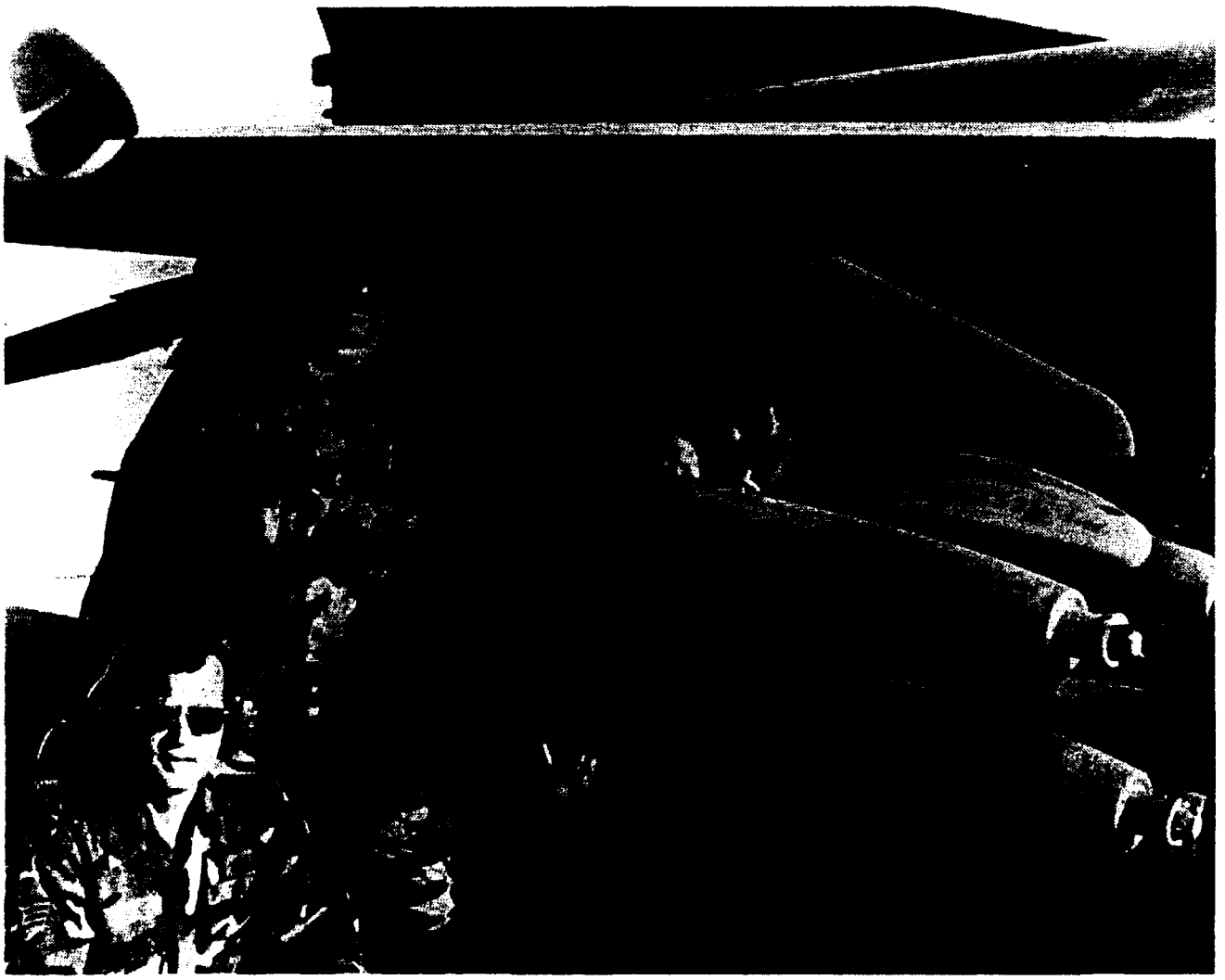
Desert Shield/Storm

Personnel Support Although not a combat unit, several Rome Lab personnel were employed by US Central Command Air Force for Desert Storm. Major Ed Miller of the C3 Directorate was a case in point. From late December 1990 to March, Major Miller worked as the Senior Air Defense Officer for CENTAF's Tactical Air Control Center in Riyadh, Saudi Arabia. As such, he was responsible for the air defense of the TACC. Lieutenant Janet Barboza, also of C3, provided technical support for five months for the proposed employment of TEMPLAR, the automated air tasking order system. She

arrived in Riyadh on 23 September 1990.

Individuals from the Lab's Intelligence and Reconnaissance Directorate also participated. Captain Mark Wilbanks and Lieutenant Paul Klyve were flight crew members on RC-135 aircraft, and provided intelligence operations support. Fred Haritatos travelled down to 8th Air Force at Barksdale AFB, Louisiana, to aid in bomb damage assessment reports for B-52 missions against Iraq and Kuwait.

Some Lab employees supported the effort without actually going to Southwest Asia. Typical was Lamont Ossont, who aided in the shipment of $500,000 in radio and navigation equipment to the region. In other instances, Lab military reservists were called to active duty to help send others overseas.



John Pizzo and Geoff Jones at Camel-Lot in Saudi Arabia

Finally, Rome Lab personnel contributed as members of the Reserve and Guard, such as David Bunker of the Surveillance Directorate and Dan Emlin and John Pizzo of Operations. Bunker, a member of the Naval Reserve assigned to COMFAIRMED (Commander, Fleet Air - Mediterranean) during Desert Shield and Storm, served from September to May in Italy and Egypt. Emlin deployed to Saudi Arabia on 12 January as part of an Air Force Reserve medical unit responsible for aeromedically evacuating patients. Pizzo went as a member of the Air National Guard's 174th Tactical Fighter Wing out of Syracuse, New York, where he served as Fuel Systems Technician. Shown with him on the previous page is the son of former Lab historian Leland Jones in Saudi Arabia.

Technical Support The Lab contributed a wide variety of efforts during Desert Shield and Desert Storm. Some of these were spur of the moment developments, rushed through the system to play a role in the fighting. Others, however, were systems or components of systems which slowly became part of the operational Air Force. A brief description of those in the latter category follow.

AWACS Rome Lab's efforts during the 1960's in overland radar technology was the forerunner to "lookdown" radar used by the Airborne Warning and Control System, a system to scan the skies in search of enemy aircraft. Other Lab efforts incorporated into AWACS included computer design, software and software aids, communications equipment, and data displays. Additionally, Lab work on Very High Speed Integrated Circuits and passive infrared surveillance systems are planned to be incorporated into the AWACS Radar System Improvement Program.

Joint Surveillance Target Attack Radar System Whereas AWACS looked for airborne enemy aircraft, Joint STARS searched the ground for slow moving ground targets behind enemy lines. It began as "Pave Mover," a Rome lab program in the mid and late 1970's.

Patriot Missile The Lab provided a great deal of support in the areas of quality control and productivity enhancement during the 1970s to the programming language used in the Patriot, JOVIAL/J3.

HAVE NOTE Rome Lab manages the Air Force's ongoing Electromagnetic Vulnerability Assessment program, dubbed HAVE NOTE. Some of the weapon systems supported by the HAVE NOTE program include the Sidewinder Infrared Air-to-Air missile, Electro-Optically Guided Bombs, Low-Level laser Guided Bombs, the Maverick Air-to-Ground missile, and various proximity fuses.

F-15 Electronic Warfare Systems The AN/ALR-56 and AN/ALQ-135 were evaluated at the Newport Antenna Measurement Facility prior to and during flight tests.

EF-111 Electronic Countermeasures The Lab performed measurements and analyses on experimental and preproduction antennas.

F-111 At Newport, Rome Lab evaluated the AN/ALR-62 radar warning receiver antenna system.

Electronic Countermeasure Pods Over the years, the Lab evaluated three different ECM pods on the F-4, F-111, A-10, F-15 and F-16 aircraft.

B-52 and C-130 ECM At the Stockbridge site, Rome Lab personnel evaluated ECM antenna systems on the C-130 and B-52 aircraft.

F-16 Reliability Lab scientists and engineers from the Reliability Physics Branch visited the 174th Tactical Fighter Wing at Hancock Field in Syracuse, New York. The visit was aimed at gathering information on F-16 electronic system failures during deployment for Desert Storm.

Surveillance

Integrated Multi-Domain Radar Personnel successfully demonstrated the Integrated Multi-Domain Radar system in the Lab's Surveillance facility. Using an artificial intelligence, the demonstration showed the system's ability to prioritize targets and overcome simulated jamming.

B-52 Infrared Camera By the end of May, the Lab and host Griffiss AFB had completed flight tests of the B-52 infrared camera. Tests included low level day and night flights as well as aerial refueling. Previous compatibility had been only with B-52 "H" models; these tests were completed on "G" model aircraft as well.

Commander's Day Radar Signatures During the Griffiss AFB Commander's Day held in early June, Rome Lab's Surveillance Directorate collected radar signature data on various military aircraft. The data was to be used to support the Lab's Non-Cooperative Target Identification and Hostile Target Identification programs. Recordings of twelve military and six civilian aircraft were obtained.

Intelligence

Discovery Flies with TODS NASA purchased the Lab-developed Tactical Optical Disk data storage system for use aboard the space shuttle Discovery. The 5.25-inch TODS, launched with Discovery on 28 April, was used in a robotics experiment.

Mobile Threat Tracking Testbed Rome Lab's Mobile Threat Tracking Testbed was deployed to Fort George Mead in early June. The MT3 provided real-time identification and tracking of enemy mobile air defense systems by using advanced signal intelligence and correlation techniques from a variety of intelligence sources.

Other

Three Inch Indium Phosphide Crystals A Division of the Electromagnetics and Reliability Directorate at "Rome Lab East" grew indium phosphide crystals three inches in diameter and weighing around one kilogram. Larger diameters permit a more efficient use of substrate materials and greatly reduce processing costs.

Anchor's Away With the help of the Lab's Logistics Division, the Village of Oriskany, New York received the anchor used aboard the USS Oriskany war ship. Rome Lab arranged the required equipment and permits for the move.

RADC/ROME LAB COMMANDERS

Name	Dates
1. Colonel Paul E. Burrows	12 Jun 51 - 1 Aug 51
2. Brig Gen Daniel C. Doubleday	29 Aug 51 - 29 May 54
3. Maj Gen Stuart P. Wright	29 May 54 - 1 Jul 57
4. Maj Gen Donald P. Graul	1 Aug 57 - 3 Jul 61
2. Maj Gen Daniel C. Doubleday	3 Jul 61 - 1 Dec 63
5. Colonel David M. Crabtree	1 Dec 63 - 1 Jul 64
6. Brig Gen Allman T. Culbertson	15 Jul 64 - 31 Jul 67
7. Colonel George A. Zahn	31 Jul 67 - 1 Aug 69
8. Colonel Robert C. Mathis	1 Aug 69 - 15 Jan 71
9. Colonel John C. Toomay	15 Jan 71 - 22 May 72
10. Colonel Phillip N. Larsen	22 May 72 - 10 Sep 73
11. Colonel John W. Hepfer	14 Sep 73 - 31 Jan 74
12. Colonel Lloyd H. Geisy	4 Feb 74 - 12 Jun 76
13. Colonel John Z. Dillon	13 Jun 76 - 14 Jul 78
14. Colonel Don J. Stukel	14 Jul 78 - 26 Jun 81
15. Colonel Philippe O. Bouchard	15 Jul 81 - 5 Oct 83
16. Colonel Charles F. Stebbins	6 Oct 83 - 10 Oct 84
17. Colonel Carl G. O'Berry	11 Oct 84 - 14 Jul 86
18. Colonel Charles E. Franklin	14 Jul 86 - 12 Jul 88
19. Colonel Raymond A. Shulstad	12 Jul 88 - 24 May 90
20. Colonel Robert L. Rhame	24 May 90 - 11 Sep 90
21. Colonel John M. Borky	11 Sep 90 - Present

RADC/ROME LAB TECHNICAL DIRECTORS/CHIEF SCIENTISTS

1. Ralph Cole	12 Jun 51 - Jun 52
2. Harry Davis	8 Jul 52 - Mar 60
3. Dr John S. Burgess	4 Sep 60 - Jun 71
4. Dr Irving Gableman	12 Jun 72 - 18 Jul 76*
3. Dr John S. Burgess	19 Jul 76 - Jun 80
5. Fred I. Diamond	19 Apr 81 - Present

*Although Dr Gableman officially retired in December 1974, he continued as acting Chief Scientist until mid-1986.

ACRONYM/DESIGNATION GLOSSARY

AABNCP	Advanced Airborne Command Post
ABRES	Advanced Ballistic Missile Reentry System
Ada	computer programming language
ADAR	Advanced Design Array Radar
ADARS	Adaptive Antenna Receive System
ADI	Air Defense Initiative
AFB	Air Force Base
AFLC	Air Force Logistics Command
AFOEA	Air Force Organizational Excellence Award
AFOUA	Air Force Outstanding Unit Award
AFSC	Air Force Systems Command
AIRES	Advanced Imagery Requirements Exploitation System
AMaRV	Advanced Maneuvering Reentry Vehicles
AMOS	ARPA (or Air Force) Maui Optical Station
APS	Advanced Planning System
ARDC	Air Research and Development Command
ARPA	Advanced Research Projects Agency
ASCM	Advanced Spaceborne Computer Module
ASDE	Airport Surface Detection Equipment
ASFIR	Active Swept Frequency Interferometer Radar
ASOC OTS	Air Support Operations Center Optical Transceiver System
ASTROMAST	deployable 60 or 100-foot antenna
ATEC	Automated Technical Control Program
ATVS	Ada Test and Verification System
AWACS	Airborne Warning and Control System
BADGE	Japanese Base Air Defense Ground Environment
BISS	Base Installation Security System
BMEWS	Ballistic Missile Early Warning System
BUIC	Back-Up Intercept Control
C2	Command and Control
C3	Command, Control, and Communications
C3I	Command, Control, Communications, and Intelligence
CAEWIS	Computer Aided Electronic Warfare Information System
CATIS	Computer Aided Tactical Information System
CAVS	COBOL Automated Verification System
CHICODER	Chinese-English language translator machine
CIS	Compensated Imaging System
CNI	Communications, Navigation, and Identification
COBAL	computer programming language
COIC	Combat Operations Intelligence Center
COINS	Community On-Line System
COZI	Communications Zone Indicator
CRONUS	advanced computer distributed operating system
CRT	cathode ray tube

DART	Dynamic Analysis Replanning Tool
DCEM	Digital Communications Efficiency Model
DCS	Deputy Chief of Staff
DEW	Distant Early Warning
DIAOLS	Defense Intelligence Agency On-Line System
DICOSE	Digital Communications System Evaluator
DIDHS	Deployable Intelligence Handling System
DMA	Defense Mapping Agency
DMED	Digital Message Entry Devices
DRIPS	Dynamic Real-Time Information Projection System
EARS	Emergency Airborne Reaction System
ECCM	Electronic Counter Countermeasures
ECM	Electronic Countermeasures
EHF	extremely high frequency
ELINT	electronic intelligence
ESAAP	EHF Satellite Adaptive Array Processor
ESAR	Electronically Steerable Array Radar
ESD	Electronic Systems Division
FORDAD	Foreign Disclosure Automated Data
FORTRAN	computer programming language
GAUGE	Graphical Aids for the Users of GEMACS
GEMACS	General Electromagnetics Model for the Analysis of Complex Systems
GCA	ground controlled approach
HF	high frequency
HFLLDF	High Frequency Luneberg Lens Direction Finder
Hound Dog	AGM-28, an Air-to-Ground Missile
IDHS	Intelligence Data Handling System
IFF	Identification Friend or Foe
INTIPS	Integrated Information Processing System
IR&D	Independent Research and Development
IROC	Intrusion Resistant Optical Communications
JOVIAL	computer programming language
LACE	Low-Powered Atmospheric Compensation Experiment
LAMP	LODE (or Large) Advanced Mirror Program
LES-5	Lincoln Experimental Satellite
LIPS	Laser Image Processing Scanner
LOBAR	Long Baseline Radar
LODE	Large Optics Demonstration Experiment
LORAN	Long Range Navigation

MAIRS	Medium Altitude Infrared System
MARRES	Manual Radar Reconnaissance Exploitation System
MBC	meteor burst communications
MEECN	Minimum Essential Emergency Communications Network
METAL	German-English machine translator
MIPR	Military Interdepartmental Purchase Request
MIRACL	Mid Infrared Advanced Chemical Laser
MIRAGE	Microelectronic Indicator for Radar Ground Equipment
MMIC	monolithic microwave integrated circuit
MOCTR	Multichannel Optical Communications and Tracking Receiver
MT3	Mobile Threat Tracking Testbed
MTI	Moving Target Indicator
MULTICS	Multiplexed Information and Computing System
MX	advanced intercontinental ballistic missile, later dubbed "Peacekeeper"
NAVAGLOBE	Long Distance Radio Navigation System
NAVARHO	long-distance, ground-based navigation system
NORAD OPSTAR	North American Air Defense Command Operational Status Reporting System
NSA	National Security Agency
ORACLE	Optimized Reliability and Component Life Estimator
OTH	Over-the-Horizon
OTH-B	Over-the-Horizon Backscatter
PACER	Program Assisted Console Evaluation and Review
PATS	Precision Angular Tracking System
QUINCE	prototype Chinese-to-English machine translator
R&D	Research and Development
RAAP	Rapid Application of Air Power
RADALON	weather resistant paint
RADC	Rome Air Development Center
RADC "East"	RADC's Directorates at Hanscom AFB, Massachusetts
RATSCAT	radar reflectivity measurement range
RCA	Radio Corporation of America
RDJTF	Rapid Deployment Joint Task Force
RFSS	Red Flag Scheduling System
RME	Relay Mirror Experiment
ROAMA	Rome Air Material Area
ROMANS	Range Only Multiple Aircraft Navigation System

SAC	Strategic Air Command
SAFE SIDE	intrusion detection equipment
SAGE	Semi-Automatic Ground Environment
SAMSO	Space and Missile Systems Organization
SAPE	Survivable Adaptive Planning Experiment
SARAC	Steerable Array Radar and Communications
SATKA	Surveillance, Acquisition, Tracking, and Kill Assessment
SCARS	Status Control and Alerting and Reporting System
SDI	Space Defense Initiative
SEA	Southeast Asia
SEMANOL	Semantics Oriented Language
SHARP	Super High Accuracy/Resolution Processing radar
SHF	super high frequency
SIF	Selective Identification Features
SITS	Secure Imagery Transmission System
SLR	side-looking radar
SOI	space object identification
SPANS	Spectral Analysis Processing System
TAC	Tactical Air Command
TACAN	Tactical Air Navigation
TACSAT-1	Tactical Satellite Communications System
TEMPLAR	Tactical Expert Mission Planner
TISSS	Testor Independent Support Software System
TIPI	Tactical Information Processing and Interpretation
TODS	Tactical Optical Disk System
TWT	Traveling Wave Tube
UHF	ultra high frequency
USCENTCOM	United States Central Command
USTRANSCOM	Untied States Transportation Command
VHF	very high frequency
VHSIC	very high speed integrated circuit
WAF	Women in the Air Force

MISSION

OF

ROME LABORATORY

Rome Laboratory plans and executes an interdisciplinary program in research, development, test, and technology transition in support of Air Force Command, Control, Communications and Intelligence (C^3I) activities for all Air Force platforms. It also executes selected acquisition programs in several areas of expertise. Technical and engineering support within areas of competence is provided to ESD Program Offices (POs) and other ESD elements to perform effective acquisition of C^3I systems. In addition, Rome Laboratory's technology supports other AFSC Product Divisions, the Air Force user community, and other DOD and non-DOD agencies. Rome Laboratory maintains technical competence and research programs in areas including, but not limited to, communications, command and control, battle management, intelligence information processing, computational sciences and software producibility, wide area surveillance sensors, signal processing, solid state sciences, photonics, electromagnetic technology, superconductivity, and electronic reliability maintainability and testability.