TABLE OF CONTENTS FOR PART III

The Flight Environment: Altitude, Temperature, Ozone ... and Radiation

Altitude

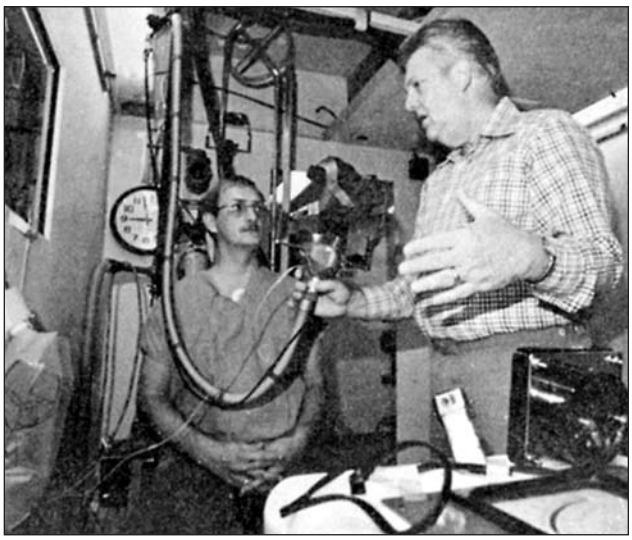
Studies on altitude and oxygen masks were undertaken by John Swearingen and his small team prior to the opening of CARI. They were continued by Ernest McFadden and, later, by E. Arnold Higgins, Ph.D. The continuation of that important line of work resides in the periodic development of new oxygen masks and types of delivery systems. The work comprises evaluating any safety issues in accessing and using those devices, assessing the effects of their use on emergency evacuation times, and testing the integrity of the masks in the aviation environment. The latter includes research regarding the fit of masks on bearded men and on the smaller face structure of women and children.

Temperature

Research on temperature as an aviation stressor was conducted primarily by P. F. Iampietro, Ph.D., (original head of the physiology laboratory) and by Carlton E. Melton, Ph.D., (who later succeeded Iampietro), in the '60s and early '70s. Melton's work was closely associated with his studies on assessing stress issues in the training of general aviation pilots. In those studies, the effects of high cockpit temperatures on flight simulator performance and pilot physiology were studied for their training implications and for application to crop duster pilots. In 1968, during the developmental stages of the supersonic transport (SST), Higgins examined complex performance in temperatures up to 140° F over a time period required to get an SST down from cruising flight altitudes in the event of an in-flight air compressor failure. (Other CAMI studies assessed emergency passenger evacuation in an SST model.)

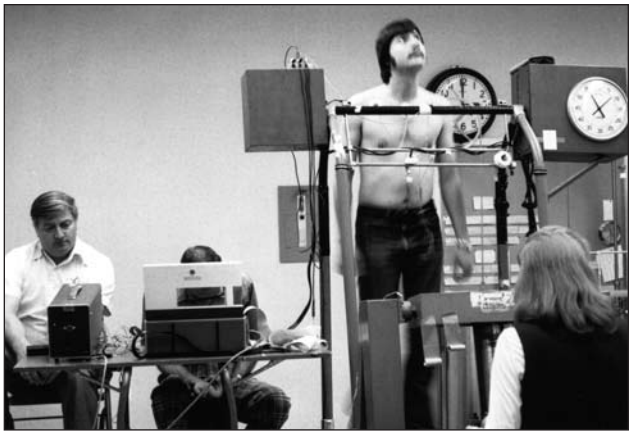
Ozone

Higgins and Melton, along with Michael T. Lategola, Ph.D., also led the work on ozone assessments. Ozone level exposures had been raised as a subject of concern by aviation industry employees in the late '70s (and again in the late '80s, stimulated as an off-shoot of concerns over urban environments). CAMI's research was conducted with an emphasis on pulmonary function. That work assured that no harmful ozone effects were present in the aviation environment. An updated review of ozone findings was provided in a 1989 CAMI report by Melton.



Chamber Flight. Higgins preparing for an altitude run and oxygen mask testing.

High Temperature. Some early temperature research involved performance in a Link trainer.



Ozone Concerns. Treadmill, spirometer, visual, and short-term memory tests, along with symptom questionnaires, were used to assess potential effects of exposure to ozone in the laboratory.

FEDERAL AVIATION ADMINISTRATION
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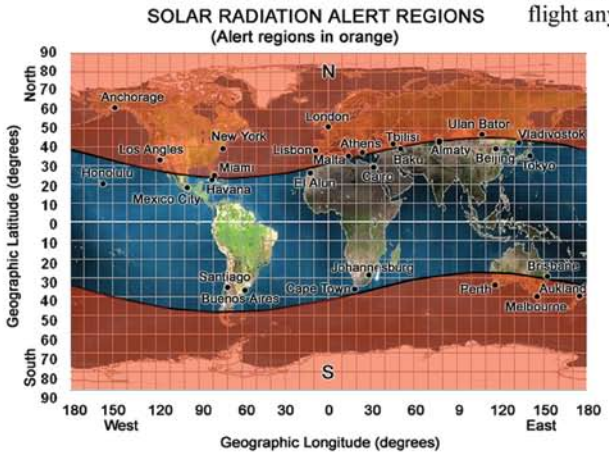
These forms require a javascript enabled browser.

Left Click on HELP For Instructions
HELP

Galactic Radiation Received In Flight

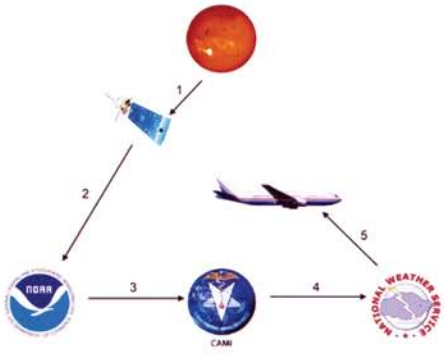
Enter Flight Data		
Date of Flight	03/2005	01/1995 = January 1995 00/1995 = Average for 1995
Origin Code	TUL	- Enter ICAO Code or Look Up Origin Code
Destination Code	OKC	- Enter ICAO Code or Look Up Destination Code
Number of en route altitudes	2	
Minutes to 1st en route altitude	6	
	Continue	On the next screen you will be asked for en route altitudes, flight times and time spent in final descent..

Radiation Exposure. Friedberg periodically reviews a map of altitude and aircraft routes across the United States with updated information to gauge exposures of aircrew and passengers to normal galactic radiation for individual flights.Those exposure levels can be calculated for any flight anywhere in the world via the CARI program on the Internet.



Radiation Alert. Friedberg's and Kyle Copeland's description of the radiation alert system; the map of alert regions is regularly updated.

Solar Radiation Alert System



1. **Occasionally, a disturbance in the sun (solar flare, coronal mass ejection) leads to a large flux of high-energy particles in the vicinity of the earth.**

2. **Instruments on a GOES satellite continuously measure the radiation and the information is transmitted to NOAA. From there it is sent to the Civil Aerospace Medical Institute (CAMI).**

3. **A computer at CAMI analyzes the measurements.**

4. **If the measurements indicate the likelihood of a substantial elevation of ionizing-radiation levels at aircraft flight altitudes, a Solar Radiation Alert (SRA) is issued to the NOAA Weather Wire Service within 10 min.**

5. **NOAA Weather Wire Service subscribers are provided effective dose rates at 30,000, 40,000, 50,000, 60,000, and 70,000 ft. This information is updated at 5-min intervals for the duration of the SRA.**

Radiation

One of the less well-known areas of research contribution by CAMI may be that of radiation levels and their effects on aircraft crew members, passengers, and fetuses. Studies by Wallace Friedberg, Ph.D., have included the levels of radioactive materials sometimes transported by civilian aircraft with regard to meeting safety criteria. A series of reports by his radiobiology research team provided recommendations for placement of packages of radioactive material in cargo areas of passenger-carrying aircraft so that radiation exposure of passengers would not exceed limits specified by the U.S. Department of Transportation.

Other radiobiological studies have focused on cosmic radiation exposure at various altitudes (it increases with altitude), latitudes, and during periods of solar particle events (solar flares or coronal mass ejections). Air travelers are constantly exposed to ionizing radiation at higher dose rates than normally received by the general population at ground level; the principal ionizing radiation is galactic cosmic radiation. With regard to altitude issues, Friedberg's work has led to advisories and to airline company guidelines limiting exposure of crewmembers based upon the altitudes, duration, and frequency of various flight schedules. Risk ratios for potential development of radiation-induced cancers continue to be calculated to assure travelers and flight crews of the safety of air travel; guidelines for pregnant crewmembers have been established to assure protection of developing fetuses.

Radiation levels are calculated based on the date of the flight (to tap the effects on galactic radiation levels in the atmosphere due to changes both in solar activity and in the earth's magnetic field) and the variation in altitude and geographic location during the course of a given flight. Exposure levels are determined and plotted in Friedberg's laboratory for every U.S. airline flight profile by a regularly updated, proprietary computer program called "CARI" (as a purely historical whim). That program has been made freely available, can be run (with MS-DOS) on most personal computers, is used by countries around the world, and has been the model for those countries that have developed their own programs.

A second CAMI radiation program deals with solar flares. These occasional disturbances in the sun lead to a large flux of solar protons with sufficient energy to penetrate the earth's magnetic field, enter the atmosphere, and increase ionizing radiation levels at aircraft flight altitudes. A solar radiation alert system has been developed by CAMI's Friedberg and Kyle Copeland in a collaborative effort with CIRES-University of Colorado and National Geophysical Data Center of the National Oceanic and Atmospheric Administration (NOAA) located in Boulder, Colorado. Radiation measurements from instruments on a GOES geosynchronous satellite are collected and provided by NOAA's Space Environment Service Center facility from where they are accessed by CAMI. The CAMI system provides for the continuous evaluation of proton measurements and the issuing of timely alerts to the aviation community through NOAA's Weather Wire Service if the measurements indicate the likelihood of a substantial elevation of ionizing radiation levels at aircraft flight altitudes. In the case of an issued alert, the entire process takes only a few minutes...another unique and ongoing aviation contribution by CAMI. ❐

High Fliers. Friedberg addressed a joint meeting of the Air Transport Association's medical panel and cabin operations panel held at CAMI in 1991. He provided descriptions of the cosmic radiation environments at air carrier flight altitudes and addressed concerns related to possible associated health risks. Demonstrations were provided of his early CARI computer program (then called CARRIER) for estimating the amount of radiation received on individual flights. Friedberg also organized a successful international scientific symposium entitled "Cosmic Radiation Exposure of Air Carrier Crewmembers," held at CAMI in 1990.

Human Factors: Performance ... Doing It Right

Many of the CAMI research projects on human performance in aviation-related tasks have involved the effects of various stressors on complex performance (more recently referred to as time sharing performance or multi-tasking). The range of types of performance studies extends from laboratory task consoles (e.g., the Multiple Task Performance Battery) to flight (or radar) simulators, to in-flight (or on-site) observations. Stressors evaluated for their effects on performance — and often on physiological responses — have included simulated altitude exposure, alcohol, sleep loss, various drugs and medications, temperature, startle, smoking, motion vs. static environments, and others, singly and in combination.

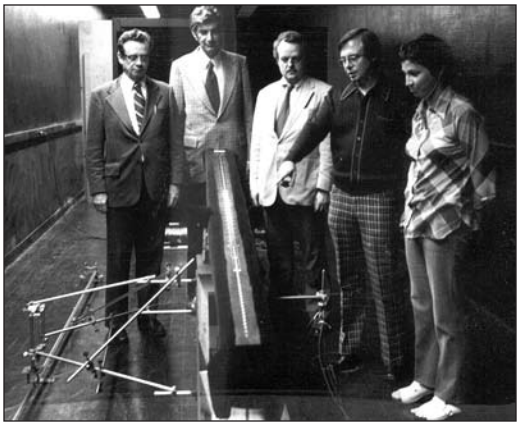
Other research has investigated the effects on performance of color-coded targets, flash rates for target detection, peripheral visual cues, various visual approach slope indicators, communication methods, situational awareness, and other conditions affecting safe performance.

Sensing It

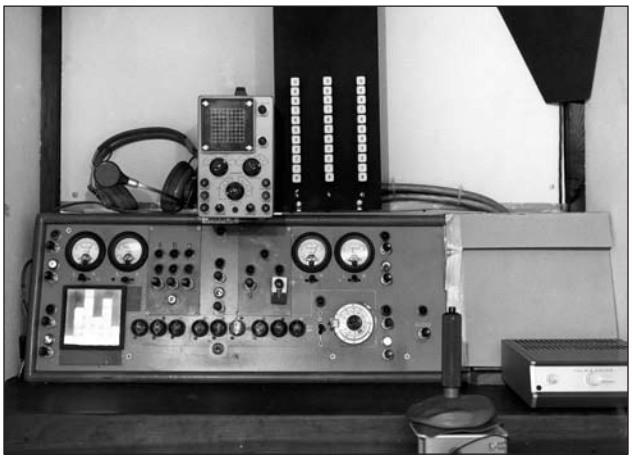
Some research during the '60s used both simulators and the CARI single-engine aircraft. A highly experienced pilot and former aircraft accident investigator, A. Howard Hasbrook, in addition to exploring the potential safety increments of using cockpit systems he devised for instrument approaches, also assessed ways to enhance peripheral vision cues. Other vision research involved a series of studies on depth perception issues by Walter C. Gogel, Ph.D., and the extension of those concepts by Henry W. Mertens, Ph.D., and Mark F. Lewis, Ph.D., to the influence on glide slope angle of perceived depth, distance, and size and on the effectiveness of various models of visual approach slope indicators (VASI systems).

Indeed, with the exception of the air traffic controller selection and training research program, the psychologically based research during the decade of the '60s was largely sensory-based. In addition to the vision work, auditory research by Jerry V. Tobias, Ph.D., who also edited two books on auditory theory (57), and vestibular research by William E. Collins, Ph.D., were prominent and included such foci as cockpit noise and speech intelligibility and studies of adaptation to vestibular stimulation (stimulation associated with spatial disorientation or pilot's vertigo). With respect to the latter, considerable scientific attention was generated by studies of professional figure skaters

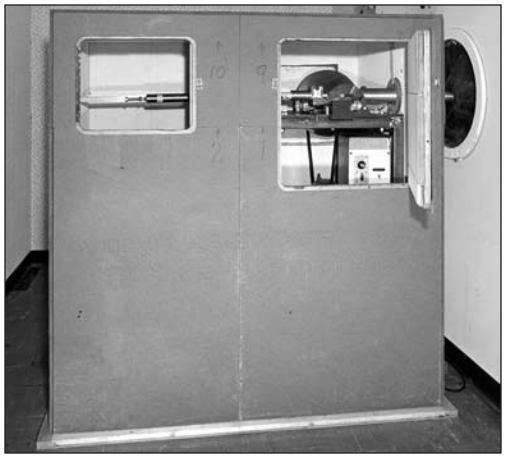
In the Air and on the Ground. (l) Stanley R. Mohler, M.D., CARI director (top) and Hasbrook (lower) used the CARI single-engine aircraft to collect performance data. (above) Hasbrook also engaged in laboratory research on piloting skills.



Sound, Sight, and Position. (clockwise) Tobias researched cockpit noise levels and hearing loss; Mertens (2nd from r) in "The Alley" described laboratory procedures on glideslope/depth perception laboratory research to the executive secretary and 2 members of the National Academy of Sciences/National Research Council Committee on Vision; vestibular research by Collins involved motion and position sensing, performance measures, and eye movement recordings to define motion effects.



Workload and Performance. (l) The original Multiple Task Performance Battery (MTPB) used by Chiles in studies of pilot workload; (lower l) the updated MTPB assessed both individual and group performance as a function of workload demands; (below) air traffic control laboratory tasks provided information regarding vigilance, distraction, and various potential aids to maintaining performance levels.



Booms. International interest in supersonic aircraft in the 1960s led to CAMI research on the effects of sonic booms on performance and sleep. Thackray (above l) engaged in several laboratory studies of physiological and performance effects using CAMI's sonic boom simulator developed by the Stanford Research Institute. The "boomer" was also used in sleep studies conducted by Collins and P.F. Iampietro, Ph.D.

who appear to have trained themselves to be impervious to vertigo and disorientation (13, 14). Results showed the importance of the visual system and visual reference to objects (e.g., the audience) fixed relative to the earth. The set of studies on figure skaters was partially documented by film of their laboratory and on-ice responses to vestibular stimulation, including telemetered eye movements during their spins – the first such use in vestibular research; the film was widely shown (and purchased) on an international basis (including the BBC) and came to be regarded as a scientific classic.

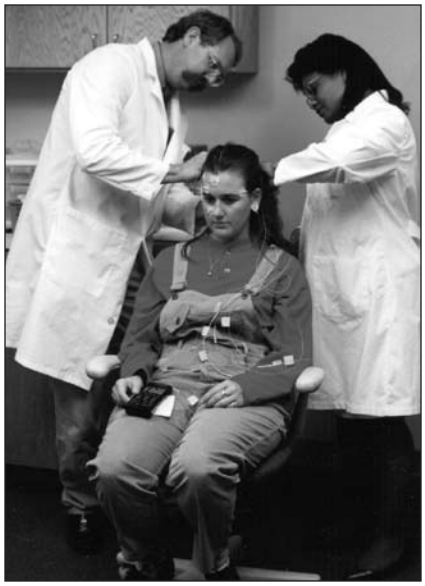
The differential effects of motion (dynamic vs. static environments) on glide slope tracking performance was assessed for a variety of conditions that included alcohol and hangover effects, sleep loss effects, use of anti-motion sickness drugs, and others. The addition of motion exacerbates any performance decrements produced by these conditions in a non-motion (static) environment.

Complex Performance

CAMI's programmatic laboratory research in complex human performance initially used a testing device developed by the Lockheed-Marietta Corporation for assessing time-sharing skills of importance to piloting aircraft. It was brought from a U.S. Air Force laboratory in 1968 by W. Dean Chiles, Ph.D., when he joined CAMI. The equipment was upgraded over the years with advances in technology to provide improved control of informational stimuli and recording of responses, along with the capability of obtaining team-based as well as individual performance measures. This unique device — the Multiple Task Performance Battery — was used in a variety of settings to assess stressor effects on the kinds of performance required of aircraft pilots. Moreover, its so-called "synthetic" tasks tap such basic skills that, by arraying the tasks differently, they can provide tests of performance that relate to the demands on air traffic controllers.

Perceptual-motor responses, physiological effects, and performance recovery on tasks requiring sustained attention such as in radar monitoring, were assessed by Richard I. Thackray, Ph.D., under conditions in which distracting auditory stimuli or startle occurred; boredom and monotony effects were evaluated and described as were the presence or absence of a sweep line or of computer aiding, the use of bifocals, gender and age differences, and other factors. Subsequent work on blink rates and saccades during monitoring was conducted in a joint project with Russian scientists, university researchers, and CAMI's David J. Schroeder, Ph.D., (now head of the Aerospace Human Factors Research Division). Such complex visual monitoring is basic to work in both the cockpit and air traffic control.

Visual monitoring tasks involving tracking behavior were also used in a series of laboratory studies of the performance effects of simulated sonic booms. (Those



Non-Smoking and Non-Sleeping. (above) Nesthus assessed smoking/non-smoking effects on complex performance at simulated altitude and (pictured right assisting with electrode placement) measured effects of extended sleep loss.

studies led to the invited participation of Thackray in field studies of sonic booms conducted in Sweden). One issue was the potential startle effect of a boom that might result in a decline in visual-motor efficiency. Instead, the booms produced an alerting (or orienting) response and performance efficiency was improved for about one minute along with a decrease (rather than a startle-produced increase) in heart rate. (The boom simulation was also used to assess effects on sleep using electroencephalographic and other physiological recordings.)

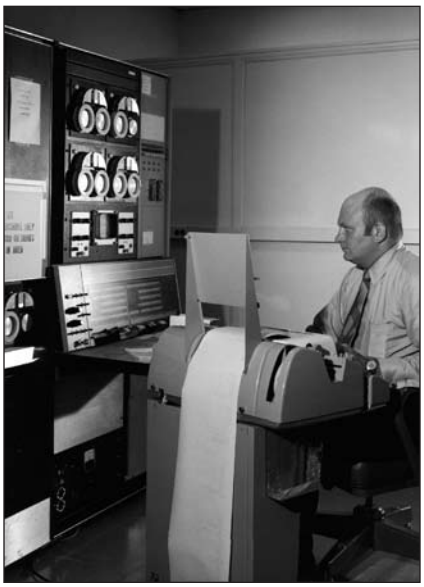
Other more recent studies by Thomas E. Nesthus, Ph.D., have used complex performance measures to determine effects of mild hypoxia, up to 34 hours of sleep loss, and smoking vs. non-smoking effects on subsequent performance at simulated altitude.

Computer Capability: State-of-the-Art

Basic to a world class research facility is a state-of-the-art computer capability. From the late '60s throughout the '70s, Lewis, in addition to his vision research, provided the depth of knowledge and ingenuity necessary for the early development of what quickly became, and continues to be, an outstanding computer resource that serves not only research and rapid complex data analysis but also the administrative needs of the Institute. Parenthetically, in 1972, Lewis also organized the world's first symposium on the aeromedical aspects of marijuana when use of the illegal drug had become widespread. The CAMI symposium included major researchers and authorities in drug behavior and stimulated some university research projects relevant to aeromedical issues. A book on the proceedings was published by Academic Press in 1972 (33).

Advanced Aviation Systems: New Research Approaches

The Systematic Air Traffic Operations Research Initiative (SATORI) developed by Mark D. Rodgers, Ph.D., was designed to permit an analysis of the dynamics associated with ATC operational errors and incidents. (In fact, before its expanded utility was recognized, it was called Situation Assessment Through Re-creation of Incidents.) Data from air route traffic control centers' magnetic and audio tapes are integrated on a sophisticated graphics display to re-create ATC incidents. Its success was attested to by its almost immediate installation in Washington Headquarters as well as at the Atlanta En Route Center where it was first tested. Since then, SATORI has been incorporated in all enroute centers in the country, not



Computer Excellence. Lewis' knowledge and skills established a foundation of computer excellence for CAMI.

Technology Applied. Rodgers created SATORI in the CAMI laboratories; it was field-tested (and kept) in the Atlanta Center. All Centers and Washington Headquarters now have the technology.

only to investigate operational errors and accidents but also to present operational error briefings and improve simulation training and training management. Other potential uses of SATORI have been proposed to help assess system designs and traffic management. CAMI's POWER project, initiated by Carol A. Manning, Ph.D., is one such application, evaluating objective indices of air traffic (such as aircraft mix) and their association with subjective workload assessments.

Human factors problems specific to general aviation received increased attention with the development by Dennis B. Beringer, Ph.D., of a sophisticated PC-based Basic General Aviation Research Simulator (BGARS) that permits rapid, low-cost performance assessments using various types of instrument enhancements. Almost simultaneously, more complex studies became feasible using the unique capabilities of CAMI's elegant Advanced General Aviation Research Simulator (AGARS), a device that is reconfigurable into four different aircraft types, the development of which was expertly guided by Robert E. Blanchard, Ph.D. AGARS reconfigurability extends to the capability of testing innovative display concepts and has also been used by Beringer to study effects on pilot behavior of loss of some instrument capability and to assess the decision-making of pilots using the NEXRAD weather display. The latest addition to this array of general aviation research simulators is VGARS – a vertical-flight simulator developed by Beringer that can represent a variety of helicopters. VGARS can be configured with various kinds of head-down instrumentation as well as being interfaced with other types of cutting-edge displays (e.g., Electronic Flight Instrumentation System, head-mounted displays). Its out-the-window view depicts features of the "outside world" (buildings, terrain, weather) with realism. And, most recently, an Air Traffic Control Advanced Research Simulator (ATCARS) has been developed under the guidance of Dennis Rester to permit laboratory testing of the effects of new ATC equipment and programs on controller workload, situation awareness, and performance.

AGARS. The high fidelity, realistic 150° field-of-view simulator and Beringer (seated) at its communication and control center.

BY GAR. The BGARS "cockpit" shown here as used in the CAPSTONE project faces a large display screen with programmable flight scenarios.

VGARS – a vertical flight simulator - is a very recent Beringer-developed addition to CAMI's general aviation flight research capability.

Kevin W. Williams, Ph.D., has employed BGARS to assess ground position systems, to conduct part of the Capstone Project (an Alaska Region safety office project to assess new displays outfitted in 200 aircraft to increase awareness in Alaskan pilots of terrain, traffic, and weather in an effort to reduce the high accident rates in Alaska). Currently, he has begun to assess the requirements (medical as well as skill and training) for ground "pilots" of unmanned aircraft; some applications of these unmanned vehicles include crop dusting, fire fighting, and border patrol.

Still other work, by O. Veronica Prinzo, Ph.D., has focused on pilot/controller communications and has provided evaluations and recommendations regarding the Cockpit Display of Traffic Information (CDTI) and the controller-pilot data link communication (CPDLC) systems in studies conducted both in the laboratory and using data from the Dallas-Fort Worth Tracon. Meanwhile, Lawrence L. Bailey, Ph.D., has explored communication between controllers (e.g., ground and local control at low-volume airports) and team work

ATCARS. This innovative capability developed by Dennis Rester provides a means of testing new air traffic control equipment and procedures and their effects on workload, performance, and situation awareness.

Communicating. Prinzo's laboratory (l) and field studies (above) of communication between pilots and air traffic controllers included the effects of data-link communication on operational communication. The Dallas-Fort Worth Tracon was the site of the field monitoring of audio and video transmissions during system assessment.

The Flight Strips Issue. Manning's studies of the changing role of flight strips in advanced air traffic control systems included field observations at Payne Tower (WA) (above), Atlanta Center (top r), and the Minneapolis Center (lower r) (note the reduced size of flight strips in the Minneapolis study).

among controllers in general. Carol Manning's ATC work extends to researching situation awareness issues and exploring the role of flight progress strips in advanced system air traffic control. The latter work has included on-site data collection at 10 towers, the Atlanta Center, and the Minneapolis Center.

An innovative approach by Scott A. Shappell, Ph.D., to aircraft accident investigation — the Human Factors Analysis and Classification System (HFACS) —is leading to new, more complete ways of examining potential causation issues in civil aircraft accidents. The HFACS provides a comprehensive four-level analysis (with subdivisions): human error or conscious rule violation, preconditions (operators and practices) for unsafe acts, unsafe or inadequate supervision, and organizational factors.

That approach is being extended to air traffic control by CAMI's Julia Pounds, Ph.D., in a joint effort with Eurocontrol where it is being used as part of an operational incident investigation process called JANUS. Pilots, air traffic controllers, and, more recently, aviation maintenance groups (with whom more than a decade of human factors work was also conducted and reported by William T. Shepherd, Ph.D., and Jean Watson in the Office of Aviation Medicine in Washington, D.C.) have been the main focus of these HFACS studies. Moreover, HFACS has also been applied to the computer-based re-creation of flight situations (the SATORI approach) to help assess the causes of incidents or operational errors. ❑

HFACS → JANUS. A controller is interviewed for the JANUS project.

Aeromedical Education: Spatial Disorientation ... and Technology Transfer

R&E Interactions

Interactions between CAMI's research and educational activities have been considerable. They include joint efforts with the hypobaric (altitude) and environmental chambers and with the ditching tank, use of researchers in the presentation of specialty lectures during the training of aviation medical examiners, and use of research findings in physiological and other safety training of pilots by the education staff. But perhaps the most visible and most widely applicable interaction is that related to familiarizing general aviation pilots with spatial disorientation.

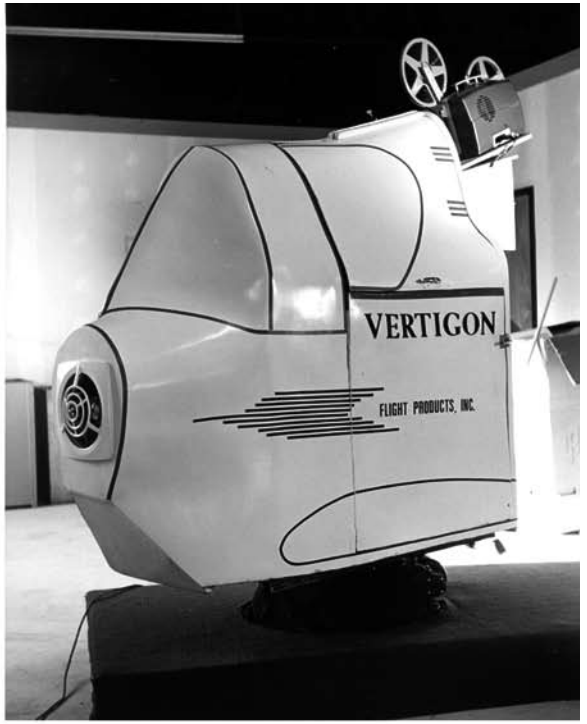
Medic Updates. CAMI researchers regularly provide the latest data in their fields to new aviation medical examiners during their week of basic training.

Spatial Disorientation

Throughout the '60s, spatial disorientation (SD) – sometimes called "pilot's vertigo" – was a significant factor in fatal general aviation accidents – a persistent 16% annually. The physical locus for SD – that is, an incorrect perception of one's position, attitude, and motion relative to the earth – is in the vestibular (motion and gravity sensing) system of the inner ear. To provide a demonstration of false-motion sensing, CAMI's aeromedical education staff used a manually rotatable stool and equipped the student with blinder goggles (which presented two stationary points of light) and a "joystick" (which was used to signal direction of motion). Strong sensations of false motion could be elicited in this manner.

To improve this educational experience, CAMI scientists developed a stimulus profile in the early 1960s using a precision angular accelerator — an elegant Stille-Werner RS-3 rotation device that was primarily used for motion research — to enhance practical demonstrations of SD to aviation medical examiners and groups of visiting pilots. Initially, the chair was fitted with a partial metal surround, the interior of which was coated with luminescent paint so that observers could watch the motion in otherwise total darkness and the "rider" could see only the interior of the surround that, like the cockpit of an aircraft, moved with him and eliminated breeze cues to motion. By the mid '60s, CAMI's engineering support branch had fabricated a sleek cockpit-like enclosure for the rotator that had eye appeal as well as providing capability for expanded motion research.

Developing an Application. Stages in the development of CAMI's angular accelerator for vestibular research and laboratory demonstrations of spatial disorientation.



Research and Education. (Above) The 1969 Vertigon and a replica of the stickers issued to "pilot" riders at safety education events. Harry L. Gibbons, M.D., then-head of the aeromedical research branch, Dr. William E. Collins, scientist and then-head of the psychology laboratory (seated), and Lou Zigler, engineer/president of Flight Products, Inc., are pictured during delivery of the first Vertigon.

(Below) An advanced design of the Vertigon, a Gyro I, and a more recent GAT II spatial disorientation demonstrators.

The Vertigon

The laboratory demonstrations were designed to show how powerful the SD experiences could be in the absence of visual references fixed to the earth and as a result of simple head movements during angular motion. That protocol was designed to induce incorrect but vivid sensations of pitching, climbing, rolling, the absence of experienced movement during real motion, movement in a direction opposite that of real motion, and angular movement in the absence of real motion. The stated lesson was the powerful misperceptions of position and of direction of motion that could occur in flight, and the need to obtain an instrument rating and maintain instrument proficiency.

That compelling demonstration, made one day to a visiting aviation engineering group, led to the joint commercial development of the Vertigon – a portable, enclosed, programmed SD demonstrator. CAMI's technical and procedural specifications and fidelity testing were freely provided in the interest of enhancing aviation safety education. Flight Products, Inc., engineers developed a programmable rotating base that was capable of smoothly accelerating at a predetermined rate to a desired constant velocity and, when decelerated, smoothly coming to a stop. An enclosure was constructed with a rudimentary cockpit interior (including a screen) attached to the base. Projection onto the interior (windscreen) of a motion picture of a flight sequence was added along with sound track directions to the rotating "flyer" to scan the windscreen, search for a map or notebook, or jot down "air traffic" guidance resulting in head movements that would induce compelling vestibular stimulation (including so-called coriolis effects) during the various depicted "flight" maneuvers from take-off to landing. The critical lesson of this experience – the importance of an instrument rating and instrument proficiency - was always a concluding statement.

The first Vertigon was completed in 1969, and its portability and ease of operation resulted its regular use by CAMI's James L. Harris and his aeromedical education staff at numerous airshows and training courses around the country. The Vertigon provided an excellent familiarization for pilots and others regarding the power and degree of misleading information that can characterize spatial disorientation. In fact, CAMI's education staff developed circular red stickers that announced "Wow! I flew the Vertigon" – "riders" at air shows and related safety events wore them proudly.

Advanced Models

A later version of the Vertigon (Vista) in the 80s, two versions (I and II) of the Gyro demonstrators in the 90s, and the GAT II in the 2000s were sleeker in appearance and kept pace with technology advances in electromechanics and the presentation of the "flight," but the basic simulation and procedural paradigms have remained (12).

Virtual Reality. The latest concept in spatial disorientation familiarization was the direct result of ideas from Antuñano when he headed aeromedical education.

However, just before the start of the new century, a novel approach was suggested to the manufacturer by Melchor J. Antuñano, M.D., then-head of CAMI's aeromedical education staff. That approach incorporated virtual reality technology and an external computer screen to monitor the "flight." The device – the Virtual Reality Spatial Disorientation Demonstrator – was manufactured and CAMI immediately put it into use – the first of its kind.

A Useful Tool Internationally

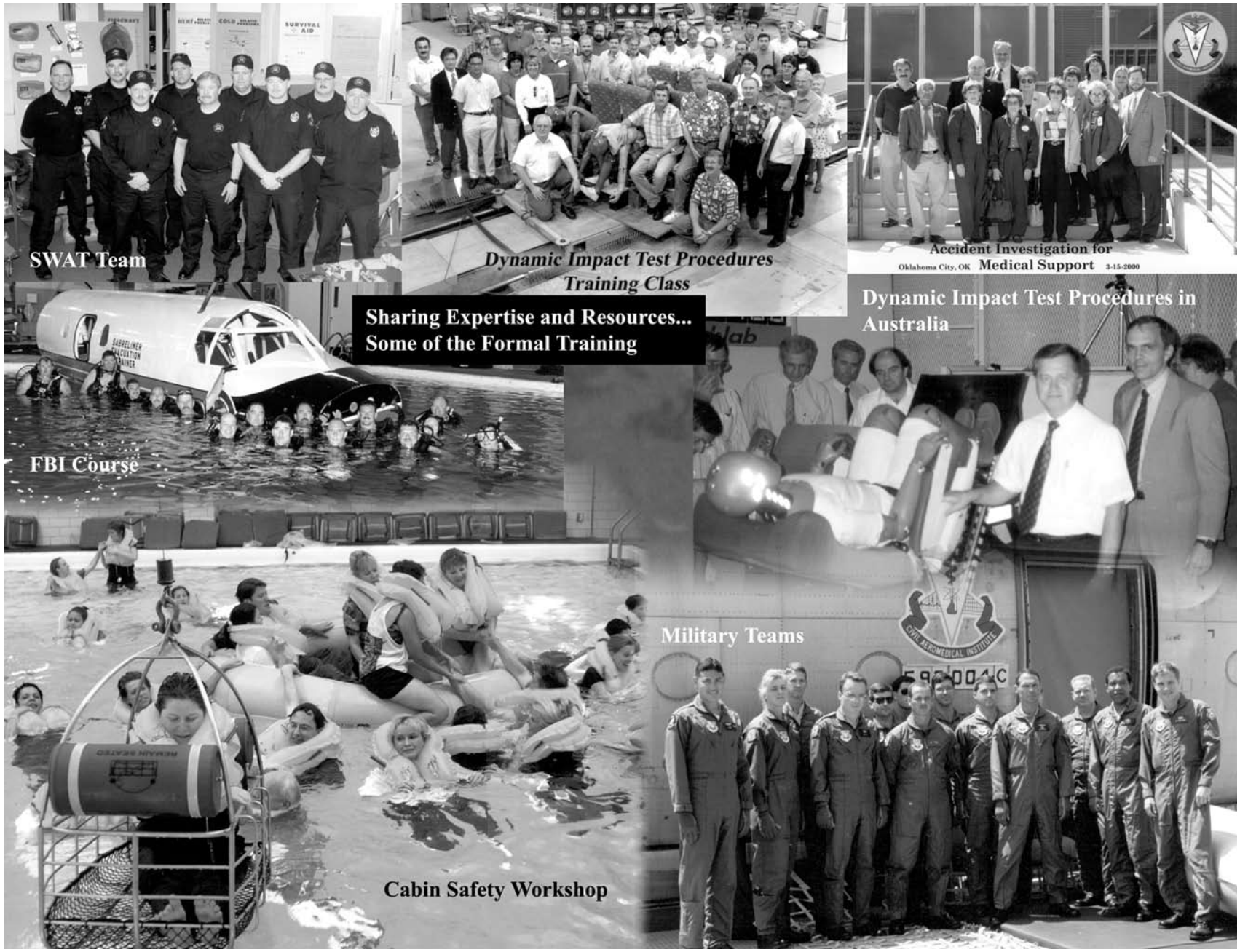
CAMI's aeromedical education specialists have used the Vertigon and its successors at air shows and seminars around the country with great success, as have numerous other aviation safety programs around the world. Tens of thousands of U.S. pilots have "flown" the device over the years. The proportion of private pilots with an instrument rating has climbed slowly, but regularly, along with a small but steady reduction in the proportion of fatal general aviation accidents ascribed to SD – outcomes that appear at least partly attributable to this unique form of educational experience. ❑

Sharing Knowledge...and Resources

CAMI's research outcomes and their by-products have immediate conduits to the FAA, the National Transportation Safety Board, NASA, the National Highway Traffic Safety Administration, the military, and the aviation and aerospace industries. And there are regularly scheduled exchanges with scientific and professional groups. All of these conduits tend to involve regular, intensive, and largely formal interactions…many of which are evident in the preceding sections of this report. But CAMI's contributions and free sharing of knowledge and resources extend to other entities and involve the development and modification of formats at CAMI for providing special opportunities for special groups. For example, many local junior college, college, and university students have gained research experience as summer aides or part-time aides through special student programs or via the participation of CAMI researchers on university faculties. Some other types of opportunities are depicted in this section. They comprise important elements in the conduct, scope, and meaningfulness of CAMI's scientific enterprise…all in support of improving aviation and aerospace safety.


Sharing the Knowledge...Kids Count


Canada
Russia
Taiwan
Japan
Sharing Knowledge...
International Visitors
...A Few of the Many
China
Hungary
England
Norway
CAMI


SWAT Team
Dynamic Impact Test Procedures
Training Class
Accident Investigation for
Oklahoma City, OK Medical Support 3-15-2000
Sharing Expertise and Resources...
Some of the Formal Training
Dynamic Impact Test Procedures in
Australia
FBI Course
Military Teams
Cabin Safety Workshop

References

1) Aviation Committee, Know your civil aviation activities. Oklahoma City Chamber of Commerce, Oklahoma, 1949.

2) Benford, Robert J. Doctors in the sky. Springfield, Illinois: Thomas, 1955.

3) Billings, Charles E. (NASA-AMES; Ohio State University), personal communication, 2005.

4) Branting, Henri, personal communication, 2005.

5) Briddon, Arnold E., Ellmore A. Champie, and Peter A. Marraine. FAA historical fact book (A chronology, 1926-1971). FAA Office of Information Services, 1974, p 74 & 85.

6) Burns, Robert D. Vestibular investigations in mammals. Final Report: FAA Contract No. FA-3039, University of Oklahoma, Norman, Oklahoma, 1964.

7) Carter, Earl T., personal communication, 2005.

8) Chandler, Richard F., personal communication, 2005.

9) Civil Aeronautics Administration Aeronautical Center. Telephone directory. Oklahoma City, Oklahoma, September 1958.

10) Civil Aerospace Medical Institute. Shiftwork coping strategies. Key Multimedia Solutions, 2001.

11) Collier, B. In his own words an Atlanta psychiatrist worries over air traffic controllers who crack under the strain. An interview with Dr. Morton Berger. People, 8, 54-58, 1977.

12) Collins, William E. Effective approaches to disorientation familiarization for aviation personnel. Report No. DOT/FAA/AM 70-17, Oklahoma City, Oklahoma, 1970.

13) Collins, William E. Problems in spatial orientation: Vestibular studies of figure skaters. 16 mm color film. (converted to videotape): 28 minutes. FAA/CARI, Oklahoma City, Oklahoma, 1964.

14) Collins, William E. Vestibular adaptation and figure skaters: Finding obtained during skating performances. 16 mm color film (converted to videotape): 15 minutes. FAA/CARI, Oklahoma City, Oklahoma, 1964.

15) Demaree, James. Examination of aircraft interior emergency lighting in a postcrash fire environment. Report No. DOT/FAA/CT 82-55, Atlantic City Airport, New Jersey, December 1980.

16) Department of Transportation, FAA. 14 CFR Parts 25 and 121. Floor proximity escape path marking. Notice of proposed rulemaking. Federal Register, 48 (No. 197), October 11, 1983.

17) Dille, J. Robert and Marcia Grimm. Background of FAA aeromedical research: Forty years in Oklahoma City. In Dille, J.R. and M. Grimm Index to FAA Office of Aviation Medicine Reports: 1961 through 1986. DOT/FAA Report No. AM-87-1, iii-vi, Oklahoma City, Oklahoma, 1987.

18) FAA Aeronautical Center. Survey of organization of Aeronautical Center. Oklahoma City, Oklahoma, 1965.

19) FAA Aeronautical Center. Telephone directory. Oklahoma City, Oklahoma, March 1959.

20) FAA Aeronautical Center, Public Affairs. Aeromedical research center studies vertical deceleration. Beacon, Oklahoma City, Oklahoma, November 1959.

21) FAA Aeronautical Center, Public Affairs. (1) Medical research center. (2) CARI publishes research. Beacon. Oklahoma City, Oklahoma, February 1960.

22) FAA Aeronautical Center, Public Affairs. (1) CARI gets new director. (2) CARI moves to Norman. Beacon. Oklahoma City, Oklahoma, September 1960.

23) FAA Aviation Medical Library. Aviation medical papers and reports: A bibliography. Report No. FAA/AM 64-20, Oklahoma City, Oklahoma 1964.

24) FAA Bureau of Aviation Medicine. Dr. Robert T. Clark heads agency's CARI. Medical Newsletter, Washington, D.C., 1 (No. 4), 1960.

25) FAA Office of Aviation Medicine. National Directive No. N1100.271, Washington, D.C., May 24, 2001.

26) FAA Office of Public Affairs. (first) FAA Employee Attitude Survey results: Agency-wide and Washington Headquarters. Washington, D.C., VHS, 1984.

27) FAA Office of Public Affairs. (third) FAA Employee Attitude Survey results: Directors Management Team meeting. Virginia, VHS, 1988.

28) Garner, J.D., personal communication, 2005.

29) Holbrook, Heber A. Civil aviation medicine in the bureaucracy. Banner Publishing Co., Bethesda, Maryland, 1974.

30) Johnson, Myrna. Civil Aeromedical Research Institute, 1959-1966. ln Collins, W.E. and M.E. Wayda. Index to FAA Office of Aerospace Medicine Reports: 1961 through 2000. DOT/FAA Report No. AM-03-1, v-viii, Oklahoma City, Oklahoma, 2003.

31) King, Barry G. and John J. Swearingen. Some biological factors in the design of civil aircraft. Journal of Aviation Medicine., 1948, 19, 414-419, 441.

32) Leshner, Alan I. Don't let ideology trump science. Science, 2003, 302, (28 November), 1479.

33) Lewis, Mark F. Current research in marijuana. New York: Academic Press, 1972.

34) Lindsey, David. Developing an effective floor proximity escape path lighting system for commercial aircraft: a technical and historical perspective. Plumly Industries, Inc. Report, Fort Worth, Texas, May 31, 1985.

35) Lopez, Cornelio O. Development of civil aviation in the FAA. Office of Civil Air Surgeon, FAA, Mimeographed Report, Washington, D.C., 1959.

36) Martindale, D. Sweaty palms in the control tower. Psychology Today, 1977, 10, 73-75.

37) McFadden, Ernest B. and John J. Swearingen. Forces that may be exerted by man in the operation of aircraft door handles. Human Factors 1958-1959, 1(1), 16-22.

38) McFadden, Ernest B., John J. Swearingen, and C.D. Wheelwright. The magnitude and direction of forces that man can exert in operating aircraft emergency exits. Human Factors, 1958-1959, l (4), 16-28.

39) Miller, M. Clinton III. Investigation of the training-performance criteria for several Federal Aviation Agency occupational specialties. Final Report: FAA Contract No. FA/AC-4-730, University of Oklahoma Medical Center, Oklahoma City, Oklahoma, 1964.

40) Mohler, Stanley R., personal communication, 2005.

41) Olson, Enar B. Projected growth of the Aeronautical Center. FAA Memorandum for the Record. FAA Aeronautical Center, Oklahoma City, Oklahoma, February 29, 1960.

42) Plumly Airborne Products. Preliminary design approach: advanced egress lighting system for compliance with DOT, FAA 14 CFR parts 25 and 121 floor proximity emergency escape path marking and Final Rule. Plumly Industries, Inc. Report, Fort Worth, Texas. January 1985.

43) Plumly Airborne Products. Plumly Airborne Products advanced incandescent egress lighting systems. Plumly Industries, Inc. Report, Fort Worth, Texas, March 29, 1985.

44) Pollard, Donell, personal communication, 2005.

45) Pritchett, Becky (Aeronautical Center, Office of Facility Management, Architecture and Engineering Division), personal communication, 2005.

46) Prochorff, A. Military controllers jumped into the breach. FAA World, 1982, 12 (1), 14-17. (Excerpted from "A towering effort" in Airman Magazine, November 1981).

47) Preston, Edmund (Ed). FAA historical chronology (civil aviation and the federal government, 1926-1996). FAA Office of Public Affairs Publication, Washington, D.C., 1998, p. 49.

48) Quesada, E.R. Authorization of medical research buildings. FAA Memorandum from the Administrator to the Director, Aeronautical Center. June 1, 1960.

49) Quesada, E.R. Supplemental authorization for the medical research building. FAA Memorandum from the Administrator to the Acting Manager, Aeronautical Center. July 28, 1960.

50) Smith, John E. The organizations and functions of the Office of Civil Air Surgeon, Federal Aviation Agency. Aerospace Medicine. 1959, 30 (7), 471-475.

51) Smith, Warren W. What's new in aviation safety. In: CAA Aero. Center "Beacon," Oklahoma City, Oklahoma, May 3, 1950 (vol. 1, no. 2).

52) Swearingen, John J. A ten-year history of human factors research: 1948-1958. CD, 35 min.

53) Swearingen, John J. Design and construction of a crash dummy for testing shoulder harness and safety belts. CAMRL preliminary report. CAA Aeronautical Center, Oklahoma City, April 1951.

54) Swearingen, John J. Design and construction of an adjustable cockpit mockup. CAMRL Report No. 1 (Project No. Biotechnology 2-48). CAA Aeronautical Center, Oklahoma City, July 1949.

55) Swearingen, John J. Determination of the most comfortable knee angle for pilots. CAMRL Report No. 1 (Project No. Biotechnology 3-48). CAA Aeronautical Center, Oklahoma City, May 1949.

56) Teal, M. Improved interior emergency lighting study. Report No. DOT/FAA/CT 83-31. Atlantic City Airport, New Jersey, (Sept.) 1983.

57) Tobias, Jerry V. (Ed.). Foundations of modern auditory theory. Vol. I and II. New York: Academic Press, 1970 and 1972.

Appendix

Historical Vignettes

These historical vignettes capture different aspects of the CARI/OAM research story. They have been published previously in the OAM series as prefaces to some of the periodically issued cumulative indexes of OAM research reports as a means of preserving historical perspectives. Because that context tends not to highlight their presence, the vignettes are reproduced here in the interest of incorporating in a single document the additional history they provide. The vignettes are presented in the order in which they appeared in the Index issues, viz., in OAM Reports No. AM 87-1, 97-1, 98-1, 01-1 (2 vignettes), 03-1 (2 vignettes), and 05-1.

BACKGROUND OF FAA AEROMEDICAL RESEARCH

Forty Years in Oklahoma City

By J.R. Dille, M.D., and Marcia Grimm

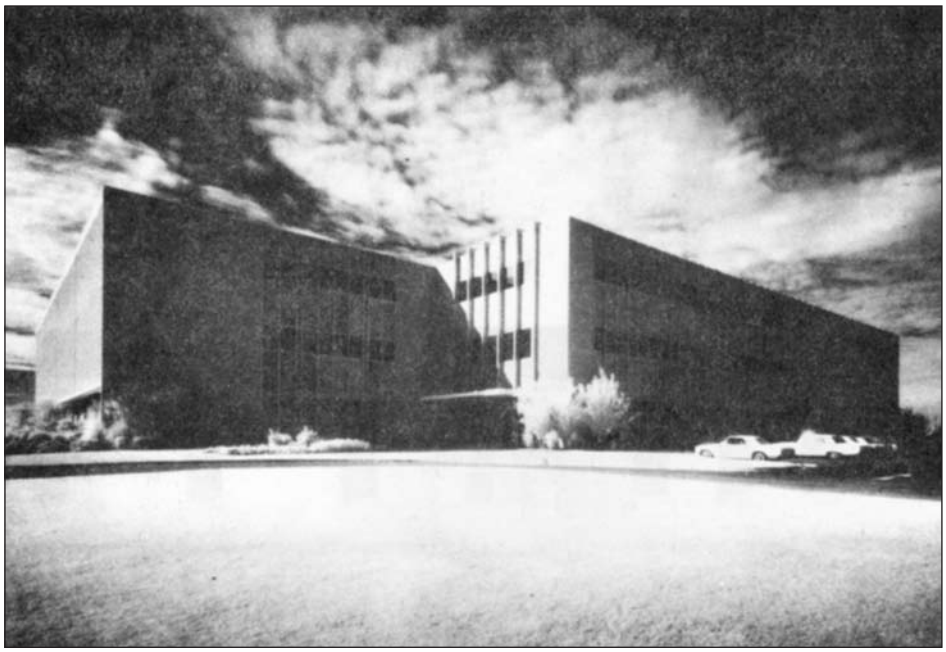
Dormant medical research plans at the Civil Aeronautics Administration (CAA) Standardization Center in Houston were transferred to the new Aeronautical Center at Will Rogers Field, Oklahoma City, in 1946. Dr. W.R. Stovall, Director, Aviation Medical Service, planned to name the program the Aviation Medical Development Center to be headed by a deputy to him. When the medical facility actually opened in late 1947--40 years ago--it was the Aviation Medical Branch of the Aeronautical Center. John J. Swearingen joined the staff as a senior scientist in October 1947; Ernest B. McFadden and J.D. Garner followed soon after. In 1948, research reports started to appear from the, by then, Civil Aeronautics Medical Research Laboratory (CAMRL).

CAMRL, CAA Aeronautical Center, Oklahoma City, OK

"The lack of enthusiasm within the CAA and the Department of Commerce hierarchy to pursue research projects which could prove costly to the aviation industry appears to have been a source of constant friction between Dr. Stovall and federal officials having flight operations and regulating duties." This problem, plus a perceived need to have the resources of a large university nearby, resulted in the transfer of CAMRL to the campus of the Ohio State University School of Medicine effective July 1, 1953. CAA Administrator James T. Pyle ordered CAMRL moved back to the Aeronautical Center on June 30, 1958, where it became the Protection and Survival Branch of the new Civil Aeromedical Research Institute (CARI) in late 1959.

Twenty-fifth Anniversary of CARI Building

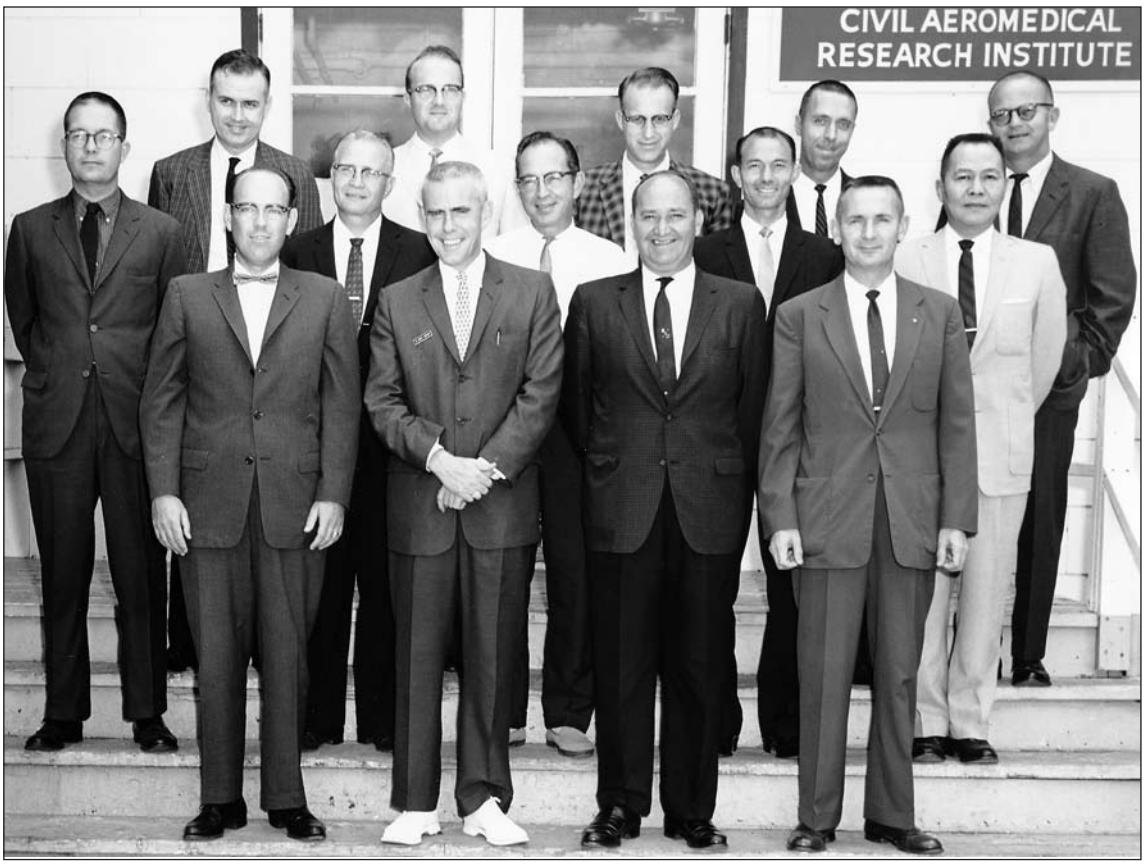
On August 8, 1961, Dr. Stanley R. Mohler became director of CARI. He guided the final staff design, dedication, and occupancy of a new building and fostered development of the research program. A few classic CAMRL reports were reprinted as CARI Reports 62-1, 62-14, and 63-9.



CARI, FAA Aeronautical Center, Oklahoma City

At the dedication of the CARI building, on October 21, 1962, FAA Administrator Najeeb E. Halaby distinguished between CARI as a concept and CARI as a building. Initially, the building contained the Aeromedical Standards Division and the Aeromedical Certification Division, both national operational medical responsibilities of the FAA, in addition to civil aeromedical research.

In December 1965, CARI became the Aeromedical Research Branch of the Civil Aeromedical Institute (CAMI). Also included in CAMI were the medical certification program; the aeromedical education program; positions from the Georgetown Clinical Research Institute, which was closed in 1966; and clinical and industrial hygiene responsibilities. Dr. J. Robert Dille was named chief of CAMI in 1965 and has continued to serve as manager of the institute, which now has five branches: the Aeromedical Certification Branch, the Aeromedical Education Branch, the Aeromedical Research Branch, the Human Resources Research Branch, and the Aeromedical Clinical Branch.



Key personnel in the FAA medical program in the early 1960's, left to right,

First row: Stanley R. Mohler, M.D., Director, CARI, 1961-65, and later, Chief, Aeromedical Applications Division, in FAA Headquarters
James L. Goddard, M.D., Civil Air Surgeon, 1959-62;
George R. Steinkamp, M.D., Deputy Civil Air Surgeon for Research and Operations, 1962-63;
Peter V. Siegel, M.D., Chief, Aeromedical Certification Division, 1962-65, and later, Federal Air Surgeon

Second row: Herbert C. Haynes, M.D., Staff Psychiatrist
Paul W. Smith, Ph.D., Chief, Pharmacology-Biochemistry Branch, CARI
John J. Swearingen, Chief, Protection and Survival Branch, CARI
P.F. Iampietro, Ph.D., Chief, Physiology Branch, CARI
P.C. Tang, Ph.D., Chief, Neurophysiology Branch, CARI

Third row: William R. Albers, M.D., Chief, Aeromedical Standards Division, 1962-64;
J. Robert Dille, M.D., Program Advisory Officer, CARI, and later, Chief, CAMI
Vaughan E. Choate, CARI Executive Officer
Michael T. Lategola, Ph.D., standing in for Bruno Balke, M.D., Chief, Biodynamics Branch, CARI
George T. Hauty, Ph.D., Chief, Psychology Branch, CARI

The Civil Aeromedical Institute Facility In Its 35th Year

By Stanley R. Mohler, M.D., and William E. Collins, Ph.D.*

The CARI Building and Its Mural

The building that houses the Civil Aeromedical Institute was dedicated and formally opened on a sunny, pleasant Sunday in October 1962. The facility was constructed as a research building and was initially named the Civil Aeromedical Research Institute (CARI). In 1965, its mission expanded: CARI became the Aeromedical Research Branch of the Civil Aeromedical Institute (CAMI), and the building was accordingly renamed. Aeromedical certification and education, along with clinical and industrial hygiene responsibilities were and remain, the other components of CAMI.

Prelude

The first Civil Air Surgeon of the newly established Federal Aviation Agency (1958), was James L. Goddard, M.D., a Public Health Service officer. He reported directly to the first FAA administrator, General Elwood Quesada (USAF, Ret.), and was "seconded" to the FAA as an active duty Public Health Service officer. General Quesada had authorized the establishment of the Civil Aeromedical Research Institute (CARI - now the Civil Aeromedical Institute, or CAMI) and Dr. Goddard set about implementing its staffing and the construction of a new building for it. Detailed documentation of the measures that led to the establishment of the FAA, the

The CARI Building during construction in 1961. The barracks buildings in the background are remnants of the Will Rogers Army Air Base, built during World War II.

*Stanley R. Mohler, M.D., served as the first CARI director. He is now dean of the Aerospace Medicine program at Wright State University School of Medicine. William E. Collins, Ph.D., is the current director of the FAA Civil Aeromedical Institute. He was also present at the dedication of the new building in 1962.

Civil Air Surgeon position, and the Institute (CARI) are contained in the book Civil Aviation Medicine in the Bureaucracy (1), by Heber A. Holbrook. Some additional historical background by J.R. Dille, M.D. appears in the Preface of Office of Aviation Medicine Report DOT/FAA/AM/87-1 (2).

The original facility was a product of the Oklahoma City Airport Trust, which had started an innovative building program after World War II, aimed to entice government agencies, especially the FAA, to place organizational entitles at the Aeronautical Center (now the Mike Monroney Aeronautical Center), located at Will Rogers World Airport in Oklahoma City. The Trust program issued bonds that provided money to build structures necessary to house various FAA components at the Aeronautical Center. The FAA leased from the Trust the various individual facilities that were tailor-made to the needs of various offices and services.

The CARI Building

In 1960, while occupying temporary quarters in wooden barracks (built to house sailors at the now-closed U.S. Navy base) at Westheimer Field in Norman, Oklahoma, on the North Campus of the University of Oklahoma, the scientists at CARI set to work laying out their individual laboratory plans in a customized approach. This was probably one of the few times in history that a group of scientists — psychologists, physiologists, anthropologists, crash-worthiness engineers, and other specialists —actually designed and, within three years, moved into, a large technical bio-medical research space they had planned.

The CARI building was initially to be located directly to the west and across the street from the Aeronautical Center manager's building. The manager, Mr. Lewis Bayne, decided to relocate the CARI site to the south about a city block in distance. He felt that, since some animal research was projected at that time, a more remote location would be desirable. The change was accomplished without the knowledge of the medical personnel or of newly-appointed CARI director, Stanley R. Mohler, M.D., until ground breaking started. In the long-run, the more distant location proved ideal. However, in the "short" run, it led to pulling some non-research components (including medical certification) out of the building and locating them in the Airman Records Building (near the Center's consolidated records computer facilities).

The CARI Dedication Program

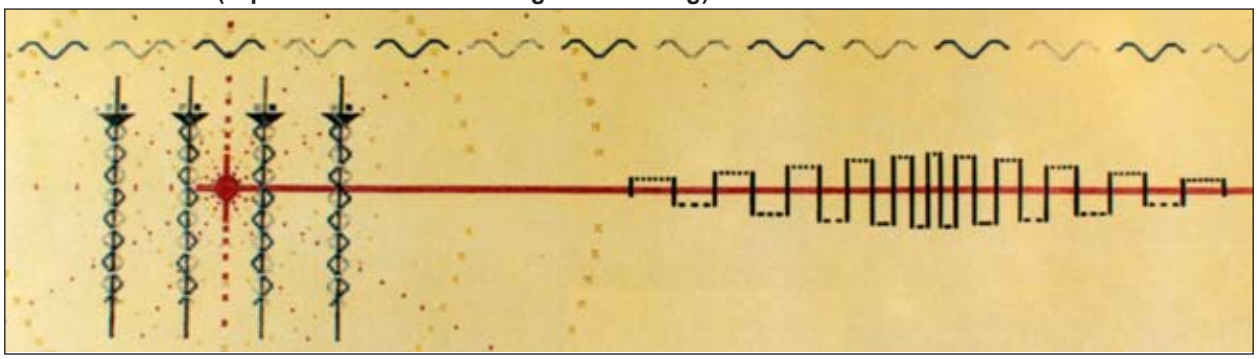
On October 21,1962, an outdoor ceremony was held at 3 p.m. to dedicate the new Civil Aeromedical Research Institute. On the previous day, a scientific seminar had been held in the auditorium of the Aeronautical Center manager's building, and that night, the immortal Jimmy

FAA Administrator Najeeb Halaby speaking at the dedication ceremony.

Doolittle gave a banquet talk in downtown Oklahoma City in honor of the Institute; the text of that talk appeared in the column "Aviation Medicine Heritage" by J.R. Dille, M.D., published in Aviation, Space and Environmental Medicine (3).

The outdoor dedication ceremony was conducted on the north side of the Institute and was attended by FAA Administrator Halaby and Acting Civil Air Surgeon, Don Estes, M.D. (Dr. Goddard had departed the FAA on September 1, 1962). Speakers included Oklahoma Senator Mike Monroney and Congressmen Tom Steed and Jon Jarman. Texan Albert Thomas, the powerful Chairman of the House Independent Agencies Appropriation Subcommittee covering the FAA, also attended. Local Oklahoma business leaders and other officials participated, including one of the most famous military and civilian flight surgeons, Randolph Lovelace, II, M.D. Mr. Delos Rentzel, former head of the Civil Aviation Administration (predecessor of the FAA), served as Master of Ceremony and Mr. Halaby delivered the keynote dedicatory address. A 45-minute movie was made of the ceremony (and is available at the Institute).

The CARI mural (reproduced from the original drawing).



The CARI Mural

A spacious entrance to CARI was designed by Hudgins, Thompson, and Ball, (the "HTB" architectural firm for the Aeronautical Center). A highlight of the entrance was to be a large, multi-colored tile mural that, following the architectural designers' rendition, would be prepared through a computer program by a subcontractor. The mural was delivered in sub-assembled tile blocks, with the proper colored tiles in the proper places (the individual tiles are about one inch on each side) to be glued in strips to the wall. The mural design covered the west wall of the entrance lobby.

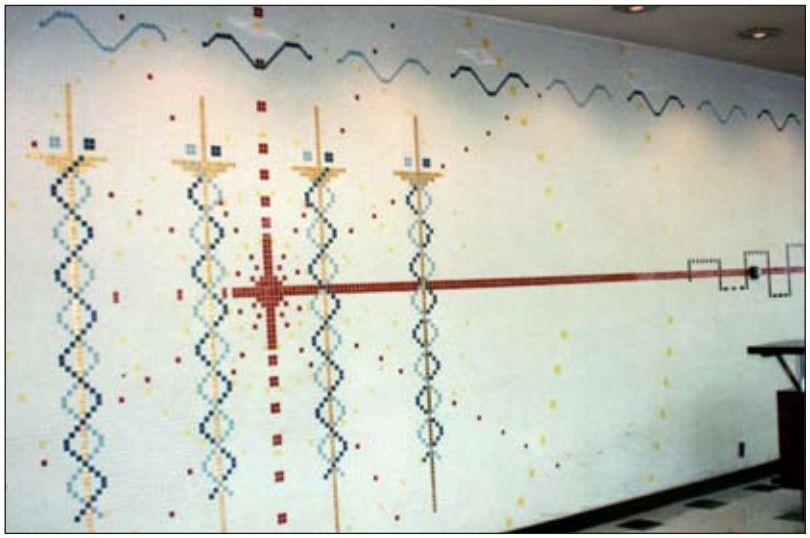
The mural that went into the rapidly evolving CARI building was computer designed (perhaps the first to be so done for a federal building) by an employee of the architectural firm and was of a somewhat abstract nature. The design had a symbolic supersonic transport with a shock wave and a symbolic biomedical electrical signal as obtained in research data collection. The four main aeromedical areas — research, standards, certification, and education/preventive medicine — were abstractly portrayed by caduceus renditions. Above the mural, a series of head-on bird silhouettes denoted airmen.

By October 1962, the entire mural was in place. It drew many favorable comments. Dr. Mohler had clocks put around the upper margins of the lobby walls to show the various world time zones. Visitors were brought through for tours of the new building prior to the its dedication. The visitors uniformly went away with a very positive feeling about the Institute, and they were impressed with the total effect of the structure and interior as being very modern (and they liked the mural).

The Airman With a Waiver

There was an accidental misplacement of a single tile (it is located one tile space lower than its proper position) on the wing tip of one of the symbolic airmen (a bird) near the ceiling of the erected mural (the second bird from the left). While leading a dedication-day tour through the building, a guest in a crowd of visitors teased Dr. Mohler, pointing out the error, proclaiming loudly, "There's an error in your mural." Dr. Mohler's immediate response was, "That's no error! That's an airman flying on a waiver!"

The visitors loved it.



1. Holbrook, Heber A. Civil Aviation Medicine in the Bureaucracy. 1974. Bethesda, MD:Banner Publishing Co. (Library of Congress 74-82414).
2. Dille, J.R., and Grimm, M.H. Index to FAA Office of Aviation Medicine Reports: 1961 through 1986. Washington, DC: DOT/FAA; 1987. FAA report no. DOT/FAA/AM/87-1. (#ADA180281).
3. Dille, J.R. Aviation Medicine Heritage. Aviation, Space and Environmental Medicine. 1987, *58*, 1036-7.

A portion of the CAMI lobby with the tile mural. (The "airman on a waiver" is in the upper left corner.)

ORIGIN OF THE JET PASSENGER DROP-OUT OXYGEN SYSTEM AND THE DOUBLE PANE PROTECTIVE DECOMPRESSION WINDOWS

By Stanley R. Mohler, M.D.
and William E. Collins, Ph.D.

JOHN J. SWEARINGEN retired from the Civil Aeromedical Institute (CAMI) as Chief of the Protection and Survival research program in 1971. His many accomplishments in the areas of crash injury protection, human tolerances to abrupt acceleration forces, and proper restraint system design are widely known in the aerospace safety field.

Somewhat less well known is his earlier work (1950s) that anticipated the need in the evolving generation of jet passenger aircraft for passenger drop-out emergency oxygen equipment and his passenger window designs that afforded protection should a window under pressurization forces be lost.

On October 15, 1957, John Swearingen and colleague Ernest B. McFadden patented an "adhesive-type oxygen mask" and an automatic drop-out mechanism, both of these for airline passenger protection in the event of a decompression at altitudes where passenger oxygen is desirable (U.S. Patent 2,809,633). Both Swearingen and McFadden were researchers at the Civil Aeronautics Medical Research Laboratory, a forerunner of the Civil Aeromedical Institute, located at various times in Columbus, Ohio, and Oklahoma City, Oklahoma. The mask and automatic drop-out apparatus were first described in a presentation on April 15, 1956, at the 27th annual meeting of the Aeromedical Association (now the Aerospace Medical Association) held in Chicago. The presentation was published (1) in the February 1957 issue of the *Journal of Aviation Medicine* (now *Aviation, Space, and Environmental Medicine*).

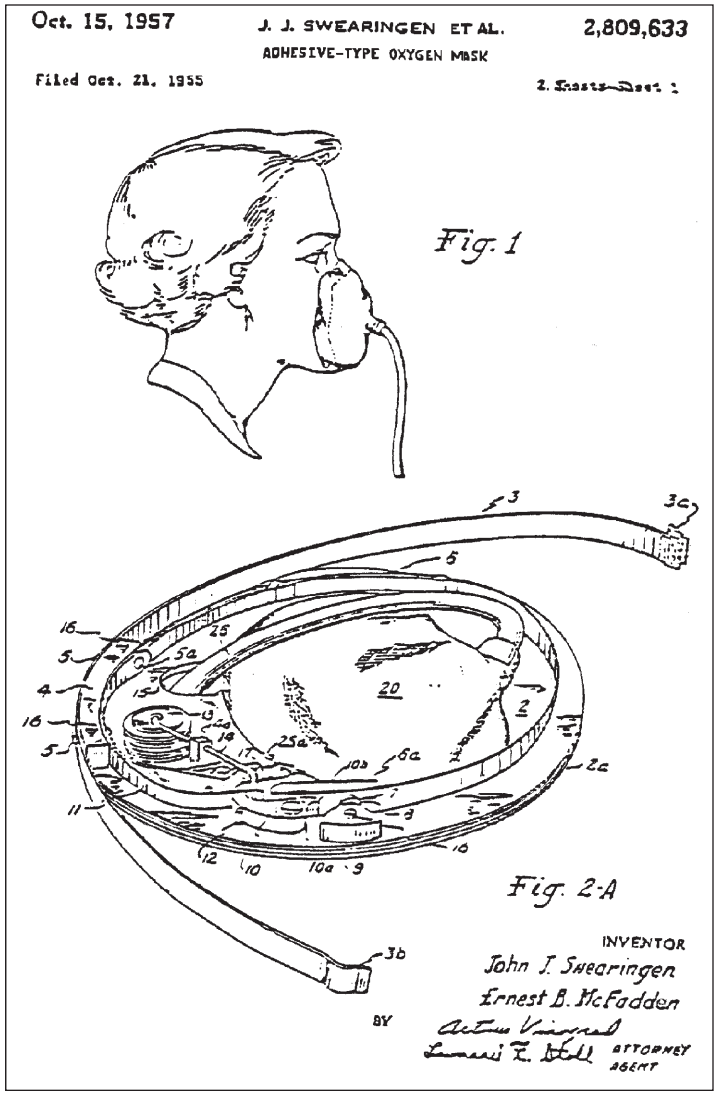


Figure 1. A replica of part of the Swearingen-McFadden original patent. The patent covers the total passenger emergency oxygen system, including the automatic drop-down mechanism triggered by altitude and the associated adhesive oxygen mask. The descriptive emphasis was on improving protection of the passenger, rather than on the release mechanism.

The accomplishments by Swearingen and McFadden in developing the oxygen drop-out mechanism with a proposed new passenger mask were reflected in the equipment carried by the first generation of passenger jets, the Boeing 707, the Douglas DC-8, and the Convair 880. Although the adhesive mask proposed by Swearingen and McFadden provided a superior seal to the passenger masks actually installed in those early flights, industry concern with the shelf life of the then-available adhesive material precluded introduction of the adhesive mask. However, the presentation aspects they developed, with automatic deployment of the mask should the cabin of an airliner exceed a given altitude (12,000 - 14,000 foot range), are in use today.

With respect to high altitude pressurized cabin flight, instances of occupant ejection through a failed window of a pressurized aircraft began to occur with the World War II era. Large pressurized piston engine aircraft retained the large, single pane window design of unpressurized aircraft. As altitudes increased, window failures occurred for one or another reason. The rapid outflow of the air from within would at times bring objects in the airflow path through the window to the outside, including any hapless human who was nearby and unrestrained.

Figure 2. A typical work-setting photo of John Swearingen in CAMI's "high bay" area during 1963. Long-time associate J.D. Garner stands in the background.

Swearingen began his airflow studies in the 1950s and conducted further studies through the transition of the Civil Aeronautics Medical Research Laboratory to the Civil Aeromedical Research Institute to CAMI. His early work revealed the utility of utilizing double pane windows so that, should the outer pressure-bearing window fail, orifices at the perimeter of the inner window would allow the airflow to escape, leaving the inner window pane intact. This double pane safety concept was introduced in the first generation of jet passenger aircraft. Swearingen worked out a series of profiles that illustrated the safe distance of a passenger from a lost single pane window of various diameters. These profiles are published in the 1963 report, "Studies of Airloads on Man" (2). The report provided data for design engineers of aircraft with respect to specifications for windows that enhance air safety should an airliner decompress during its flight profile.

This historical summary is prepared in recognition of the pioneering work accomplished by personnel of the Civil Aeromedical Institute and its predecessor organizations. Other brief historical summaries regarding the Institute are available elsewhere (3, 4, 5).

References

1. Swearingen, J.J. An adhesive type oxygen mask. *Journal of Aviation Medicin*e, 1957, *28*, 19-22.

2. Swearingen, J.J. and McFadden, E.B. Studies of air loads on man. Oklahoma City, OK: 1963. Civil Aeromedical Research Institute Report. No. 63-9. NTIS #AD602207.

3. Dille, J.R. and Grimm, M.H. Index to FAA Office of Aviation Medicine Reports: 1961 through 1986. Washington, DC: 1987. FAA Report No. DOT/FAA/AM/87-1. NTIS #ADA180281

4. Dille, J.R. Aviation Medicine Heritage. *Aviation, Space and Environmental Medicine*, 1987, *58*, 1036-7.

5. Mohler, S.R. and Collins, W.E. The Civil Aeromedical Institute facility: In its 35th year. In: Collins, W.E. and Wayda, M.E. Index to FAA Office of Aviation Medicine Reports: 1961 through 1996. Washington, D.C: 1997. FAA Report No. DOT/FAA/AM 97-1. NTIS #ADA322331

SOME HISTORICAL OBSERVATIONS OF CARI/CAMI 1960-1984

By S.R. Mohler, M.D., K.A. Hayes, and W.E. Collins, Ph.D.

Completed in 1962, the Civil Aeromedical Institute is the home of aeromedical research, certification, education, and occupational health programs (photo circa 1985).

The Civil Aeromedical Research Center, later called the Civil Aeromedical Research Institute (CARI), was established in August 1960 to develop medical data to meet the problems of civil air operations as civil aviation moved into higher altitudes and supersonic speeds. CARI was placed under the executive and technical direction of the Research Requirements Division, Bureau of Aviation Medicine. Hilliard D. Estes, M.D., a physician in the U.S. Public Health Service, was appointed the first Medical Director of CARI, and Robert P. Clark, Ph.D., was appointed the first Research Director. This dual-directors situation resulted in some confusion regarding primacy of roles, but was resolved when, on August 7, 1961, S.R Mohler, was appointed Director of the Civil Aeromedical Research Institute, and William E. Collins, Ph.D., was already recently onboard instituting vestibular and visual research. There were approximately 20 full-time scientists and research support personnel at the new institute plus additional administrative and secretarial staff.

CARI consisted of an Office of the Director, Audio Visuals Service and Research Engineering, and six branches specializing in the areas of biochemistry, biodynamics, environmental physiology, psychology, protection and survival, and neurophysiology. A total of 21 positions was authorized in the operations appropriation for CARI at that time. Researchers concentrated on the following types of projects: (1) man's aging process and the relation to chronological age and pilot proficiency; (2) selection criteria for an environmental stress factors experienced by air traffic controllers; and (3) inflight fatigue affecting flight engineering on jet aircraft. Researchers were housed in several temporary wooden buildings and a gymnasium that were owned by the University of Oklahoma and located at Westheimer Field (a former World War II naval aviation training base) in Norman, Oklahoma, until the CARI Building was completed in October 1962.

The scientists noted above had drawn up their respective aeromedical research projects and had planned and designed the layout for their individual laboratory space in the emerging new 220,000 square foot, four level (one level underground) medical research building at the Aeronautical Center, Will Rogers Field, Oklahoma City. This was said to be the first time that an enthusiastic cadre of scientists had a major role in the design and preparation of their future institute's laboratories.

The scientists were drawn from the US Air Force at Randolph Field, the US Army, the University of Oklahoma Medical School, Ohio State University (the group of protection and survival research personnel led by John J. Swearingen who had previously been moved from the Aeronautical Center to Ohio State University by the Civil Aviation Administration and were now being returned by the FAA to Oklahoma), and other organizations.

In June 1962, the Office of the Deputy Civil Air Surgeon for Research and Operations and the Certification, Research, and Standards Divisions under the Civil Air Surgeon in FAA Headquarters were all moved to Oklahoma City. Also, as a part of this move, the Washington Office Clinic became a part of a new medical Clinical Services Division. The Deputy Civil Air Surgeon was established to provide centralized medical standards, certification, research, and clinic activities for the agency. The only medical operation retained at FAA Headquarters at that time was program planning and management in the immediate Office of the Civil Air Surgeon. The Deputy Civil Air Surgeon's charge consisted of a Medical Research Division (which included CARI and FAA's Clinical Research Institute in Georgetown), Medical Clinical Services division, Medical Certification Division, and Medical Standards Division. A total of 112 positions was allocated to this organization. This included 50 positions in the operations appropriation and 62 in the facilities, engineering, and development (FE&D) appropriation.

As the scientists settled into the new CARI facility during the fall of 1962, and began their respective aeromedical research studies, a troubling cloud appeared in the form of a Congressional House of Representatives mandated budget ceiling on personnel and funding for the new institute, imposed by Mr. Albert Thomas, then congressman from Houston, Texas, and a powerful appropriations committee chairman. There was, at that time, some tension between Mr. Thomas and Oklahoma Senator Robert S. Kerr regarding the establishment of several FAA and NASA sites.

The planned institute staffing of 212 persons was formally cut back to 100. Recruiting activities for scientists and research support personnel were slowed and the number of planned projects was reduced. The time of the Institute's scientists was concentrated on regrouping and reformulating their research plans, and the new Director and the branch chiefs spent much time juggling priorities. When the new institute building was dedicated in October 1962, Mr. Najeeb Halaby, FAA Administrator, invited Mr. Thomas to participate in the proceedings. Senator Kerr had passed away by this time, but Mr. Thomas' concerns did not seem to have been relieved. Senator Mike Monroney of Oklahoma participated in the dedication and the discussions at that time between Mr. Thomas and Senator Monroney may actually have been primarily responsible for saving the Institute from a support perspective. At the evening dedication banquet, the featured speaker was Jimmy Doolittle who told of the important role flight surgeons had performed during his illustrious aviation career.

A peculiar development had occurred in 1960-61 in that the FAA instituted the Georgetown Clinical Research Facility (approximately 20 persons in 1961), later renamed the Georgetown Clinical Research Institute (GCRI). The purpose of the GCRI was to study "longitudinal" pilot aging and look for ways to make individual exceptions to the 1961 FAA "age 60" mandatory retirement regulation for airline pilots. It developed that a similar longitudinal research program on airline pilots was established in 1960 by the National Institutes of Health (NIH) at the Lovelace Foundation, Albuquerque, New Mexico, with the help of S.R. Mohler, M.D., a Public Health Service officer in the Center for Aging Research at NIH, who was about to be offered the Directorship of CARI. It also developed that certain FAA headquarters personnel proposed closing CARI and enlarging the GCRI as they felt it more convenient to administer a medical research program in the same town as FAA headquarters rather than one in Oklahoma. These Washington personnel had to take propeller airline aircraft on their periodic trips to Oklahoma City, a circumstance requiring a full day and multiple stops at the time.

As assessment of the FAA Headquarters/Aeronautical Center medical structure in December 1962, resulted in the abolishment of the Office of the Deputy Civil Air Surgeon and the transfer of the Standards Division back to FAA Headquarters to augment the Civil Air Surgeon in a major realignment of the Aviation Medical Service.

The other existing medical divisions at the Aeronautical Center were retained and reported directly to the Civil Air Surgeon.

In January 1964, CARI was placed under the executive and technical direction of the new Washington-based Aeromedical Education and Research Division in the Aviation Medicine Service. At that time, under Federal Air Surgeon M.S. White, M.D., the Georgetown Clinical Research Institute became a branch of this new division which was established to plan and direct research activities at a national level. However, this was later changed in July 1965, when Administrator Halaby directed that the medical research program be managed directly by the Federal Air Surgeon.

The CARI medical certification, research, and clinic activities were reorganized into one division in October 1965. At that time, the Institute was renamed the Civil Aeromedical Institute (CAMI) and was placed under the executive direction of the new Aeronautical Center Director, Mr. Lloyd Lane. Technical direction continued to be provided by the Federal Air Surgeon. CAMI consisted of four branches – Administrative and Technical Branch, Aeromedical Certification Branch, Aeromedical Research Branch, and Aeromedical Services Branch. J. Robert Dille, MD, was named chief of CAMI in December 1965. A total of 172 positions (93 operations and 79 RE&D) were authorized to CAMI at that time, representing what proved to be a one-year reduction of 21 RE&D positions.

The issue of CARI versus GCRI was settled by the Government Accounting Office in a report that recommended closing GCRI due in part to its duplication of the NIH supported Lovelace longitudinal aging study of pilots. The new Federal Air Surgeon, Peter Siegal, M.D., also had received an Ad Hoc Advisory Committee report to the effect that the GCRI was not following a clear statistical design relative to its study population and, accordingly, had made no notable progress toward achieving the goal for which it had been established. Moreover, the cost of maintaining two medical research facilities – one overcrowded (GCRI) and one underutilized due to the Congressional ceiling situations – was more than difficult to defend. The GCRI positions and dollars were moved to CAMI in 1966 restoring the CAMI level to 100 positions.

At that time, newly appointed FAA Administrator, William McKee, gave a speech to an Aerospace Medical Association annual meeting and stated that CARI would contract for a large moveable hydraulic lift platform that had capabilities of tilting and would raise the fuselage of an airline-type aircraft for passenger emergency evacuation studies. The money from GCRI was used for this platform and, as only one GCRI person elected to move to Oklahoma, the position authorizations began to be melded into the Institute in Oklahoma. By this time, S.R. Mohler, M.D., had moved to Washington and had assisted in preparing the Administrator's speech. The evacuation simulator proposal seemed very timely as several airline accidents involving passenger evacuation problems had occurred in the relatively recent past.

In 1966, a Clinical Research Laboratory was established in the Aeromedical Research Branch in which to place the scientists from the FAA's closed out Georgetown Clinical Research Institute. In August 1968, the aeromedical education function was moved from the Aviation Medical Service in FAA Headquarters to CAMI so that existing CAMI facilities (altitude chambers, etc.) could be utilized. At that time, the Aeromedical Education Branch was established. With this came the responsibility of aeromedical education and information programs supporting safety and promotion of civil aviation; and development of standards and procedures governing the selection, designation, training, and management of physicians appointed to conduct aviation medical examinations of civil airmen in the U.S. and abroad. Also in 1968, a Technical Staff and Administrative Staff were established to assume functions of the former Administrative and Technical Branch; however, these functions were later moved to the Aeromedical Research Branch and the division office in July 1979. A biostatistical staff was established in June 1968 but was later moved to the Aeromedical Research Branch in April 1975. The Aeromedical Services Branch was retitled Aeromedical Clinical Branch in June 1968. Based on the Federal Air Surgeon's decision that it was his office's lowest priority, the Aeromedical Clinical Branch was abolished in May 1981 during a financial crunch. However, the Aeronautical Center Director reestablished and staffed it in October 1981, under CAMI direction, in order to support the training aspects of the air traffic recovery program (not surprisingly, CAMI eventually negotiated successfully to re-own the clinic in the early 1990's). CAMI was thus structured with an Aeromedical Research Branch, Aeromedical Certification Branch, Aeromedical Education Branch, and Aeromedical Clinical Branch.

In the late 1960's and into the early 1970's, a series of events arose in aviation that led to the vitiation of the earlier mentioned resource ceiling on FAA medical research resources. Serious labor problems with the FAA air traffic controllers and FAA management at the facility, area, regional, and Washington headquarters levels, began to develop throughout the National Aerospace System.

The "vacuum tube" air traffic control hardware and the problems with the new software along with the necessary shift work rotations began to escalate air traffic controller stress concerns. The contributions by researchers at CAMI and the need to properly support CAMI scientists with respect to air traffic controller psychological, physiological, and medical aspects were becoming apparent. Mr. Albert Thomas had passed away in 1966, but the funding ceiling for CAMI persisted through 1983 (although by 1972 overall RE&D funding for OAM began to increase). Moreover, in 1973 the number of authorized research positions dropped from 100 to 97, a loss that was later attributed to an error on the part of the FAA budget office. When the loss was called to the attention of the budget office, a decision was allegedly made to leave it at 97 on the grounds that the budget document was too far along in the process to seek a correction. The correction was never made. In addition to the in-house research at CAMI, the FAA made available to OAM an additional $700,000 for a longitudinal study by Boston University's Dr. Robert Rose on controller stress and illness. The FAA designated a Headquarters medical officer to help Dr. Rose to develop the contract for the proposed landmark study during the subsequent four-year period (1974-78) and the physician who was assigned to help develop this contract and to help Dr. Rose during the four-year period it was in force and monitored by the Office of Aviation Medicine was S.R. Mohler, M.D. That influx of those contract funds established a higher dollar base for the Office of Aviation Medicine's overall research programs. It also established the use of those types of funds by the Washington office so that some research projects came to be funded and monitored outside of CAMI.

The Rose study reflected one of the agency's thrusts to evaluate scientifically issues related to air traffic controller stress. Other research was being conducted at CAMI on related stress topics. Specifically, field studies of controller shift schedules and air traffic workload along with psychological assessments of anxiety, job attitudes, and interest patterns were completed.

In the late 1970's, an interesting option began to be considered by the FAA and the Department of Transportation, specifically there was a proposal to convert CAMI to a departmental function as the Transportation Biomedical Research Institute (TBRI). That proposal received considerable attention over a number of months and appeared to be favorably viewed at the highest levels of DOT. However, interest waned and the proposal was never acted upon.

In 1979, the FAA conducted an "early out" program to reduce staffing levels. A number of research staff took advantage of the opportunity to retire early and, as a result, the authorized position levels were subsequently reduced from 97 to 90 (although actual staffing levels never approached these numbers, due, in major part, to the insufficiency of funding).

In the summer of 1981, a major event occurred in the history of the FAA and of U.S. labor law. The Professional Air Traffic Controllers Organization (PATCO) went on strike and refused to return to work at the order of U.S. President Ronald Reagan. President Reagan fired the striking controllers and the FAA undertook a strike recovery program which included the unprecedented hiring and basic training of over 8,000 air traffic controller applicants in a 2-year period. CAMI played a key role in the recovery program.

As the need for an FAA recovery plan developed, the significant skills of CAMI scientists and their considerable knowledge about air traffic controller selection and training were recognized by then FAA Administrator J. Lyn Helms. A CAMI scientist , Dr. James O. Boone, was appointed to the Administrator's staff and moved to Washington Headquarters to assist in the strategic and operational recovery planning. Other scientists, led by Allan D. VanDeventer, took full charge of CAMI's controller selection research program and provided the local research leadership for the FAA Academy to help make strike recovery work; that included changing the ATC Screen program to make it more efficient with respect to success in Academy training. The importance of CAMI's contributions to strike recovery was underscored by Administrator Helms when he provided certificates of commendation and appreciation from Pan American World Airways dated May 6, 1982, to regional and center headquarters offices, air route traffic control centers, level IV and V terminals; level III flight service stations, the FAA Academy—and to CAMI. The certificate recognized the "outstanding performance of FAA employees in maintaining a high level of safety and operations following the controller strike." Helms also noted in his August 2, 1982, memorandum that he believed that "this is the first time in the history of Pan American World Airways that the Board of Directors has authorized a commendation for a total organization."

As part of the strike recovery effort, following outcomes from contract studies of air traffic controllers (the "Jones Committee Report") and with support from CAMI psychologists, Administrator Helms requested that CAMI

scientists develop a questionnaire to assess the FAA's organizational culture as a means of establishing a baseline to determine the effects of organizational interventions. That effort was designed to provide a base of information that could help to prevent the types of impasse that led to the air traffic controller strike and firings. The first FAA Employee Survey was conducted in 1984 as a census of all FAA employees. It was a major undertaking. All aspects of the survey from development of the items, to printing, mailing, scoring, statistical analyses, and preparation of reports were conducted at CAMI under the direction of David J. Schroeder, PhD. The scannable survey form comprised 66 substantive items, was distributed to about 47,000 employees at their home addresses (a considered decision by agency management, reflecting some of the continuing concerns of that period), and yielded a 55% return rate. Although there had been considerable managerial anxiety about the conduct of this first agency-wide survey, and although the results showed a number of areas in need of improvement, the survey project was a highly successful one – it led to consideration by management of plans to improve aspects of the work environment, and identified successful policies. In support of the perceived value of the survey approach, the Administrator decided to continue use of the survey on a biennial basis.

A confluence of events during this time led to some later organizational changes involving both the research branch and the Institute as a whole. Specifically, in 1984, the FAA Associate Administrator for Aviation Standards, Mr. Walter S. Luffsey, assigned a study of CAMI research to a staff member, William Smith, Ph.D., who had a background in physics. The so-called "Smith Report," released in 1984, presented a plan for modifying the CAMI research structure (removing some aeromedical areas from a research to an operations category), introduced the rather cumbersome term "workplace performance optimization" – to cover selection, training, and survey studies - as an area of acceptable research along with "protection and survival" and "workload and performance", emphasized the need for research sponsorship by an operational agency element, and recommended that the Institute report to the Assistant Administrator for Development and Logistics. The "workplace performance optimization" category survived for about a decade while the enhanced sponsorship recommendation was addressed and developed in future years. However, CAMI's basic research structure stayed intact, and the Institute continued to report to Aviation Standards into the 1990's. Moreover, the strike, the successful recovery efforts, and the successful survey project emphasized the need by the agency to direct more attention to its human resources. In that regard, CAMI psychologists had provided leadership and accomplishments significant enough by 1984 to lead agency executives, particularly the highly respected Associate Administrator for Administration, Mr. Gene Weithoner, to seek actively to assure a more prominent role for that group in the organization. The Aeronautical Center Director, Mr. Benjamin Demps, strongly supported the enhancement of human resources research (he had had very positive first-hand experience with CAMI psychologists when he had served as Superintendent of the FAA Academy). Mr. Demps developed a position paper in 1984, drafted by K.A. Hayes, to establish a Human Resources Research Institute at the Aeronautical Center by converting the Aviation Psychology Laboratory to that role. (A similar, less formalized attempt to effect the same type of result was generated among the human resources offices in Washington Headquarters in late 1988). However, the near-term major outcome of these suggestions was the 1986 decision and the January 1987 conversion of the Aviation Psychology Laboratory within the Aeromedical Research Branch to its own branch status as the Human Resources Research Branch. In December 1988, all of the CAMI branches were elevated to division status with the Aeromedical Clinical Branch renamed the Occupational Health Division. These organizational changes remained effective through the year 2000.

Historical Vignette

A Brief History of OAM Research Funding, Staffing, and Technical Report Production

By W.E. Collins, Ph.D. and Gale G. Dills

With the establishment of the Civil Aeromedical Research Institute (CARI) in 1960, research staffing, funding, and the production of technical reports by the Office of Aviation Medicine (OAM) were initially centered in CARI. Indeed, the first two years of research publications (1961-62) were termed CARI reports. The use of the OAM logo and the like change in the designation of those reports began in 1963. Research funding also was tied to CARI/CAMI during the 1960s; later, Washington Headquarters retained funds designated as contract dollars and issued and monitored contracts in such areas as air traffic controller (ATC) selection, aspects of air piracy research, ATC color vision, aspects of aircraft maintenance, and others over the years. The discrepancies between CARI/CAMI funding and overall Office of Aviation Medicine research funding is largely accounted for by the allocation and use of contract dollars from Washington Headquarters. CAMI has always been primarily a hands-on conductor of research and had relatively little or no annually contracted research until the 1990s. During that decade, an expansion of the vision for CAMI research and a concomitant increase in resources – both personnel and dollars – led to an enhanced approach to contracting and, for the first time in 1993, to awarding research grants in support of internal programmatic goals.

Nevertheless, the first two contracted studies by CARI/CAMI were initiated early in its history, at about the same time, and resulted in final reports in October and November 1964. One of these, not surprisingly, dealt with air traffic controllers (Investigation of the Training-Performance Criteria for Several Federal Aviation Agency Occupational Specialties by M. Clinton Miller III, Department of Preventive Medicine and Public Health, University of Oklahoma Medical Center); the other (Vestibular Investigations in Mammals by R.D. Burns, Ph.D., University of Oklahoma, University of Oklahoma Research Institute, June 1962-July 1964) had the added benefit of providing CARI/CAMI with a model RS-2 Stille-LKB rotating chair for vestibular stimulation. The Stille device was employed extensively for decades as a research tool and to demonstrate aspects of spatial disorientation; it later became the basis for commercially produced disorientation trainers, and, to date, is still operable and used as needed.

Figures 1 and 2 show the history of appropriations and authorized positions for the OAM and for CARI/CAMI, respectively. Because the Institute always received the major share of the appropriations, the time course of dollar support in both graphs is similar and, during the 1960s, was veridical.

A similar situation obtains for the position allocation data in both curves with the exception of 1965 and 1986-88. The former case represented a peculiar drop from 100 to 79 as part of the agency order that changed CARI to CAMI; the level reverted back to 100 the following year. Except for 1965 and the 1986-88 period, during which 3 positions were moved from CAMI to the Washington office, all the research positions were nominally located in Oklahoma City. The displacement of those 3 positions was effected by Federal Air Surgeon Frank Austin, M.D., who used them to support the Headquarters OAM staff that was monitoring contract research. The positions were returned to CAMI in 1990.

Dr. S.R. Mohler (c. 1962)

Aeromedical research positions moved up from 62 in 1962 to a 100-level ceiling beginning in 1963, shortly after Stanley R. Mohler, M.D., had become CARI Director. The ceiling of 100 had been set initially by Mr. Albert Thomas' Congressional appropriations committee and was never exceeded. In 1965, the level dropped to 79 as part of the order when CARI was reorganized as CAMI, but rose back to 100 in 1966 when positions at the defunct Georgetown Clinical Research Institute were transferred to CAMI. In 1974, the level dropped to 97 – allegedly on the basis of an error by the agency budget office at Washington Headquarters that was never corrected. Somewhat ironically, OAM research funding increased at about the same time due, in part, to agency support of the so-called "Rose Study" of air traffic controllers.

Overall OAM funding showed a modest linear increase from 1970-1978 and then leveled off for 5 years, but CAMI research dollars remained level over the same

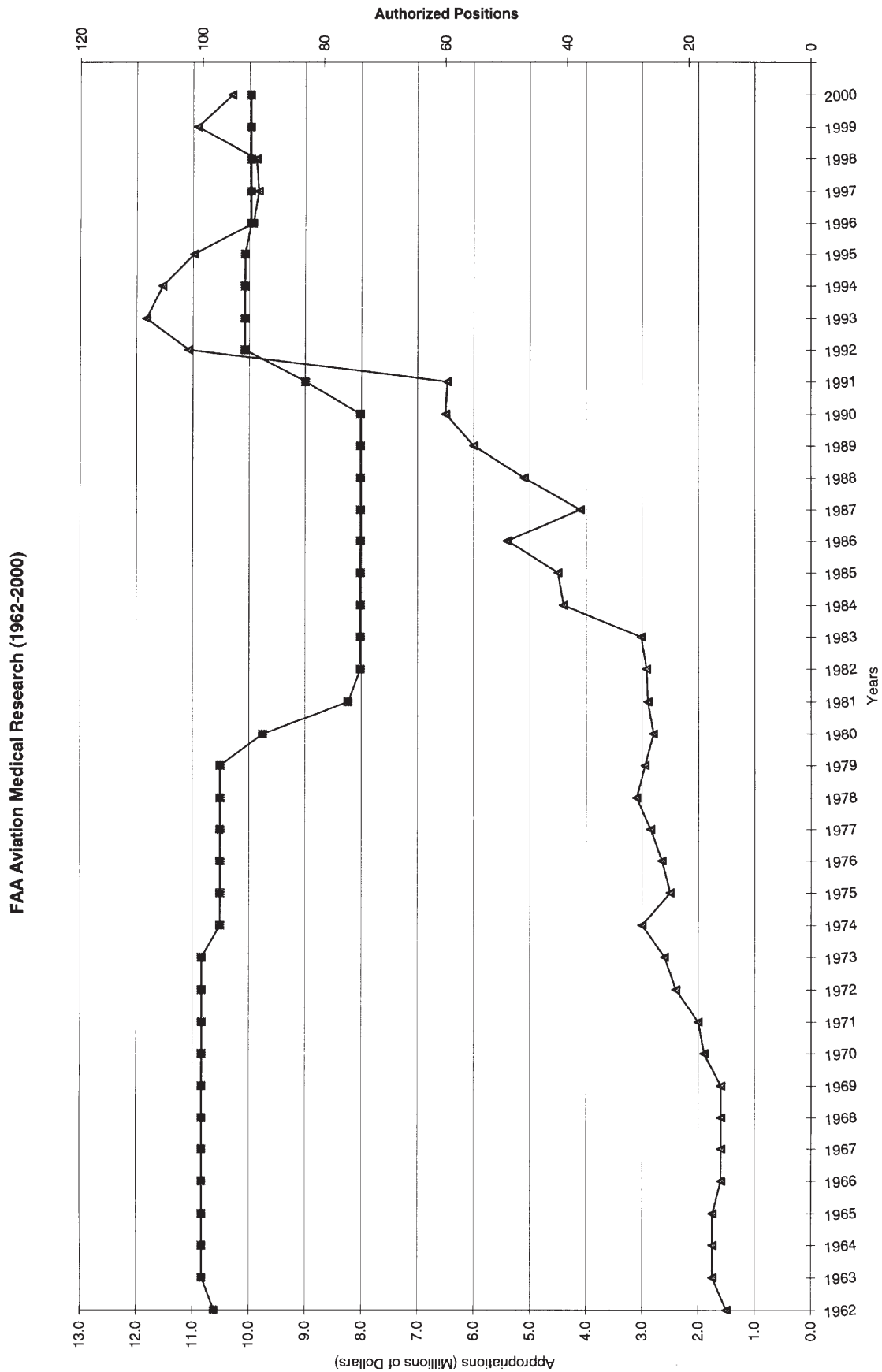


Figure 1. History of appropriations for the Office of Aviation Medicine: 1961–2000.

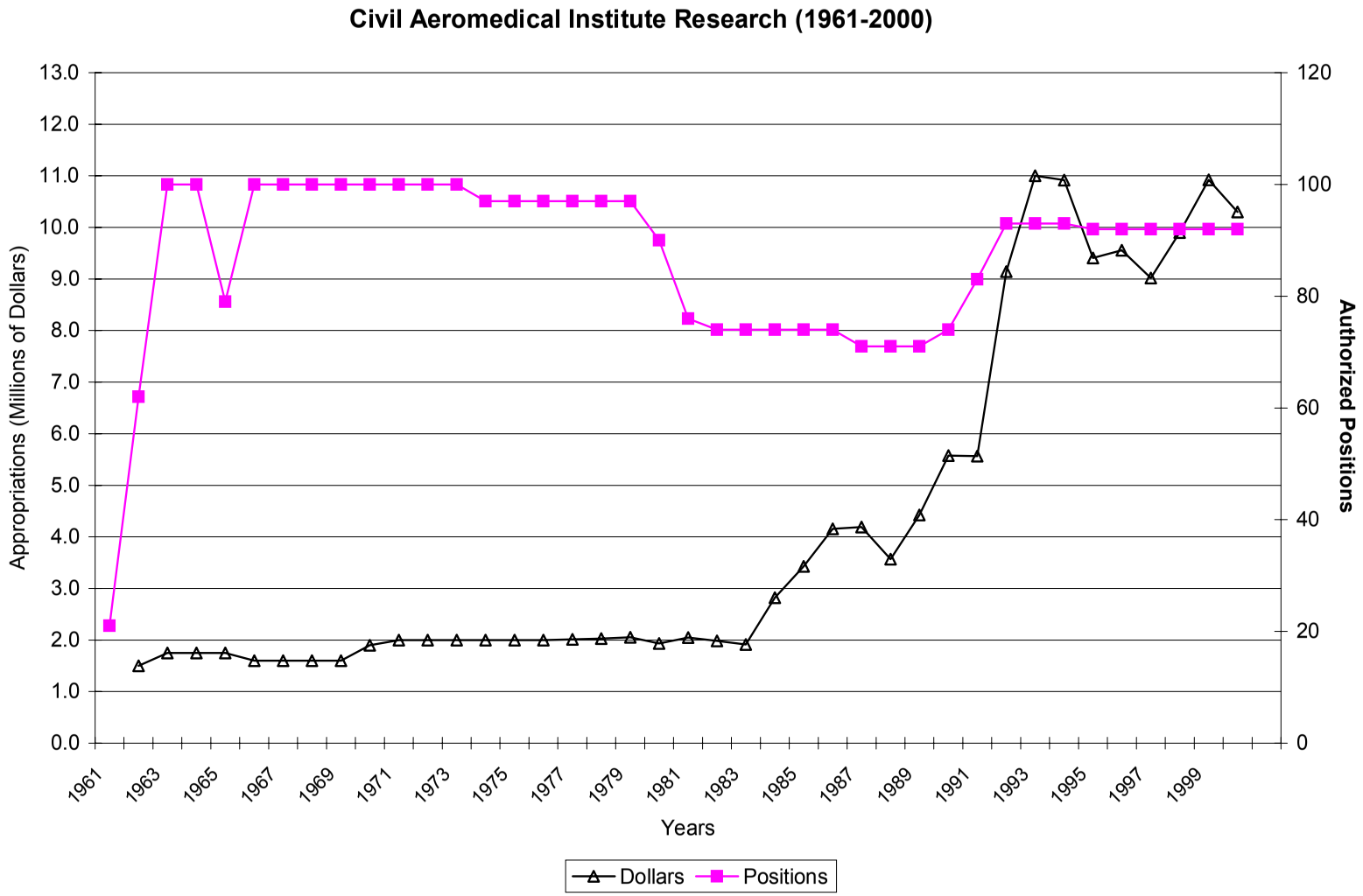


Figure 2. History of appropriations for the Civil Aeromedical Institute: 1961–2000.

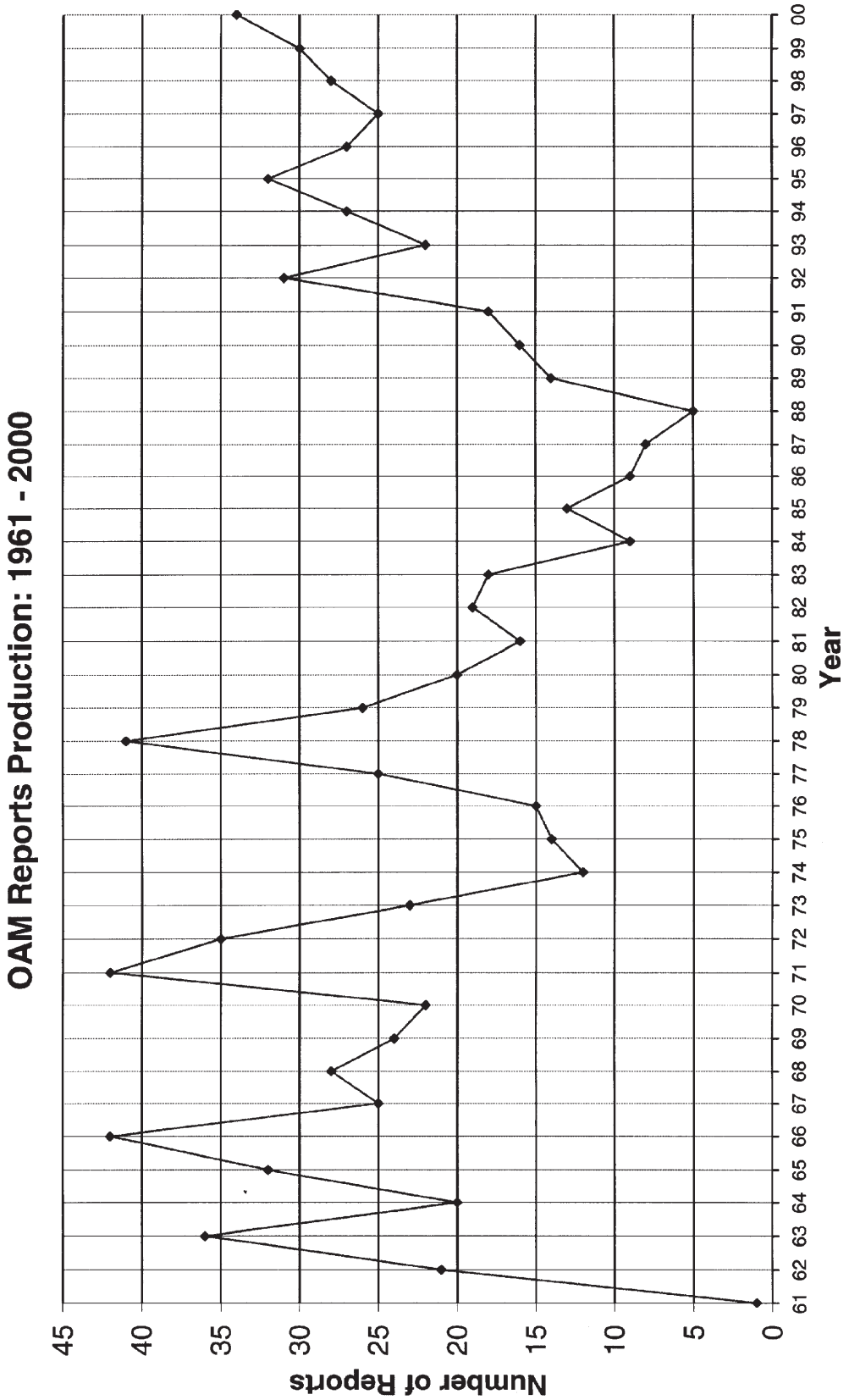


Figure 3. Office of Aviation Medicine Technical Reports: By Year, 1961–2000.

time period. During the 1978-83 period, the number of authorized positions fell on 3 occasions. The first (1980) was related to an "early out" program conducted by the agency and reduced the authorized number to 90 positions. Subsequent reductions occurred in 1981 (to 76 positions) and 1982, leveling off at 74 positions. Also, during this period, a change occurred in the allocation of positions. While previously (and subsequently) all positions were RE&D (i.e., Research, Engineering, and Development), during 1975-1983 from 58 to 77 of the positions were FE&D (Facilities, Equipment, and Development) slots; the remaining 16-20 positions were designated as RE&D. Those variations reflected Washington budget office decisions related to much larger FE&D and RE&D issues. Partly as a result of the increased emphases related to the controller strike, strike recovery, the Employee Attitude Survey, and a new look at selecting and training controllers (along with the diminishing amounts of research resources after CAMI personnel costs were deducted), some increase in OAM funding occurred from 1984-1986, a major part of which was assigned to the Institute.

J. Robert Dille, M.D., who had served as CAMI Director since 1965, retired at the end of 1987. Following several months of rotating acting CAMI managers, William E. Collins, Ph.D., was appointed deputy manager (the term "Director" was temporarily not used because agency officials had come to feel it conflicted with the titles of FAA regional and center directors – it was later restored) in 1988 and CAMI Director in 1989. During that time negotiations to return the 3 CAMI research positions that had been relocated to the Washington office in 1987 were successful; the positions were reallocated to CAMI in 1990. Although the Institute had 74 authorized research positions, by 1988 only 57 full-time permanent personnel were on board and CAMI's research funding was not adequate for a larger base of personnel. Given the approximate 2-year lag in the normal budget process, an immediate concerted effort to negotiate an improvement in resources was needed at every level (Agency, Department, Office of Management and Budget (OMB), and the Congress). Those efforts were successfully undertaken and resulted in significant increases in both positions and dollars. Positions jumped from 74 to 83 in 1991 and then to 93 in 1992. Funding went from less than $4 million in 1987-88 to over $5 million in 1990 to more than $11 million in 1993.

It is perhaps of some interest that these staffing increases were almost topped during the 1993 budget process. At that time CAMI had successfully requested 5 more positions - uniquely the Agency was requesting no others - and had seen them retained during the first FAA-DOT-OMB pass through of the budget (although no new funding was being requested). The positions survived the final FAA cut but were dropped during the final DOT pass through by Admiral James B. Busey who had served as the FAA Administrator from 1989 - 1991 and had moved from there to a DOT position. The grounds reported for removing the 5 positions at that stage were that no new air traffic control or safety positions were being requested in the budget, and no funding for the 5 CAMI positions was in the budget. The OAM-CAMI position level stayed at 93.

Dr. J. Robert Dille (c. 1963)

Dr. W.E. Collins (c. 1965)

Throughout the first three decades of CARI/CAMI research, budgets were submitted through the Office of the Federal (nee Civil) Air Surgeon, and funding was provided to that office and distributed to the Institute. Aviation Medicine was a research budget line. By 1989, however, as part of a response to industry/professional organization/advisory group recommendations, the agency initiated a "human factors" research emphasis that included the hiring of a scientific and technical advisor for human factors. The appointee, Clay Foushee, Ph.D., began to develop a human factors research plan and to work with the agency budget officials. The agency research budget was divided into chapters and the new human factors thrust was assigned to Chapter 8. There was considerable interaction in the budget meetings regarding the title for Chapter 8 – Dr. Foushee and some others preferred "Human Factors" as the title to subsume aviation medicine, aspects of research at the FAA Technical Center (particularly with respect to air traffic controllers), and Washington-based research contracts in various human factors areas. However, perseverance by aviation medicine in these budget meetings led finally

to titling Chapter 8 as "Human Factors and Aviation Medicine" – an accomplishment largely attributable to the on-site work of William T. Shepherd, Ph.D., an OAM-based psychologist. The importance of maintaining the identity of aviation medicine research in this instance, and in a later instance regarding logos, transcends any purely nominal issues. Because the agency is largely geared to, and staffed in, regulatory, engineering, and development areas, the unique person-oriented research approach that typifies the OAM research programs needs to be imbedded in a similarly oriented office if it is to maintain its human-centered thrust.

The funding mechanisms subsequently changed. Dr. Foushee developed an office and a staff within the agency's aviation research organization and by 1992 CAMI was being funded directly from the research budget office while the contract research being conducted from the office of Aviation Medicine was given separate funds. In 1995, the latter transfer of funds ceased and, while aviation medicine's contract research from the Washington office continued with the small staff there, funding was drawn from the Office of Aviation Research (AAR) and not allocated to OAM. In 1997, a similar change was attempted for CAMI funding but a case was vigorously and successfully made to allocate immediately to CAMI each year's funding for all "in-house" costs (i.e., everything except contracts and grants for research by outside organizations) and to follow-up during the first quarter of the year (beginning in FY-98) with CAMI's contract research/grants funding. In 1996, the Congressional appropriation for all of FAA's RE&D funding changed, without notice, from a "no-year appropriation" to a "3-year appropriation."

CAMI's research productivity is largely defined by its output of technical reports. Indeed, it is probably the best indicator of its published (or public) research results. Such a measure, while of singular importance, represents only part of the value derived from its research program. CAMI researchers also publish in scientific journals, make scientific presentations at national and international meetings, give safety lectures, provide data and knowledge for educational purposes, and serve as agency, department, national, and international consultants in their areas of expertise. However, as is evident from Figure 3, productivity as measured by technical reports was highly variable irrespective of funding levels during the first two decades. The peak in 1978 is partly attributable to some extra efforts to complete projects before a 1979 "early out" program by the agency to reduce overall staffing levels. From that peak, however, two clear trends emerged. Productivity dropped steadily from 1978 to 1988 to a low of 5 reports; it then increased steadily to an average of about 28 per year during the later half of the 1990's. It is perhaps of some interest that in 1995, AAR developed a logo and initiated an undertaking to use that logo on OAM reports - first in place of the OAM logo, later along with it. Pursuit of both alternatives was discontinued after several months of intermittent discussions to insure the integrity of the medical programs.

The position gains (to 93) were later tempered when the agency introduced a "buy out" program in 1994 (along with a required change in the ratio of employees to supervisors/managers – to reduce the size of the supervisory staff) as part of U.S. Vice President Gore's goal to reduce the size of government. As a result, the agency's overall research program was required to reduce its number of authorized positions and restrict filling the remaining positions by 7 positions per year for the following 3 years. CAMI was able to retain 92 authorized positions (an initial determination to set the level at 88, based on prior-year vacancies, was successfully changed), and the allowed employment level (staffing ceiling) settled at 89 in meeting these agency goals. Those levels were maintained through the year 2000.

Similarly, the peak funding levels achieved by CAMI in 1993 and 1994 were affected following the 1994 "buyout" by reductions in 1995 - 1997; a return to those peak levels began in 1998 and was sustained in years 1999 and 2000.

The data in this report were derived from analyses and resolution of budgetary documents and memoranda initiated at the Aeronautical Center, OAM, and CARI/CAMI.

Some Observations on the Origins of The Civil Aerospace Medical Institute (CAMI): Its First Predecessor, The Civil Aeromedical Research Institute (CARI)

By William E. Collins, Ph.D., and Stanley R. Mohler, M.D.

The following vignette was created by Myrna Johnson during 1966. On October 3, 1960, Ms. Johnson joined CAMI (then CARI) as a receptionist and later served as a budget analyst for Mr. Vaughan E. Choate; the Institute's Administrative Officer. On her own initiative and based on her own sense of history ("all organizations have a history and it should be recorded"), Ms. Johnson undertook the writing of this piece during her last few months at the Institute.

The special section on the Institute's library has some roots in the fact that her husband, who had twice been a part-time employee of the Institute as an editorial clerk/writer (June 1961-September 1962; June-September 1963) while he attended graduate school at the University of Oklahoma, helped set up the library prior to the hiring of the first official librarian.

Ms. Johnson completed the manuscript in July 1966, just prior to her leaving the Institute (August 26, 1966) for Texas where her husband had secured a teaching position following completion of his Ph.D. degree. The text of the article, which is referenced as a "mimeograph" under a slightly different title ("Civil Aeromedical Research Institute – A Brief History, 1959-1966") in Heber Holbrook's 1974 *Civil Aviation Medicine in the Bureaucracy*, is presented below exactly as written. What is not presented is a listing appended by Ms. Johnson, of every federal research employee of the Institute during the period covered along with their job titles, grades, dates they joined the Institute, and for those who left, a date and a one-word description of the reason for leaving. All of the latter data are now available in the CAMI Library.

Ms. Johnson's focus is on the original function of the Institute – research – and, as such, there is no detailing of personnel who came to occupy non-research positions (e.g., in aeromedical certification) as organizational changes (which she notes) took place. Also, when the name (and functions) of the Institute changed to the Civil Aeromedical Institute in late 1965, she uses the acronym CAI for the organization's new title; the acronym became CAMI shortly after she left in 1966 and has been preserved to identify the Institute with its new name – The Civil Aerospace Medical Institute – authorized in 2001 to reflect the FAA's responsibilities associated with the commercial space transportation program.

With Ms. Johnson's permission, we have taken one liberty with her article, i.e., we have added archival photographs that supplement the text.

A rare grouping of key figures in the CARI story. *Pictured in the northeast corner of the CARI lobby in 1963 are (l to r) Heber Holbrook (Administrative Officer in Aeromedical Certification and later author of "Civil Aviation Medicine in the Bureaucracy"), J. Robert Dille, M.D. (CARI Program Advisory Officer – next CARI Director), Peter V. Siegel, M.D. (Chief of Aeromedical Certification – the next Federal Air Surgeon), M.S. White, M.D. (Federal Air Surgeon, September 1963-September 1965 and the first to hold that title – it had previously been "Civil Air Surgeon"), Stanley R. Mohler, M.D. (CARI Director), and Vaughan E. Choate (CARI Administrative Officer).*

Historical Vignette

Civil Aeromedical Research Institute, 1959 – 1966

By Myrna Johnson
July 1966


Ms. Johnson

From its beginning in 1959 until in October 1965, the research facility in Oklahoma City has been called the Civil Aeromedical Research Institute, CARI, for short. To those who were CARI employees during this period of time, the Institute will be remembered as CARI. The purpose of this history is to sketch the growth of this institution.

The Federal Aviation Agency announced on October 31, 1959, plans for the Civil Aeromedical Research Center, later called Civil Aeromedical Research Institute (CARI), to be established at the Aeronautical Center in Oklahoma City, Oklahoma. The purpose of the new medical research center was to develop medical data to meet the problems of civil air operations as civil aviation moved into higher altitudes and supersonic speeds (1).

Late in December 1959, the first CARI personnel arrived in Oklahoma City. John Swearingen, J.D. Garner, Ernest B. McFadden, and John Blethrow had been with the Civil Aeronautics Medical Research Laboratory (CAMRL) in Columbus, Ohio. Dr. Robert T. Clark arrived from the School of Aviation Medicine (SAM) in San Antonio, Texas, to become CARI's Director of Research. The first home of CARI was the second floor, Hanger 8 at the Aeronautical Center. In February 1960, a group of researchers and other staff members arrived at CARI from SAM. This group was comprised of Dr. Jess McKenzie, physiologist; J.D. Allred, audio visual specialist; Dr. Bruno Balke, biodynamics; Dr. James Green, biochemist; Dr. P.C. Tang, neurophysiologist; Aline "Corky" Koch, secretary; M.C. Oviatt, engineering technician; and Claude Jones, administrative officer. During the spring and summer, staff members continued to arrive. Dr. George Hauty, Rollo Beebe, and Bart Cobb, all in psychology, came from SAM.

In April, Dr. Michael T. Lategola, physiologist, arrived. Dr. Don H. Estes joined the staff in July as the Director of CARI. Vaughan E. Choate became the executive officer in July. Drs. P.F. Iampietro and L.J. O'Brien, physiologists, joined the staff in August. Howard Hasbrook, crash injury specialist, arrived in September. In the last four months of the first year, Dr. Wallace Friedberg, physiologist; Dr. William Stavinoha, pharmacologist; Dr. Richard Snyder, anthropologist; and Dr. E.E. Phillips, physiologist, joined the staff.

The main efforts during the first year were spent in setting up the laboratories and recruiting researchers and technicians. Several moves were accomplished during the first six or seven months. In May 1960, the small group moved form Oklahoma City to Building 604, North Campus, Norman. This building was part of the University of Oklahoma Research Institute. In August, the group moved again into Building 803, Building 805,


The "gym" on the North Campus of the University of Oklahoma in Norman, Okla., housed biodynamics and related research by CARI scientists in 1960-1962. The several buildings occupied by CARI personnel had been temporary U.S. Navy buildings during World War II.

and a gymnasium, which were leased from the University of Oklahoma. Three more buildings were acquired later. The institute remained in these quarters until it moved into new facilities at the Aeronautical Center in October 1962.

The Bureau of Aviation Medicine in Washington, D.C., was established on March 14, 1960 – an indication of the growing significance of the medical program in aviation safety. CARI researchers concentrated on the following projects during the next three months:

1. Man's aging process and the relation to chronological age and pilot proficiency;
2. Selection criteria for and environmental stress factors experienced by air traffic controllers; and
3. Inflight fatigue affecting flight engineers on jet aircraft (2).

At the end of the first year, the staff consisted of a Director, Director of Research, 18 researchers, 4 secretaries, a receptionist, an executive officer, an administrative officer, a supply specialist, and 20 technicians and scientific aides. Each branch had several members, and the audio visual and engineering services were functioning.

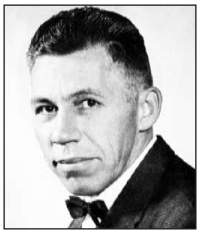
During FY 1961 the accomplishments were threefold: design of the new facility, recruitment of key staff; and initiation of long-range research programs.

The second year was marked by several significant developments and continued growth. The first major change occurred in April 1961, when Drs. Estes, Clark, and Green and several technicians resigned or transferred.

Dr. Hauty served as Acting Director of CARI until the appointment of Dr. Stanley R. Mohler as Director in August 1961. On September 20, 1961, the staff consisted of 89 members, including temporary and part-time workers. The authorized permanent staffing was 64, authorized temporary 18, and authorized part-time 20. Listed below is the staffing by branches and services:

10: Director's Office
8: Biochemistry Branch
6: Branch Chiefs
17: Psychology Branch
2: Clinical Examination
4: Environmental Physiology Branch
6: Employee Health
11: Protection & Survival Branch
1: Library
2: Animal Care
5: Research Engineering
6: Biodynamics Branch
6: Audio Visual
3: Neurophysiology Branch
2: Biometrics

Branch secretaries were added in October and November 1961.


Dr. Estes

Plans originally called for a staff of several hundred in five years or less. However, growth was limited by a congressional ceiling on staffing. The budget prepared in June 1960 for 1961 and 1962 requested 61 positions for 1961, which were within the limit, and requested 150 additional positions over the ceiling. For 1962, 320 positions were requested. Seventy-five positions were authorized for 1962, and this authorization still holds for Research and Development (FY 1966).

At the end of 1961, 18 professional researchers, 7 secretaries and clerks, and 21 technicians and scientific aides had joined the staff in its second year. Part-time employees are included in these numbers.

During FY 1962, 13 CARI reports and 45 scientific articles were published. Research developed methods of predicting success of air traffic controllers in training. The investigations of air crashes furnished information for improvements in air safety. Preliminary work was completed on toxic hazards in aerial application of insecticides.

In June 1962, decentralization of the Washington office occurred, and Certification and Standards Divisions moved to Oklahoma City. The new organization was headed by Dr. George Steinkamp, Deputy Civil Air Surgeon for Research and Operations. CARI, Georgetown Clinical Research Institute, and Research Direction became a part of the Aeromedical Research Division, one of the four divisions, and the Clinic became Aeromedical Clinical Services Division. The remaining two divisions were Aeromedical Certification Division and Aeromedical Standards Division. In December, the Office of the Deputy Civil Air Surgeon was abolished, and the 15 positions given to CARI and Certification. Standards Division moved back to Washington in November 1963.


Mr. Halaby

The major event in FY 1963 was the move in October 1962 into the new $8.5 million research facility at the Aeronautical Center. On October 21, the building was dedicated by FAA Administrator N.E. Halaby (3).

In FY 1963, the staff reached full strength with 35 professional research scientists, 25 research scientists, 15 scientific aides, and 20 part-time aides. In Research Direction, 11 were in the

Office of the Director, and there were six branch chiefs and six branch secretaries. During this year, CARI participated in the supersonic program and Project "Little Guy," in addition to the approved projects. Thirty-five CARI reports and one Technical Publication were issued.

With the move into the new building completed and the labs set up and working, the new facility allowed new projects to be undertaken in FY 1964. Experiments were conducted in the altitude, pressure, and environmental chambers. Ditching, evacuation, and rescue experiments were conducted in the pool. Drug, alcohol, and decompression studies were made at high altitudes. Tests of oxygen masks were conducted. Twenty OAM reports (13 from Georgetown and seven from CARI) were published during this year.

The major projects were retitled in FY 1965 to more clearly describe the medical research program at CARI. Thirty-three professional research scientists, 30 research scientists, 12 scientific aides, and 20 part-time positions were abolished. Thirty-two OAM reports were issued during this year.

During FY 1966, the first major turnover of personnel occurred. Sixteen members of the scientific staff left during this year. Their vacancies were filled with scientific aides. Highlights of FY 1966 included 24 OAM reports, 23 presentations by staff members at various meetings, and 14 papers published in open scientific literature. Late in FY 1966, the Federal Air Surgeon announced the move of [the] Georgetown [facility] to Oklahoma City. This added 25 more researchers and aides to the research program in Oklahoma.

During CARI's existence, CARI has maintained a good relationship with the University of Oklahoma, the OU Medical School, and the communities of Norman and Oklahoma City. Students at OU and the medical schools have worked with CARI scientists, and many of CARI's researchers have had faculty status at OU and the medical school.

Organization

When CARI was established, there were six branches and the Office of the Director, Audio Visual Service, and Research Engineering. Animal Care was added later. The branches and branch chiefs were

- Biochemistry – Dr. James Green;
- Biodynamics – Dr. Bruno Balke;
- Environmental Physiology – Dr. P. F. Iampietro;
- Psychology – Dr. George T. Hauty;
- Protection & Survival – Mr. John Swearingen; and
- Neurophysiology - Dr. Pei Chin Tang.

As mentioned previously, the first change occurred in April 1961 when Dr. Estes transferred to Washington, and Dr. Clark and Dr. Green resigned to take academic appointments. The Director of Research position was abolished. Biochemistry Branch became Pharmacology-Biochemistry, and Dr. Paul Smith became its new chief. In August, Dr. Mohler became CARI's second director and remained in that position until December 1965, when he transferred to the Office of Aviation Medicine in Washington, D.C.

In September 1964, Dr. Balke took an academic position, and Dr. Lategola became the Acting Chief of Biodynamics. In FY 1964, the six branches were changed to laboratories, and in January 1965, the Neurophysiology and Biodynamics Laboratories were dissolved and the personnel absorbed by the remaining four laboratories.

In September 1965, Dr. Hauty resigned to become a department head at an Eastern university [and] Dr. William E. Collins became the new Psychology Laboratory chief.

From CARI's beginning in 1959 to the present time, the Washington organization has changed from time to time, and consequently affected CARI's operation and organization. From 1960 to 1962, CARI was under the Research Requirements Division in Washington. In June 1962, the Office of the Deputy Civil Air Surgeon for Research and Operations was moved to Oklahoma City, and CARI and Georgetown came under the Aeromedical Research Division in this new organization. Dr. Mohler, in addition to continuing as Director of CARI, was the Division Chief of the Aeromedical Research Division from July 8, 1962, until January 2, 1964. In January 1964, CARI came under the Aeromedical Education and Research Division in Washington. Dr. Romney Lowry was the new division's chief. In October 1965, the medical activities at the Aeronautical Center (Certification, CARI, and the Clinic) were reorganized into one division entitled the Civil Aeromedical Institute (CAI). In December, Dr. J. Robert Dille became the new division chief. Dr. Dille had been Program Advisory Officer for CARI from June 1961 until February 1965, when he was transferred to the Western Region as Flight Surgeon. CAI no longer has direct contact with Washington but is under the Director of the Aeronautical Center. There are four branches and the Office of the Division Chief in the new organization.

Dr. Mohler


Dr. Dille

The branches are Administrative and Technical Branch, Aeromedical Certification Branch, Aeromedical Research Branch (formerly CARI), and Aeromedical Services Branch.

The latest reorganization or change is the move by Georgetown to Oklahoma City, to be accomplished by September 30, 1966. In August, Dr. Harry L. Gibbons will become chief of the Aeromedical Research Branch.

CARI Library

A research facility needs a library and CARI was no exception. Early in CARI's history, beginning steps were taken to obtain a library. A library committee was established, and Dr. Jess McKenzie became its first chairman. The original purpose of the committee was established to oversee the entire library functions. Dr. Larry J. O'Brien arrived at CARI in August 1960 and was appointed the committee chairman.

With the establishment of the library committee, the first step was taken. At first, the incoming subscriptions were passed from desk to desk. The receptionist checked in the journals and books as they arrived in the mail. In June 1961, Bobby H. Johnson, a part-time editorial clerk, handled the library materials and set up an efficient operating library. Two rooms of Building 803 became the first library.


Miss Heck

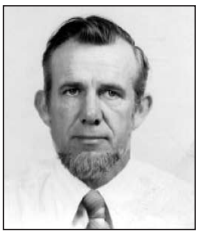
In March 1962, Miss Lilah B. Heck, medical librarian at the University of Oklahoma Medical School, became the first CARI librarian. At this time, the library moved into Building 802 and occupied four rooms (1,175 sq. ft.). With the additional space, there was a library office, a current journals and general reference room, a room for bound periodicals and book stacks, and a photo duplication room. New shelving, reading tables, reading carrels, and duplicating equipment were added.

In FY 1962, the funding responsibility for the librarian, furnishings, and physical appointments was given to the Aeronautical Center library, but the books, subscriptions, and other needs came from medical funds. The function of the committee was changed because of this policy. Instead of overseeing all functions of the library, the committee became representatives of the staff to decide how the budget would be spent for books and journals. In August 1962, Dr. O'Brien accepted an academic appointment and left CARI, and Dr. Carlton Melton became the new chairman.

In October 1962, the library moved into its spacious new home. At first, it occupied rooms 256 and 379. Bound periodical stacks, current periodicals, reference books, patron's work space, and charge desks were on [the] second floor. The book stacks, card catalog, and the library staff's workroom were on [the] third. This move was not final by any means. Office space was required on [the] third floor, so the book stacks were moved to the basement. Later, partitions were removed form the back part of the second floor library, and the stacks were moved to second floor. Finally, all the library was on a single floor.

In June 1965, Miss Heck retired because of poor health, and Mrs. Alfreda Hanna became the new librarian. Mrs. Hanna resigned in February 1966 because of the lack of library help, and Ted Goulden became the third librarian.


Ms. Hanna


Mr. Goulden

The present library committee is comprised of Drs. Melton, Crane, Tobias, McKenzie, Fiorica, Davis, John Ice, and Ted Goulden.

The main problem of the library at the present time is to stay within the assigned library space. The library is growing at the rate of 30 shelf-inches a week. The library budget is another problem. An equipment ceiling in the past couple of years has held the purchase of books and back issue journals to a minimum.

Footnotes

1. "Federal Aviation Agency Historical Fact Book: A Chronology, 1926-1963," P. 45, 1966.
2. *Ibid.*, p. 47.
3. *Ibid.*, p. 60.

A 1960 PRELUDE TO NEW FAA MEDICAL LEADERSHIP AT WASHINGTON HEADQUARTERS AND CAMI: SOME PERSONAL RECOLLECTIONS

By Stanley R. Mohler, M.D.

Preludes

General Dwight D. Eisenhower was elected the 34th President of the United States in November 1956. On August 23, 1958, he signed the Federal Aviation Act that included the creation of the Federal Aviation Agency (FAA). On November 1, 1958, he selected Elwood "Pete" Quesada, Lt. Gen. USAF (Ret.) to become the first Administrator of the newly established Federal Aviation Agency. General Quesada arranged for James L. Goddard, M.D., a career U.S. Public Health Service officer, to become on July 12, 1959, the FAA's initial Civil Air Surgeon (Holbrook, 1974), a new title for the enhanced top FAA medical position that was elevated to report directly to the Administrator (who reported to the President).

In collaboration with William F. Ashe, M.D., Chair of the Department of Preventive Medicine, Ohio State University School of Medicine, Dr. Goddard convened on September 15, 1960, his first FAA formal assemblage of aviation medical examiners (AMEs). This was in conjunction with the 7th Annual Postgraduate Course in Aviation Medicine that Dr. Ashe had been conducting for several years. A group of selected interested physicians and aviation professionals comprised speakers for this prototypical AME seminar, held in the fall of 1960, that has grown to become today's outstanding seminar presentations by the Civil Aerospace Medical Institute (CAMI). At the conclusion of the course, Dr. Goddard announced that he intended to initiate FAA seminars of this type for AMEs before the end of the year. And he did so. Mr. James L. Harris organized the first one in December of 1960. CAMI AME seminars are now provided nationally and internationally and continue to achieve Dr. Goddard's objective to upgrade the aviation medical certification practice of AMEs.

Those attending the historic 1960 gathering included the following:

- Charles I. Barron, M.D., Medical Director of the Lockheed Aircraft Company, speaker
- George P. Kidera, M.D., Medical Director, United Airlines, speaker
- Peter V. Siegel, M.D., Smithton, Missouri, AME
- Stanley R. Mohler, M.D., Medical Officer, Center for Aging Research, NIH, speaker
- Philip B. Phillips, M.D., Psychiatrist, U.S. Navy, speaker
- Richard G. Snyder, Ph.D., Crash Injury Researcher, Phoenix, Arizona, speaker
- Ralph F. Nelson, Aircraft Owners and Pilots Association, Bethesda, Maryland, speaker
- Duane A. Catterson, M.D., Student/resident, aerospace medicine, OSU
- Charles E. Billings, M.D., Student/resident, aerospace medicine, OSU
- Richard L. Wick, M.D., Student/resident, aerospace medicine, OSU
- Luis A. Amezcua, M.D., International AME
- Bert D. Dinman, M.D., Occupational medicine facility, OSU

In addition to Dr. Goddard, other attending FAA medical personnel included:

- William R. Albers, M.D., Assistant Eastern Region Flight Surgeon, New York
- James L. Harris, M.Ed., tasked to organize the first AME seminar, Washington, DC
- John E. Smith, M.D., Chief, FAA Research Requirements Division, Washington, DC
- Arthur E. Wentz, M.D., Head, FAA Georgetown Clinical Research Branch, Washington, DC
- Carl E. Wilbur, M.D., USN, Assigned to FAA, Accident Investigation, Washington, DC

Developments

By the summer of 1961, Dr. Goddard had asked Dr. Siegel to join the Headquarters Certification Division and Dr. Mohler to become the Director of the emerging Civil Aeromedical Research Institute (CARI) at the FAA Aeronautical Center, Will Rogers Airport, Oklahoma City, Oklahoma. Both accepted. In 1962, Dr. Goddard moved the Headquarters Certification Division plus the Standards Division to facilities in the new Institute. Dr. Albers was asked to be the new Standards Division Chief and he quickly accepted. Dr. Siegel was asked to be the

Participants in Dr. Ashe's 7th Annual Postgraduate Course in Aviation Medicine, Ohio State University, 1960.

1. Dr. Mohler, 2. Dr. Siegel, 3. Dr. Dinman, 4. Dr. Smith, 5. Mr. Nelson, 6. Dr. Amezcua, 7. Dr. Goddard, 8. Dr. Kidera, 9. Dr. Ashe, 10. Dr. Catterson, 11. Dr. Wick, 12. Dr. Billings, 13. Dr. Barron, 14. Dr. Wentz, 15. Dr. Albers, 16. Mr. Harris, 17. Dr. Snyder, 18. Dr. Phillips, 19. Dr. Wilbur. Others are primarily AMEs.

Chief of the Certification Division and he accepted. Mr. Harris transitioned to the Institute to manage aviation medical examiner and airman education programs.

The Research Requirements Division remained in Washington, DC. When Dr. Smith retired, Dr. Mohler was appointed to head the Washington-located Division, giving him both an Oklahoma base and a Washington Headquarters base. He could write a memo to Washington as CARI head and send himself an answer as Washington Division head. This was a very efficient arrangement. Support for a soon-to-be-famous and widely quoted decompression study (Barron and Cook, 1965) by Dr. Charles Barron of Lockheed (Barron and Mohler had become acquainted at the 1960 OSU meeting) was requested by "the CARI Dr. Mohler" and subsequently approved by "the Division Chief Dr. Mohler."

Drs. Albers, Siegel, and Mohler obtained homes in Norman, Oklahoma, and often rode back and forth to the Institute together, providing useful opportunities for program coordination. Their "triad" formed an interlocking, synergistic, and functional exchange mechanism that benefited their periodic briefings for national and international aviation executives. A new FAA "National Aviation System Course," monthly five-day seminars for aviation industry executives, and engineering and operational professionals (including airline pilots), was introduced in 1963 by General Quesada's successor, Mr. Najeeb E. Halaby. The course made heavy use of the three physicians for several years as regular presenters. A guided tour through the Institute was a highlight for the "student" visitors and gave the three medical programs considerable visibility throughout the aviation industry.

The Aviation Medical Service programs became increasingly known and consulted. Dr. Siegel oversaw the computerization of the FAA medical records certification process for airmen. He moved the Class One airman ECG reception point address from Georgetown University to his Division in Oklahoma where the responsibility for assessment and action lay. Dr. Albers, with Charles R. Harper, M.D., made the first definitive study of the number of fatal alcohol-associated general aviation accidents. Dr. Mohler assisted the researchers to expeditiously prepare, communicate, and publish their aeromedical safety findings for use by the aviation community, including manufacturers, airmen, and FAA flight standards and air traffic personnel.

In September 1965, Dr. Siegel was asked by the new FAA Administrator, General William F. McKee, USAF, to be the Federal Air Surgeon (the position that was originally entitled Civil Air Surgeon). Dr. Siegel asked

CERTIFICATE OF PARTICIPATION

This is to certify that

STANLEY R. MOHLER, M. D.

was a participant in the Seventh Annual

POSTGRADUATE COURSE IN AVIATION MEDICINE

given at Columbus, Ohio, September 12 to 16, 1960
under the auspices of the

Department of Preventive Medicine of
The Ohio State University
and the
Bureau of Aviation Medicine
Federal Aviation Agency

Replica of a certificate, signed by Drs. Ashe and Goddard, documenting participation in the 7th Annual Postgraduate Course in Aviation Medicine, 1960.

Dr. Mohler to accompany him to headquarters as Chief of the new Aeromedical Applications Division (research planning branch, accident investigation branch, and bioengineering branch). Both moved to Washington. Dr. Albers was now with United Airlines, Washington, DC, and subsequently became Medical Director of the Atomic Energy Commission.

In order to consolidate and more efficiently conduct the FAA medical research, Dr. Mohler suggested, Dr. Siegel concurred, and General McKee agreed, that the FAA Georgetown clinical research activity (set up to study pilot aging) be amalgamated with the now Civil Aeromedical Institute (CAMI) in Oklahoma City. The move was facilitated by a Government Accounting Office (GAO) report suggesting that similar research was being accomplished at the Lovelace Foundation, Albuquerque, New Mexico. Some of the Georgetown resources were applied to construct a large-scale emergency evacuation research facility adjacent to CAMI (Mohler, Hays, and Collins, 2001). Longitudinal pilot aging studies at the Lovelace Foundation continued to provide the FAA with data on the topic after the FAA Georgetown activity ended. While at the Center for Aging Research, National Institutes of Health (NIH), prior to joining the FAA, Dr. Mohler had assisted Lovelace scientists to obtain large-scale support to study airline pilot aging. In fact, the invitation by Dr. Goddard to Dr. Mohler to attend the 1960 OSU seminar was for the latter to give a presentation on the latest developments from the NIH perspective in the field of research in aging (Mohler, 1961).

Dr. Siegel retired from the FAA in 1976. Dr. Mohler retired in 1978, becoming Professor and Director of the new Aerospace Medicine Residency Program being established by National Aeronautics and Space Administration (NASA) at the new School of Medicine, Wright State University, Dayton, Ohio. With the departure of its key faculty, Ohio State University had just closed out its aerospace medicine residency program.

CARI/CAMI

With regard to CARI, in October 1965, just prior to Dr. Mohler's December move to Washington, DC, Administrator McKee gave the Aeronautical Center Director, Mr. W. Lloyd Lane, managerial authority over all Center activities. As part of the general reorganization of the Aeronautical Center, CARI, the Medical Certification Division, and an Aeromedical Services Branch that included a medical clinic were combined into one new division and CARI became CAMI – the Civil Aeromedical Institute. Succeeding Dr. Mohler was J.R. Dille, M.D., who had served as Program Advisory Officer to Dr. Mohler from 1961-1964 before spending a year as Regional Flight Surgeon, Western Region, Los Angeles, California. Dr. Dille directed CAMI from December 1965 until his retirement in December 1987. He was succeeded by William E. Collins, Ph.D., a psychologist who had been jointly selected in December 1965 by Dr. Mohler, Dr. Dille, and Mr. Lane to head CAMI's Aviation Psychology Laboratory. Dr. Collins was acting CAMI Director during 1988 and served as Director from 1989 until his retirement in 2001. Melchor J. Antuñano, M.D., who had been hired by Dr. Collins in 1992 to head the Aeromedical Education Division, was appointed the new Director of CAMI in 2001.

In the continuation of historical linkages, Dr. Antuñano was a former aerospace medicine resident with Dr. Mohler at Wright State University, graduating in 1987. Dr. Antuñano, a native of Mexico, had been recommended to Dr. Mohler for the residency program by none other than Dr. Luis Amezcua, who had risen to the top in Mexico's civil aviation medicine programs. It will be recalled that at the 1960 meeting at Ohio State University, Dr. Mohler and Dr. Amezcua had become acquainted and evolved a lasting professional friendship! Dr. Amezcua's recommendation of Dr. Antuñano thus received a high weighting, a fully justified decision as subsequent events have so well demonstrated.

After Word

In late 2001, CAMI was given "commercial space flight" responsibilities and enters the 21st century with the same acronym but an updated name: the Civil Aerospace Medical Institute. Under Dr. Antuñano's guidance, the personnel at the Institute are looking forward to the completion of a large-scale renovation of the Institute building, currently in progress, as they continue their national and international aerospace medical and human factors research, medical certification, aeromedical education, and medical standards safety work and contributions.

References

Barron, C. and Cook, T. (1965). Effects of variable decompressions to 45,000 feet. Aerospace Medicine, 36(5): 425-430.

Holbrook, H.A. Civil Aviation Medicine in the Bureaucracy. Banner Publishing Company, Inc. Bethesda, MD. 1974. pp 1-347.

Mohler, S.R. (1961). Aging and pilot performance – current related research and research needs. Geriatrics, 16(2):82-88.

Mohler, S.R., Hayes, K.A., and Collins, W.E. Some historical observations of CARI/CAMI: 1960-1984. In Collins, W.E. and Wayda, M.E. Index of Office of Aviation Medicine Reports: 1961 through 2000. FAA Civil Aeromedical Institute. DOT/FAA/AM-01-1. pp iii-vii.

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